STATE OF THE WATERSHED – Report on Surface Water Quality

The Santa Clara River Watershed

November 2006

California Regional Water Quality Control Board – Los Angeles Region
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PREFACE

This report is a descriptive document and no policy or regulation is either expressed or intended. It is one in a series written by the Regional Board's watershed coordinator which summarizes and characterizes surface water quality data for the Region's watersheds. These reports may serve many functions but they are primarily written to educate the public on the kinds of water quality data available and what the data are generally saying. The Regional Board is often asked very basic questions about water quality in the Region and in many instances State of Watershed reports answer these questions. Some previous State of Watershed reports have been cited by other agencies in their environmental impact reports for various projects or have been used to justify pursuing grant funding to address problems noted. Another major purpose of the reports is to show how effectively or ineffectively we are all collectively doing monitoring and sharing data by going through the process of acquiring and merging data (including much historic data) from different sources and making these data accessible. Some of the people accessing them in the future may be Total Maximum Daily Load (TMDL) staff at the Regional Board but these reports are not pre-determining their conclusions, just reducing time spent on data/information assemblage and organization.

Reference to groundwater quality is made due to the close linkage in this watershed between surface water and groundwater quality. However, this report is not meant to be a thorough evaluation of groundwater quality or the interactions between surface and ground water. Much work by other Regional Board staff on the latter topic will be forthcoming in the near future. There is some discussion of the watershed's natural resources due to their extensive nature and since there are many wildlife-related beneficial uses sensitive to water quality problems; however, this report is not meant to be a complete documentation of these resources.

While a number of stakeholders in the watershed are currently involved in litigation on water issues, this topic has not been addressed in the report which is focused on a description of the watershed, descriptions of discharges and diversions of water, and an evaluation of surface water quality data.

The report does contain an evaluation of data by stream Reach; however, this is not an official Water Quality Assessment, merely a point of discussion. It should be noted that the Reach designations described here are as they appear in the Regional Board's Basin Plan; some Reaches may be described differently in the current 303(d) list. Hydrologic areas/subareas, and groundwater basins/subbasins are based on California Department of Water Resources descriptions as are the groundwater subbasin acreages.

An announcement of the draft report's availability for review and comment was made to the E-mail list previously assembled by UC Cooperative Extension for the Santa Clara Watershed U. Comments were received from the City of Santa Clarita, Castaic Lake Water Agency, County Sanitation Districts of Los Angeles County, Friends of the Santa Clara River, United Water Conservation District, and Ventura County Watershed Protection District. Prior to release of the public draft, in-house comments were provided by Regional Board staff.

November 2006

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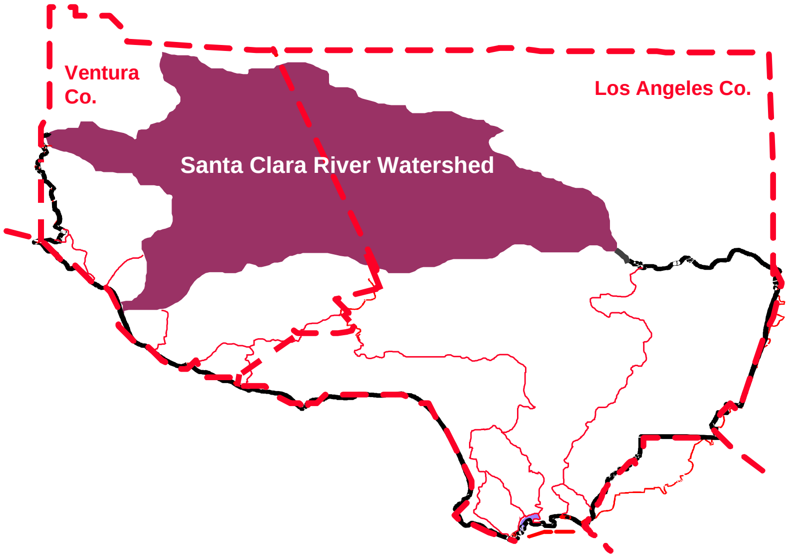
EXECUTIVE SUMMARY

The Santa Clara River is the largest in southern California (about 1,600 sq. mi.) that remains in a relatively natural state; this is a high quality natural resource for much of its length. The approximately 100miles long river originates in the northern slope of the San Gabriel Mountains in Los Angeles (LA) County, traverses Ventura County, and flows into the Pacific Ocean halfway between the cities of San Buenaventura and Oxnard (CRWQCB, 2004).



Extensive patches of high quality riparian habitat are present along the length of the river and its tributaries. The endangered fish, the unarmored stickleback, is resident in the river. One of the largest of the Santa Clara River's tributaries, Sespe Creek, is designated a wild trout stream by the state of California and supports significant spawning and rearing habitat. The Sespe Creek is also designated a wild and scenic river. Piru and Santa Paula Creeks, which are tributaries to the Santa Clara River, also support good habitats for steelhead. In addition, the river serves as an important wildlife corridor. A lagoon exists at the mouth of the river and supports a large variety of wildlife (CRWQCB, 2004).

Beneficial Uses in watershed:

Estuary	*Above Estuary*
Contact & noncontact water recreation	Contact & noncontact water recreation
Wildlife habitat	Wildlife habitat
Preservation of rare & endangered species	Preservation of rare & endangered species
Migratory habitat	Migratory habitat
Wetlands habitat	Wetlands habitat
Spawning habitat	Municipal supply
Estuarine habitat	Industrial service supply
Marine habitat	Industrial process supply
Navigation	Agricultural supply
Commercial & sportfishing	Groundwater recharge
	Freshwater replenishment
	Warmwater habitat
	Coldwater habitat

There are four major National Pollutant Discharge Elimination System (NPDES) dischargers (all Publicly-Owned Treatment Works [POTWs]), 11 minor dischargers, and 15 enrolled under general NPDES permits (non-stormwater). One hundred and fourteen facilities are currently enrolled under the general industrial stormwater NPDES permit. There are approximately 300 construction sites enrolled under the construction stormwater permit (the number of enrollees varies from year to year). And, there are eight facilities with Chapter 15 requirements while there are 54 facilities with non-Chapter 15 waste discharge requirements. Included in the latter facilities are POTWs which discharge to percolation or evaporation ponds (CRWQCB, 2004).

Various reaches of the watershed are currently 303(d)-listed (2002 list) as impaired for nutrients (and related effects), bacteria, salts (chloride, total dissolved solids [TDS]), and sulfate), trash (in lakes), and legacy pesticides (CRWQCB, 2004).

STATE OF THE WATERSHED

Physical Description of Watershed

The Santa Clara River is the largest river system in southern California remaining in a relatively natural state. Its headwaters begin at Pacifico Mountain in the San Gabriel Mountains near Acton and it flows in a westerly direction toward the Oxnard Plain before discharging to the Pacific Ocean near the Ventura Marina. The watershed area is 1,634 square miles. Major tributaries include Castaic and San Francisquito Creeks in Los Angeles County and Sespe, Piru, and Santa Paula Creeks in Ventura County. About 40% of the watershed is located in Los Angeles County and 60% is in Ventura County. Much of the watershed is in mountainous terrain within either the Angeles or Los Padres National Forests (AMEC, 2005) (Figure 1).

The river exhibits some perennial flow in its eastern-most stretches within the Angeles National Forest, then flows intermittently westward within Los Angeles County. The principal tributaries of the upper river are Castaic Creek, Bouquet Canyon Creek, San Francisquito Creek, and the South Fork of the Santa Clara River. Placerita Creek is a large tributary draining the westernmost end of the San Gabriel Mountains; it joins the South Fork which flows directly into the Santa Clara River (CDWR, 1993). Castaic Creek is a south-trending creek originating near Liebre Mountain that confluences with the Santa Clara River downstream of the City of Santa Clarita. The Castaic Lake Reservoir is located on Castaic Creek (CPUC website). San Francisquito Canyon Creek is an intermittent stream in the watershed adjacent to Bouquet Canyon to the southeast (CDWR, 1993).

Three small lakes are located in a normally enclosed valley in the northeastern portion of the watershed. Lake Elizabeth and Lake Hughes are maintained by seasonal runoff and may also be fed by subsurface flows trapped by the San Andreas Fault. Lake Elizabeth overflows occasionally through a meandering channel into Munz Lake and thence into Lake Hughes. Munz Lake, an artificial lake, is maintained by ground water pumped into it from a nearby well. A bedrock sill prevents surface outflow from Lake Hughes to Elizabeth Lake Canyon (and thence into Castaic Lake), except during heavy storms (CDWR, 1993).

Prior to the 1960s, the upper Santa Clara River (east of the County line) was largely rural/agricultural. By 1993, agricultural lands represented less than 7 percent of the developed lands. The city of Santa Clarita is the only incorporated city in the upper watershed (incorporated in 1987). Approximately 75% of the land in the upper Santa Clara River is within the Angeles National Forest (CDWR, 1993).

The braided streambed and floodplain of the Santa Clara River mainstem consists of sandy and gravelly material and is highly permeable over much of its length which results in large quantities of surface water infiltrating into the ground water (CDWR, 1993).

Because they are perennial, effluent discharges to the river may have a greater potential effect on ground water quality, particularly during dry seasons and dry years, whereas flood flows may pass quickly through the basin. Conversely, the ground waters generally contain higher concentrations of dissolved solids than surface waters at the same locality so greater discharge of ground water to the stream can greatly affect the quality of surface waters, particularly during low flows (CDWR, 1993).

The Saugus WRP discharges to the river below Bouquet Canyon (Reach 6) and has a dry weather design capacity of 6.5 millions of gallons per day (MGD). The Valencia WRP discharges to the river further downstream (Reach 5), about 1/3 mile downstream from the Old Highway Bridge and the Interstate-5 freeway near Rye Canyon Boulevard and has a dry weather capacity of 12.6 MGD (CRWQCB, 2004). Some of the treated effluent from the facilities is recycled for use in landscape irrigation. Ground water begins rising just upstream of the discharge, therefore, most of the effluent remains as surface flow and can be a large component of surface flow at the county line. Other sources of perennial flows besides rising groundwater and WRP effluent include tributary flows from Castaic Creek as well as agricultural return flows (CDWR, 1993).

The mainstem river continues to flow above-ground from the upper Santa Clara River until upstream of the confluence with Piru Creek where it generally becomes dry due to highly permeable soils. Perennial flow generally returns downstream of the confluence with Hopper Canyon Creek and continues through Piru, Sespe, and Santa Paula Creeks, and into the Oxnard Plain (Bachman, 2006). There are a total of eleven reaches defined in the Basin Plan by the Regional Board for the river and its tributaries (Figure 2) which very generally correspond to hydrologic areas (HAs) and subareas (HSAs) referenced frequently in documents produced by the Department of Water Resources (CRWQCB, 1994) (Figure 3).

Other wastewater treatment facilities in the lower reaches of the river which discharge to surface waters or to the ground include (CRWQCB, 2004):

- The Piru Wastewater Treatment Plant which serves the community of Piru. It has a design capacity of 260,000 gallons per day (gpd) and discharges secondary-treated effluent to two percolation ponds located about 500 feet from the Santa Clara River (Reach 4).
- The Fillmore Wastewater Treatment Plant which discharges secondary-treated wastewater (1.33 MGD design flow) to percolation/evaporation ponds and/or to a subsurface percolation field or to the Santa Clara River in Reach 3 if the groundwater table is high. The surface water discharge accounts for approximately 30% of the total effluent discharged annually.
- The Santa Paula Wastewater Reclamation Facility which discharges secondary-treated wastewater (2.55 MGD design capacity) to the Peck Road storm drain which flows into a natural, unlined channel and thence to the Santa Clara River in Reach 3.
- The Saticoy Sanitary District Treatment Facility which discharges a design capacity of 300,000 gpd treated municipal wastewater to evaporation/percolation ponds located on the north bank of the Santa Clara River (Reach 2).
- The Ventura Water Reclamation Facility which discharges tertiary-treated wastewater (14 MGD design capacity) from domestic, commercial, and industrial sources into the Santa Clara River Estuary.

Piru Creek

Piru Creek is a major tributary of the Santa Clara River that flows intermittently through portions of the Angeles and Los Padres National Forests. Piru Creek has its headwaters at approximately 5,200 feet above mean sea level (MSL) in Lockwood Valley located approximately 25 miles northeast of the City of Ventura. The subwatershed is characterized by both highly erodible and highly resistant rocks resulting in broad alluvial subbasins alternating with gorges incised in bedrock. The Piru Creek subwatershed encompasses approximately 318,000 acres (SCWRP website).

Several drainages in the upper subwatershed supply Piru Creek with year-round flows including Lockwood, Alamo, Seymour, Amargosa, and San Guillermo Creeks. The surrounding mountains contain metamorphic and granitic rocks. Historically, colemanite was mined in the headwater system and gold mines were established just south of Piru Creek. The creek meanders eastward approximately 30 miles while dropping 2,200 feet in elevation through a series of open valleys and steep gorges before reaching the Pyramid Lake Reservoir. Below the Pyramid Dam, the major tributaries within the lower subwatershed include Agua Blanca and Fish Creek located approximately a mile upstream from Blue Point Campground and 3 miles below Frenchman's Flat just south of Pyramid Lake, respectively. Most flow becomes subsurface in the lower reaches of these creeks. The creek below Pyramid Dam has an average slope of approximately two percent and contains scattered riffle-pool formations until reaching Lake Piru, behind Santa Felicia Dam. The creek then continues downstream through Piru Canyon, eventually merging with the Santa Clara River (SCWRP website).

Of the three major tributaries to the lower Santa Clara River, only Piru Creek has major structural controls on its flows (CDWR website).

Sespe Creek

Sespe Creek is a major tributary of the Santa Clara River that flows through the southern portion of the Los Padres National Forest. Sespe Creek contributes approximately 40 percent of the total natural runoff in the Santa Clara River basin, which typically occurs from January through April. Flow in the upper portions of Sespe Creek and its tributaries may be intermittent at times but generally the majority of the Creek flows year-round (CDWR, 1989). Approximately 75 percent of the Sespe Creek subwatershed is characterized by rugged slopes and canyon walls of southern Pine Mountains and the northern slopes of the Topatopa Mountains. Elevations range from approximately 2,500 to 7,510 feet above MSL. The Sespe Creek subwatershed encompasses approximately 207,700 acres (SCWRP website).

The Sespe Creek headwaters originate near the Ventura/Santa Barbara County boundary within the Transverse Range of southern California. Numerous small tributaries located within the Pine Mountains ridges supply Sespe Creek with year-round flows including Abadi, Adobe, Cherry, Ladybug, and Burro Creeks. The tributaries range from low-gradient, small channels with moderately dense riparian vegetation to steep, narrow, boulder-lined canyons with little or no riparian vegetation. The creek flows in an easterly direction through a narrow depression between the Pine Mountain and Santa Ynez Faults before flowing southward. Major tributaries include the Lion Canyon, Hot Springs Canyon, Timber, and West Fork (SCWRP website).

Sespe Creek supports a variety of land uses and vegetation types. Several campgrounds occur along the drainage that provide limited access and recreational opportunities. The lower portion of the drainage near the Santa Clara River valley contains urban (the City of Fillmore) and agricultural development (SCWRP website).

The creek has several designations aimed at preserving its unique resources. The approximately 219,700-acre Sespe Wilderness Area encompasses 31.5 miles of Sespe Creek. Established in 1992, the Wilderness Area contains a 53,000-acre Sespe Condor Sanctuary. Approximately 10.5 miles of upper Sespe Creek have been designated as Wild and Scenic. Furthermore, the stream is designated as a Wild Trout stream from the Lion Camp area in the upper subwatershed downstream to the Los Padres National Forest boundary near the City of Fillmore (SCWRP website).

Santa Paula Creek

Santa Paula Creek is another major tributary of the Santa Clara River Watershed. The Santa Paula Creek subwatershed occurs within the Transverse Ranges of southern California. The San Andreas Fault zone lies approximately 30 miles north of the creek. The perennial creek is fed by springs located on the southern slopes of the Topatopa Mountains within the Los Padres National Forest. From its headwaters located near Hines Peak at an elevation of approximately 6,704 feet above MSL, Santa Paula Creek flows in a southeasterly direction through extremely steep-walled canyons for the first 12 miles until it reaches the coastal plain near Sulphur Springs just above Steckel Park. The creek flows through Steckel Park along a gentle gradient and is relatively undisturbed. A series of riffles and pools occur in this area created by numerous granite boulders and unique channel morphology. From there the creek is joined by Mud Creek before continuing downstream approximately 5.5 miles to its confluence with the Santa Clara River. The drainage transitions from a braided stream morphology to a channelized system within the last 1,800 feet. The Santa Paula Creek subwatershed encompasses approximately 75,050 acres (SCWRP website).

The climate of the Santa Paula Creek subwatershed is typical of the moderately elevated interior of southern California with mean seasonal precipitation ranging from approximately 36 inches in the Topatopa Mountains to 18 inches near the mouth of the creek. Over 90 percent of the precipitation occurs from November to April within this region (SCWRP website).

Surface water diversions occur within the Santa Paula Creek streambed. The Santa Paula Water Works Diversion diverts surface water from the creek approximately 1,000 feet south of Steckel Park just below a United States Geological Survey (USGS) gauging station and just upstream of the confluence with Mud Creek. Diversions are made to a storage facility and used as a source of water for the City of Santa Paula and for agricultural irrigation. Built in 1923, the dam has gone through several repairs and reconstructions. The fish ladder was extended in 1950 and rebuilt in 2000 on the southern wall of the approximately 30-foot dam (however, the fish ladder was damaged during storms in 2005). Downstream of the dam, the creek is deeply eroded for approximately one mile. Beyond this, the gradient is reduced and numerous boulders are present that have developed riffle-pool formations (SCWRP website).

The subwatershed contains roadside springs which release hydrogen sulfide and active oil seeps (CDWR, 1989).

Estuary

Much of the estuary lies within the northern portion of McGrath State Beach. It is now much smaller, at about 230 acres, than its estimated size of 870 acres 150 years ago. The mouth of the estuary is typically open to the ocean during the winter and spring due to high flows following storms. Lack of rainfall, lower river flows, and smaller surf result in the estuary closing during the summer and early fall (Greenwald, 1999). The Ventura Water Reclamation Facility discharges tertiary-treated wastewater into the estuary. An extensive re-examination of the effect this discharge may be having on the estuary is currently underway (Nautilus, 2005).

Miscellaneous Information

- Santa Paula and Sespe have the most rainfall and drain into areas of lower rainfall (Downs, 2005).
- El Nino years have a very great impact on floods (order of magnitude or larger which leads to very spotty sediment transport) (Downs, 2005).
- There are higher rates of sediment production in the northwest part of watershed (Sespe and Santa Paula); over a 70 years period of time, this adds up to 1,400 metric tons/year (Downs, 2005).
- The watershed has an active geology; about 7,000 landslides were mapped after the 1994 Northridge earthquake, most occurred in mid-watershed (Downs, 2005).
- In March 1928 the St. Francis Dam collapsed; in addition to loss of life and large-scale flooding, the event released a tremendous sediment load on the watershed with long-term effects (Downs, 2005).
- Thirty-six percent of the watershed is controlled by dams; there's a 21% reduction in sediment discharge due to flood controls with the dams (Downs, 2005).
- The estuary is more a river mouth than an estuary (sediment drops out offshore) (Downs, 2005).
- The hydrology is biased by large floods; the river responds to the last large flood event – no bankful floods – as discharge increases, sediment transport increases rapidly and continuously (no peak) (Downs, 2005).

Groundwater Basins, Subbasins, and their Characteristics (Figure 4)

Author's note: There are brief discussions of groundwater at times in areas outside of and surrounding the basins and subbasins.

ACTON VALLEY GROUNDWATER BASIN

The Acton Valley Groundwater Basin is bounded by the Sierra Pelona on the north and the San Gabriel Mountains on the south, east, and west; the community of Acton is located in the area. It has a surface area of 8,270 acres (12.9 square miles). The valley is drained by the Santa Clara River. Groundwater in the basin is unconfined and found in alluvium and stream terrace deposits. The basin is recharged from deep percolation of precipitation on the valley floor and runoff in the river and its tributaries. The basin is also recharged by subsurface inflow. Groundwater flows toward the channel of the Santa Clara River and then westward. There are groundwater extractions for municipal and some agricultural use and there is some subsurface water outflow. Groundwater in the basin is generally calcium bicarbonate in character although water from some wells north of Acton are calcium magnesium sulfate or calcium magnesium bicarbonate in character. Water sampled from five public supply wells in the basin show an average TDS content of approximately 579 milligrams per liter (mg/l) with a range of 424 to 712 mg/l. High concentrations of TDS, sulfate, nitrate, and chloride in wells are an issue in some parts of the basin (CDWR, 2004b).

SANTA CLARA RIVER VALLEY GROUNDWATER BASIN AND SUBBASINS

East Subbasin

The East Subbasin has a surface area of 66,200 acres (103 square miles). The surface is drained by the Santa Clara River, Bouquet Creek, and Castaic Creek. Discharge from the subbasin is through pumping for municipal and irrigation uses, uptake by plants, and outflow to the Santa Clara River in the western part of the subbasin. Groundwater flow in the subbasin is southward and westward and follows the course of the Santa Clara River. The subbasin is comprised of two aquifer systems, the Alluvium and the Saugus Formation. The Alluvium generally underlies the Santa Clara River and its several tributaries, and the Saugus Formation underlies virtually the entire Upper Santa Clara River area (Black & Veatch, 2005). Groundwater in the alluvial aquifer varies from calcium bicarbonate character in the east to calcium sulfate character in the western part of the subbasin. Nitrate content decreases to the west and TDS content increases from about 550 to 600 mg/l in the east to about 1,000 mg/l in the west. Groundwater in the Saugus Formation aquifer is of calcium bicarbonate character in the southeast, calcium sulfate in the central, and sodium bicarbonate in the western parts of the subbasin. TDS content in the Saugus Formation aquifer ranges from about 500 to 900 mg/l (CDWR website). Most local wells draw water from the Alluvial Aquifer. A smaller portion of the Valley's water supply is drawn from the Saugus Formation, a much deeper aquifer than the Alluvial Aquifer (Black & Veatch, 2005).

Groundwater within Bouquet Canyon is calcium bicarbonate whereas in San Francisquito Canyon, calcium sulfate dominates. In Castaic Creek, groundwater changes from calcium sulfate in the upper reaches near Castaic Dam to calcium-bicarbonate-sulfate in the middle reaches near I-5 and then back to calcium sulfate in the lower reaches (Slade, 2002).

As with the Alluvium, the most notable groundwater quality issue in the Saugus Formation is perchlorate contamination. Perchlorate was originally detected in four Saugus wells operated by the retail water purveyors in the eastern part of the Saugus Formation in 1997, near the former Whittaker-Bermite industrial facility. Since then, the four Saugus municipal supply wells have been out of water supply service due to the presence of perchlorate as well as two Alluvium wells. Planning for remediation of the perchlorate and restoration of the impacted well capacity is underway (Black & Veatch, 2005).

Piru Subbasin

The surface area of the Piru Subbasin is 8,900 acres (13.9 square miles) (CDWR, 2004c). The boundary to the west is marked by a bedrock constriction near the Fillmore Fish Hatchery causing rising groundwater. The upstream extent of the groundwater subbasin is located 0.7 miles below the Blue Cut gauging station with its western boundary in the vicinity of Fillmore Fish Hatchery. Groundwater recharge to the subbasin is by percolation of runoff from Piru Creek, Hopper Creek, and the Santa Clara River (SCWRP website). Groundwater in this subbasin is generally calcium sulfate in character. TDS concentrations range from 608 to 2,400 mg/l, with an average of approximately 1,300 mg/l (CDWR, 2004c). The subbasin consists of recent and older alluvium that is recharged by percolation of surface flows along the Santa Clara River channel and its tributaries, and small amounts of subsurface flow at the upper end of the subbasin. The groundwater flow gradient within the unconfined subbasin tends to be in a westerly direction. This is considered to be an unconfined groundwater subbasin. The subbasin is replenished by rainfall, irrigation returns, and artificial recharge through spreading grounds and water conservation releases by United Water Conservation District (UWCD) (SCWRP website). The average annual artificial recharge at the Piru spreading grounds is quite variable in dry versus wet years but has been as high as 6,600 acre-feet (AF) per year in the late 1990s during a wet year (AMEC, 2005).

In general, the quality of the groundwater has historically ranged from poor to good; poor quality waters are found east of Piru Creek and near the western boundary of the subbasin located on the north side of the Santa Clara River and result from agricultural return waters, discharges from POTWs, or wells drilled into the Pico Formation. The character of the groundwater in the upper portion of the subwatershed (north of the Piru Subbasin) is either sodium bicarbonate or sodium-calcium sulfate. TDS, sulfate, fluoride, and nitrate concentrations are a problem in a few wells. Groundwater in the Santa Felicia HSA contains concentrations of boron and sulfate that exceed recommended state criteria but continue to be used in agricultural practices without significant crop damage. Further downstream, the quality of groundwater and local springs within the Hungry Valley HSA is very good. Only one parameter, fluoride, has historically exceeded the state quality standards for Basin Plan beneficial uses (SCWRP website).

Fillmore Subbasin

The lower 5.5 miles of Sespe Creek is underlain by the Fillmore Subbasin which covers an area of approximately 18,580 acres. The subbasin is located one mile upstream of the City of Fillmore. The eastern (upstream) boundary occurs at the Fillmore Fish Hatchery and the western boundary is located approximately one mile east of the City of Santa Paula in an area of geologic and hydrologic constriction (SCWRP website). The Santa Clara River and Sespe Creek drain the surface waters of the subbasin. Recharge to the subbasin is provided by percolation of surface flow in the Santa Clara River, Sespe Creek, underflow from the Piru Subbasin , direct percolation of precipitation, percolation of irrigation waters provide recharge, and releases by UWCD from Lake Piru. Groundwater in Fillmore Subbasin generally flows to the west, and the gradient decreases westward. Like the Piru Subbasin to the east, the Fillmore Subbasin recharges rapidly and fills to capacity in years of abundant precipitation. Water in this subbasin is calcium sulfate in character, although some groundwater in the Sespe Uplands area is calcium bicarbonate in character. TDS concentration ranges from 800 to 2,400 mg/l with an average of 1,100 mg/l. Data from nine public supply wells show a TDS content range of 660 to 1,590 mg/l, with an average of 967 mg/l (CDWR, 2006a).

Two areas of the Fillmore Groundwater Subbasin have been identified to contain high nitrate concentrations within the groundwater: the Bardsdale area near Fillmore and an area west of Fillmore on the west side of Sespe Creek (SCWRP website).

Groundwater in the Topatopa HSA (north of the subbasin) meet the state water quality requirements for existing and potential beneficial uses. However, concentrations of sulfate, chlorine, fluoride, boron, and TDS near Sespe Hot Springs (remote from the subbasin) generally exceed recommended limits for drinking water and irrigation. Groundwater quality in the lower subwatershed varies. High concentrations of TDS (greater than 1,000 mg/l) and sulfate (greater than 800 mg/l) were found in the Pole Creek Fan near the City of Fillmore. Recharge within this area is limited to the poor water quality of Pole Creek and urban runoff associated with the City of Fillmore. Elevated concentration of nitrate and fluoride may be associated with the native waters of the San Pedro Formation (SCWRP website).

This is considered an unconfined groundwater subbasin. The Santa Clara River and Sespe Creek are two major sources of recharge to the Fillmore subbasin, as is underflow from Piru subbasin. At the downstream end of the subbasin, there is some underflow into the Santa Paula Subbasin, although much of the water leaves the subbasin as rising groundwater which contributes to flow in the Santa Clara River (UWCD, unpublished records).

Santa Paula Subbasin

Santa Paula Creek is underlain by the Santa Paula Subbasin which has a surface area of 22,800 acres (35.7 square miles). The eastern edge of the subbasin is marked by a bedrock constriction. The western boundary of the subbasin separates it from the Mound and Oxnard subbasins (CDWR, 2004d). The subbasin is considered to be in hydraulic connection with the Fillmore Subbasin to the east. Although there is general agreement that there is some hydraulic connection between Santa Paula Subbasin and the Mound Subbasin, the degree of connection is uncertain (UWCD, 2001). Ground surface elevations range from 140 feet above sea level in the west to about 1,000 feet above sea level along the Santa Paula Creek drainage. The Santa Clara River and Santa Paula Creek drain the valley westward toward the Pacific Ocean. Groundwater in Santa Paula Subbasin flows generally toward the southwest. TDS concentrations range from 870 to 3,010 mg/l, with an average of 1,190 mg/l (CDWR, 2004d).

The subbasin encompasses an area along the Santa Clara River from the City of Saticoy to the west, the City of Santa Paula to the east, the Sulphur Mountain foothills to the north, and South Mountain to the south. The main water bearing formations are the San Pedro Formation, alluvial fan deposits, and recent river and stream sediments. Groundwater is unconfined in the western portion of the subbasin . Groundwater occurs within approximately 50 feet of the surface and is extracted from the subbasin for agricultural, municipal, industrial, and domestic uses. The primary recharge to the subbasin is by percolation from the Santa Clara River, Santa Paula Creek, and other tributaries, and by underflow from the Fillmore Groundwater Subbasin (SCWRP website). Recharge from the Santa Clara River is limited to reaches north of the Oak Ridge fault along a two-mile stretch near the City of Santa Paula. Where the river flows south of the Oak Ridge fault, it overlies impermeable Santa Barbara formation and recharge cannot occur. The location of the modern river channel severely restricts the amount of recharge the subbasin can receive in any one year (UWCD, 2001).

Mound Subbasin

The surface area of the Mound Subbasin is 14,800 acres (23.1 square miles). It underlies the northern part of the Ventura coastal plain in the western part of the Santa Clara River Valley. The subbasin is bounded on the northeast by the Santa Paula Subbasin and on the west by the Pacific Ocean. Depending on the relative groundwater levels, subsurface water may flow into or out of the subbasin across the border with Oxnard Subbasin. TDS concentrations range from 90 to 2,088 mg/l (CDWR, 2006b). The principal fresh water-bearing strata of the Mound subbasin are the San Pedro Formation and overlying Pleistocene deposits that may be correlative with the Mugu aquifer of the Oxnard Plain Subbasin. The subbasin extends several miles into the offshore (UWCD, 2001).

The majority of the recharge to the subbasin is likely from precipitation falling on the outcrops of the aquifer in the hills to the northeast of the Mound subbasin. When water levels are high in the subbasin, outflow may occur to the ocean some miles offshore. Groundwater flow in the Mound

Subbasin is generally to the west and southwest. However, during periods of drought and increased pumping, a pumping trough forms along the southern portion of the subbasin that significantly modifies groundwater gradients (UWCD, 2001).

Oxnard Forebay and Oxnard Plain Subbasin

The surface area of the Oxnard Subbasin is 58,000 acres (90.6 square miles). The groundwater system in the Oxnard Subbasin includes a main recharge area termed the Forebay, and a confined aquifer system that extends throughout the main part of the subbasin and under the Pacific Ocean (CDWR, 2006c).

The Oxnard Forebay is hydraulically connected with the aquifers of the Oxnard Plain Subbasin, which is overlain by a confining clay. Thus, the primary recharge to the Oxnard Plain Subbasin is from underflow from the Forebay rather than the deep percolation of water from surface sources on the Plain. When groundwater levels are below sea level along the coastline, there may also be significant recharge by seawater flowing into the aquifers (UWCD, 2001).

Three types of land use dominate the Forebay, agriculture, residential, and industrial (primarily gravel mining). Historically the Forebay was used for a large amount of citrus farming. Today, strawberry farming constitutes the majority of farming here. The Forebay has been extensively mined for sand and gravel resources. This mining left a number of gravel pits in the area. Surface waters are diverted into some of these gravel pits in order to recharge groundwater (CRWQCB, 1999).

Groundwater flow direction in the Forebay is generally towards the southwest but shows a high degree of local variation due to large-scale groundwater withdrawal and recharge operations (CRWQCB, 1999).

Groundwater/Surface Water Interactions

Just west of the LA-Ventura County line, is a geologic constriction called Blue Cut which forms the outlet for the Upper Santa Clara River HA (CDWR, 1993). The mainstem river flows above-ground from the Upper Santa Clara River HA until upstream of the confluence with Piru Creek where it generally becomes dry (during dry weather) due to highly permeable soils. Perennial flow generally return downstream of the confluence with Hopper Canyon Creek and continues through the Piru, Sespe, Santa Paula, and Oxnard Plain HAs (Bachman, 2006). There is a hydraulic interconnection between the Santa Clara River and the ground waters of the Santa Clara River Valley. There is also a hydraulic interconnection between the flows in the tributaries and the ground waters within the HSAs (CDWR, 1989). With a high water table, rising water occurs just east of the Fillmore fish hatchery at the western boundary of Piru Subbasin. Also, with a high water table, rising water is found along the reach of the Santa Clara River entering the eastern boundary of the Fillmore Subbasin (CDWR, 1989). Constrictions in the width of the unconsolidated deposits at these locations can cause ground water to resurface and become surface flow in the Santa Clara River (USGS, 1999). There is a tendency for the chemical character of waters to shift from bicarbonate to sulfate in these locations due to the chemical character of the rising groundwater. The groundwater component in the river can be quite large which results in a major presence of sulfate in surface waters. The duration of surface flow, rather than flow rate or volume, tends to control recharge and significant groundwater recharge occurs during flood events. This results in flood flows of water with lower concentrations of sulfate passing through the subbasin rather than recharging and having a diluting effect on the groundwater (CDWR, 1989).

Because they occur year-round, effluent discharges to the river may at times have a greater potential effect on ground water quality than does seasonal stream runoff. The concentrations of TDS in the hydraulically interconnected surface and ground waters are different which suggests other processes are occurring such as evaporation which concentrates salts in rising waters and agricultural return flows (CDWR, 1989).

Water Agencies and Water Use

WATER SUPPLIERS AND SUPPLIES

The water supply in the Upper Santa Clara River HA consists of a mix of local ground water and imported water. Local ground water is extracted by various water districts, companies, and by private wells. Water demands during 2005 in the Santa Clarita Valley were met by a combination of local groundwater resources (slightly more than one-half of the demand), State Water Project water (slightly less than one-half), and the remaining small amount by recycled water for landscape irrigation from the treatment plants operated by the County Sanitation Districts of Los Angeles County (Luhdorff & Scalmanini, 2006). Several hundred water wells have been historically drilled in the Santa Clarita Valley for domestic, agricultural, industrial, or municipal usage. There are also about two dozen high production agriculture supply wells. There are also potentially a large number of private, low capacity domestic supply wells (Slade, 2002) .

Castaic Lake Water Agency (CLWA) distributes imported State Water Project water within its service area, primarily the Santa Clarita Valley in the Upper Santa Clara River HA (CDWR, 1993). The CLWA is a public water agency that was originally formed in 1962 as the Upper Santa Clara Valley Water Agency. The agency covers the major areas of groundwater storage upstream of UWCD (Mann, 1968). The CLWA is a water wholesaler and services an area of 195 square miles. This water is treated and delivered to the local water retailers: LA County Water District #36, Newhall County Water District, CLWA Santa Clarita Water Division, and Valencia Water Company (Luhdorff & Scalmanini, 2006).

UWCD is the wholesale water district for the Ventura County portion of the Santa Clara River Valley that encompasses about 214,000 acres (CDWR, 1989). The UWCD is a mix of agriculture and urban areas, with prime agricultural land supporting high-dollar crops such as lemons, oranges, avocados, strawberries, row crops, nursery stock, and flowers. Approximately 300,000 people live within the District boundary, including those living in the cities of Oxnard, Port Hueneme, Santa Paula, Fillmore, and in eastern Ventura (UWCD, 2001).

The original founding organization for UWCD was called the Santa Clara River Protective Association. It was formed in 1925 to protect the runoff of the Santa Clara River from being appropriated and exported outside the watershed. The Santa Clara Water Conservation District was formed in 1927 to further the goals of the Association by protecting water rights and conserving the waters of the Santa Clara River and its tributaries. The District began a systematic program of groundwater recharge in 1928, primarily through constructing spreading grounds along the Santa Clara River. Sand dikes were constructed on the Santa Clara River near Saticoy to divert river water into spreading grounds (UWCD, 2001).

As seawater intrusion on the Oxnard Plain was recognized in the 1940s, it was clear that the District did not have the financial ability to raise money to construct the facilities necessary to combat the problem. With the help of the City of Oxnard, a new district was organized in 1950 under the Water Conservation Act of 1931. The new district was called United Water Conservation District for its unification of urban and agricultural concerns. UWCD then constructed a number of water conservation projects, including (UWCD, 2001):

- Santa Felicia Dam (1955) to capture and store winter runoff on Piru Creek to release in controlled amounts during the dry season. The 200-foot high dam can store about 87,000 acre-feet in Lake Piru.
- A pipeline to new spreading grounds at El Rio.
- Wells at El Rio to produce water for the Oxnard-Hueneme (O-H) pipeline (1954) that supplies drinking water to the cities of Oxnard and Port Hueneme, mutual water districts, and the two Navy bases at the coast. The O-H system supplies water from the Oxnard Forebay subbasin (the recharge area for the Oxnard Plain subbasin), rather than by pumping of individual wells in areas of the Oxnard Plain that could accelerate seawater intrusion.

The major issues of current concern for the District include groundwater overdraft and the intrusion of saline water in the Oxnard Plain and Pleasant Valley Subbasins, water quality of the Oxnard Forebay Subbasin, adjudication of the Santa Paula Subbasin, concerns related to groundwater management of the Piru/Fillmore subbasin, and chloride impacts to the Piru Subbasin.

The main water quality concern in the Forebay is the presence of nitrate at varying locations and times, in concentrations that exceed drinking water standards (UWCD, 2001).

High chloride levels were first detected on the Oxnard Plain in the vicinity of the Hueneme and Mugu submarine canyons in the early 1930s and became a serious concern in the 1950s (UWCD, 2001).

Major strategies to combat saline intrusion include increased recharge and pipeline deliveries to lessen groundwater pumping to coastal areas (UWCD), reduced pumping overall in the coastal basins (Fox Canyon Groundwater Management Agency), and switching pumping to less impacted aquifers (County of Ventura) (UWCD, 2001).

Following increasing intrusion of seawater from the 1950s to the 1980s, the UWCD built several new facilities to increase recharge to the aquifers and to decrease groundwater pumping in areas affected by the intrusion. The Freeman Diversion (1991), which replaced the temporary diversion dikes in the Santa Clara River with a permanent concrete structure, allowed diversion of storm flows throughout the winter. In addition, the Freeman Diversion stabilized the riverbed after years of degradation caused by gravel mining in the river (UWCD, 2001).

The Pumping Trough Pipeline (PTP) was constructed in 1986 to convey diverted river water to agricultural pumpers on the Oxnard Plain, thus reducing the amount of groundwater pumping in critical areas. Lastly, the Noble spreading basins (1995) were constructed to store and recharge additional river water, particularly during wet periods (UWCD, 2001).

FACILITIES

The Castaic Lake Reservoir was completed in 1973 as part of the California State Water Project and stores water transported from northern California for use by state water contractors in southern California. It has a storage capacity of approximately 323,700 acre-feet (CPUC website). In Bouquet Canyon and Dry Canyon, small regulating reservoirs are operated by the City of LA Department of Water and Power (DWP) in conjunction with the LA Aqueduct (CDWR, 1993).

The Pyramid Dam was built in 1973 and impounds water from the State Water Project and subwatershed runoff. Water releases maintained throughout the summer artificially support flow within the creek below Pyramid Dam (SCWRP website). Water flowing from Pyramid Lake through the 7.2-mile-long Angeles Tunnel spins the turbines in Castaic Powerplant. The 30-foot-diameter tunnel carries water on its way to coastal Southern California to Castaic Lake, the final Project reservoir on the State Water Project's West Branch. Castaic Powerplant generates electricity during on-peak Periods (weekday daylight hours) when extra power is needed in Los Angeles (nights and Sundays) when local power is cheaper, the plant pumps water back into Pyramid Lake. The operation also reduces the cost of power required to move Project water from Northern to Southern California (CDWR website).

The Santa Felicia Dam was built in 1955 approximately eight kilometers (km) upstream of the confluence with the Santa Clara River and impounds runoff from the subwatershed. The 200-foot high dam was constructed by UWCD as part of a region-wide conservation project for the Santa Clara River watershed. The dam was designed to capture and store winter runoff on Piru Creek for controlled release during the dry season. Approximately 87,000 acre-feet of water are stored in Lake Piru (SCWRP website). Releases from Santa Felicia Dam may be diverted from Piru Creek via an earthen dike and screened intake structure located near the confluence of Piru Creek and the Santa Clara River to be recharged at the Piru Spreading Grounds, a 44-acre recharge basin (UWCD, 2001).

Besides the Lake Piru facility, UWCD also operates the Freeman Diversion and related recharge and conveyance facilities in the Oxnard Forebay groundwater subbasin. Santa Clara River water is diverted at the Freeman Diversion and used for artificial recharge at the Saticoy and El Rio Spreading Grounds in the Oxnard Plain and for direct delivery to waters users within the Oxnard Plain and portions of the Pleasant Valley groundwater basin located along the lower reaches of Calleguas Creek in the adjacent watershed (USGS, 1999). Water diverted from the river flows via canal and pipeline to a desilting basin, where water velocity slows, allowing sediment to settle out of the water column. From the desilting basin, water flows via pipe and canal to the Saticoy spreading grounds. From the main canal at the Saticoy spreading grounds, water can be directed to either percolation ponds or to the main supply pipeline. The main supply line transports water to the El Rio spreading grounds and the Pleasant Valley and the Pumping Trough Pipeline delivery systems (UWCD, 2001).

Average annual flow on Piru creek below Lake Piru during the previous 40 years has been 71 cfs which includes spills. Controlled releases have ranged from 2.5 to 650 cfs. Mean annual streamflow in the Santa Clara River at the Freeman Diversion has been 381 cfs for the previous 40 years. The current permitted diversion capacity of the Freeman Diversion is 375 cfs, with an annual total not to exceed 144,000 acre-feet. A daily average diversion of 199 cfs can be diverted annually through the Freeman Diversion (UWCD, unpublished records).

During studies in the early 1990s, under a zero-release condition from Lake Piru, the only flow in the river was from discharge of ground water at the Fillmore Narrows at the lower end of the Fillmore subbasin. This water was characterized by high specific conductance (2,000 microsiemens per centimeter [uS/cm]) and high sulfate (800 mg/l). Ground water discharge at Fillmore Narrows increased with increasing release rates from Lake Piru. Flow studies done during the mid-1990s under dry conditions, mostly during releases from Lake Piru, showed that all flow entering the Piru subbasin from Los Angeles County to the east infiltrates (or is diverted) before reaching the stretch just upstream of Piru Creek. During releases from Lake Piru, ground water recharge occurs along lower Piru Creek and in the middle part of the Piru subbasin. In the Fillmore subbasin there is some evidence of decreasing flow in the upper part of the subbasin but there is an increasing flow between the upper and lower subbasins indicating ground water (low sulfate) discharge associated with Sespe Creek (USGS, 1999).

Major Historical Events in Watershed

Pre-European inhabitation by Chumash and Tataviam (AMEC, 2005)
1782 establishment of first Spanish mission (AMEC, 2005)
1820s to 1860s cattle ranching a dominant land use (AMEC, 2005)
1860s oil production began (USMMS website)
1860s agriculture became a dominant land use (AMEC, 2005)
1920s beginning of larger scale agricultural activities (AMEC, 2005)
1928, March, St. Francis Dam broke
1955, Santa Felicia Dam completed (SCWRP website)
1973, Castaic Lake Reservoir and Pyramid Dam completed (SCWRP website)

Biological Setting

Mainstem

Prior to 1940, the Santa Clara was one of the largest steelhead runs in southern California, next to the Santa Ynez River, numbering in the thousands at times. Fewer than 100 adult fish run either of these rivers' waters now (Kelley, 2004).

A major difficulty during migrations are anthropogenic and natural barriers such as water diversions, road-crossings, and channel modifications for sand and gravel extraction or flood control purposes. The tributaries provide the majority of spawning and rearing habitat, while the mainstem of the Santa Clara River is primarily a migration corridor (Kelley, 2004).

The Santa Clara River estuary has been significantly altered, and these changes may be impacting southern California steelhead smolt survival. While it is unknown to what extent Santa Clara River smolts used the estuary historically, it has been demonstrated that northern and central coast steelhead smolts use estuaries to gain size and acclimate to the higher concentrations of salt in ocean water. The impact of these changes on Santa Clara River steelhead smolt survival is unknown (Kelley, 2004).

A number of recommendations have been developed to address the above difficulties. A priority action relating to water flow and balance in the river is to conduct a water balance and assessment of inflows and outflows to the Santa Clara surface and groundwater resources. Associated with this would be a hydrological analysis with models to assess the amount of water flow necessary in all lower segments of the river in order to provide sufficient water for steelhead passage during the winter months (Kelley, 2004).

Upper Watershed

Approximately 75% of the land in the Upper Santa Clara River HA is within the Angeles National Forest. This open space and the relatively undisturbed riverine environment provides habitat for three endangered species: California condor, unarmored threespine stickleback, and California least Bell's vireo. The endangered slender-horned spineflower as also been identified as occurring in the area (CDWR, 1993).

The Castaic Ranges cover 404,000 acres and include Liebre Mountain, Sawmill Mountain, and the Sierra Pelona. They lie northwest of the San Gabriel Mountains, between Soledad Canyon and Piru Creek in Los Angeles County. Geologically, they are considered part of the Transverse Ranges. The area has rugged topography but is relatively low in elevation, climbing above 5,000 feet only on Liebre and Sawmill mountains. The mountains and foothills north of Castaic are dominated by chaparral-covered hills, but they also contain several low elevation streams that have high-quality riparian and aquatic habitats. In addition, the upper elevations of Liebre and Sawmill mountains contain unique and important montane habitats. The geographic position of this region, which lies between the San Gabriel Mountains to the east, the Tehachapi Mountains to the north, and the Los Padres ranges to the west, makes it a key wildland linkage (Stephenson, 1999).

Although much of Castaic Creek is now covered by Castaic Lake, there are still areas of important riparian habitat. Arroyo toads occur upstream and downstream of the lake. A pond turtle population also exists in the upper reaches of Castaic Creek. Streamflows below Castaic Lake are controlled by releases from the dam. The lake contains a wide variety of non-native species that can disperse both up and down stream. Bullfrogs and warm-water fish in particular are a threat to arroyo toads and pond turtles (Stephenson, 1999).

Elizabeth Lake Canyon contains some high-quality riparian and aquatic habitat. Swainson's thrush and yellow-breasted chat are known to occur along this drainage. It is also a historic locality for the Tehachapi white-eared pocket mouse and the foothill yellow-legged frog. A paved road runs the length of this canyon and several campgrounds are located along it. The stream flows into Castaic Lake, which makes it more susceptible to infestations of bullfrogs and warm-water fish (Stephenson, 1999).

Soledad Canyon contains high-quality riparian and aquatic habitat. Portions of the upper Santa Clara River in this canyon are designated as critical habitat for the unarmored threespine stickleback fish. Santa Ana suckers, southwestern willow flycatchers, and summer tanagers also occur in this area. Invasive, non-native species are also a problem, particularly arundo and warm-water fish (Stephenson, 1999).

Placerita Canyon State Park, in Los Angeles County, was created to preserve and protect the site of the first discovery of gold in California, in 1842. Designated as a State Historic Landmark, the park is situated in the transition zone between the San Gabriel Mountains and the Mojave Desert, and contains sandstone formations, seasonal streams and riparian oak woodlands, as well as stands of cottonwood and native sycamore trees. The park's location provides significant linkages connecting the Angeles National Forest, the Santa Susana Mountains, the Simi Hills and the Santa Monica Mountains (CDPR website).

San Francisquito Creek contains high quality, low-elevation riparian and aquatic habitat. The unarmored threespine stickleback, California red-legged frog, southwestern willow flycatcher, Swainson's thrush, yellowbreasted chat, and Nevin's barberry all occur along this drainage. The primary factors affecting ecological integrity in the area are water diversions, encroachment of non-native species, and land uses associated with a major paved road that runs the length of this canyon (Stephenson, 1999).

Piru Creek Subwatershed

There is an abundance of wildlife in the Piru Creek subwatershed. Piru Creek historically was a major spawning tributary for southern California steelhead but Santa Felicia Dam now blocks steelhead access (Kelley, 2004). Steelhead trout populations have declined dramatically since the mid-1950s coincident with construction of dams and water diversions. Those portions of the Piru Creek subwatershed that occur within the National Forests include some of the most botanically diverse preserves in the United States. Most of the land experiences Mediterranean climate characterized by cool, wet winters and hot, dry summers. This climate coupled with elevational changes creates a unique assemblage of plant communities in which chaparral dominates. Oaks, pines, fir, and juniper species occur above 5,000 feet while cottonwood, and willow communities occur within the streambed and near springs. Seasonal grasses are dominant on the soils formed on finer grained sedimentary rocks and alluvium. Adjacent upland terraces are relatively arid, supporting oaks, grassland and chaparral (SCWRP website).

Vegetation throughout lower Piru Creek consists of white alders, California sycamores, arroyo willows, coast live oak, and mule fat. The dominant overstory is alders and sycamores, with some portions being dominated by coast live oaks. The midstory is composed of smaller willows, mule fat, and poison oak, with and understory of the aforementioned species as well as California wild rose, California blackberry, cattails, and other herbaceous species. The subwatershed contains a limited distribution of rural communities and may remain free of nonnative, exotic species such as *Arundo donax* or giant reed (SCWRP website).

The middle portion of Piru Creek (below the Pyramid Lake dam) is characterized by cobbly floodplain terraces that support sporadic willow clumps within the streambed and stands of alders along the edges. Episodic channel forming flood events can result in the removal of bordering alders within this reach (SCWRP website).

Black bear populations have maintained their numbers at a relatively constant level over the past few decades. The Upper Piru and Agua Blanca areas of the Ojai District have the highest bear concentrations within the subwatershed. This success is primarily a result of previous conservation actions taken to preserve the robust habitat of the upper subwatershed system (SCWRP website).

Sensitive species potentially occurring within the subwatershed include the southwestern willow flycatcher, least Bell's vireo, Cooper's hawk, arroyo toad, and California red-legged frog. Arroyo toads are known to occur on two short segments of Piru Creek, from lower Piru Gorge downstream to the vicinity of Blue Point Campground, and between Bear Gulch and the headwaters of Pyramid Lake. However, California red-legged frogs are believed to have been eliminated in part by off-road vehicle activities in Piru Creek above Pyramid Lake (SCWRP website).

Sespe Creek Subwatershed

The confluence of Sespe Creek with the Santa Clara River provides an important connection to upland systems and potential migration corridor for four endangered species: southwestern willow flycatcher, least Bell's vireo, arroyo toad, and California red-legged frog (SCWRP website).

As with Piru Creek, abundant and diverse wildlife occurs within the Sespe Creek subwatershed. The mountains of the Los Padres National Forest have created a unique assemblage of plant communities in which chaparral dominates. Southern coast live oak, southern cottonwood-willow, southern sycamore-alder, and southern mixed riparian forests dominate the drainage network. Examples of other plant communities encountered within the upper subwatershed include southern riparian scrub and California walnut woodland. The Sespe Creek subwatershed contains similar vegetation overstory and understory as the Piru Creek subwatershed including a limited distribution of rural communities and nonnative, exotic species such as *Arundo donax* or giant reed. Common wildlife species observed within the subwatershed include black bears, deer, mountain lions, bobcats, coyotes, rattlesnakes, red-tailed hawks, and golden eagles. Black bear populations have maintained their numbers at a relatively constant level over the past few decades and the Sespe Condor Sanctuary of the Ojai District has a high bear concentration. Sespe Creek also supports remnants of the historically abundant southern steelhead (SCWRP website).

Sespe Creek is one of the main southern California steelhead spawning tributaries; there are no dams on the creek (Kelley, 2004). Due to the endangered status of southern California steelhead, Sespe Creek has been closed to fishing from Alder Creek downstream to the confluence with the Santa Clara River. Approximately 15 miles of Sespe Creek from the mouth of the Tule Creek downstream to the Hot Springs Canyon vicinity supports the largest surviving populations of arroyo toad. This upper half of the Sespe Creek drainage contains large areas of excellent adult and breeding habitats for the toad (SCWRP website).

Santa Paula Creek Subwatershed

Sensitive species within the Santa Paula Subwatershed include arroyo toads, California red-legged frogs, southern California steelhead trout, least Bell's vireo, and southwestern willow flycatcher (SCWRP website). Santa Paula Creek is one of the watershed’s main southern California steelhead spawning tributaries (Kelley, 2004). The natural communities present in the Santa Paula Creek subwatershed include riparian woodland, riparian scrub, coast live oak-walnut woodland, coastal sage scrub-grassland, and chaparral. Chaparral is found on the higher slopes of Santa Paula Canyon and mixed with coastal sage scrub and grassland along the drier, rocky slopes. Coniferous trees occur on the crests of the higher mountains. Riparian woodland and riparian scrub habitat are dominant in the upper portion of the subwatershed, but limited to narrow strips of variable size along the drainage further downstream. Upstream of Steckel Park, the riparian habitat is relatively undisturbed and characterized by a mix of black cottonwood, western sycamore, white alder, Fremont cottonwood, willow species, and mule fat. The understory is dominated by poison oak, mugwort, various brome grasses, cocklebur, wild celery, lotus, and locoweed (SCWRP website).

The portion of Santa Paula Creek which flows through Steckel Park is characterized by a mix of riparian habitats and oak-walnut woodlands. One clump of giant reed is present at Steckel Park. Alluvial scrub habitat occurs on the upper terraces of the existing banks and is composed primarily of shrubs including California sagebrush, laurel sumac, black sage, and buckwheat (SCWRP website).

In the alluvial valley below Steckel Park, the vegetation community is primarily agricultural. Citrus and avocado orchards occur along both banks of Mud Creek and a majority of the eastern bank of Santa Paula Creek. The remaining portion of the alluvial valley contains terraced hillsides that have been urbanized (SCWRP website).

Sensitive plant species that may occur within the area include the slender-horned spineflower, Gambell's waters cress, and the Santa Paula buckwheat (SCWRP website).

Least Bell's vireo historically nested along a majority of the Santa Paula Creek according to the U.S. Fish & Wildlife Service (USFWS) in 1982. However, the lower portion of the Santa Paula Creek does not currently contain suitable habitat for the least Bell's vireo or southwestern willow flycatcher (SCWRP website).

The Watershed's Designated Beneficial Uses

The various uses of waters described above are referred to as beneficial uses. The Regional Board designates beneficial uses of all waterbodies in the Water Quality Control Plan for the Ventura and Los Angeles Coastal Watersheds (usually referred to as Basin Plan). These beneficial uses are the cornerstone of the State and Regional Board's efforts to protect water quality, as water quality objectives are set at levels that will protect the most sensitive beneficial use of a waterbody. Together, beneficial uses and water quality objectives form water quality standards (CRWQCB, 1994).

Twenty-one beneficial uses for waters in the Santa Clara River Watershed are designated in the Regional Board's Basin Plan. These beneficial uses are listed by waterbody and hydrologic unit in the table below. Certain site specific water quality objectives, namely TDS, sulfate, chloride, boron, and--for surface waters--nitrogen, reflect background levels of constituents in the mid-1970s, in accordance with the State Board's Antidegradation Policy. Water quality objectives for these and for other constituents and parameters can be found in the Basin Plan (CRWQCB, 1994).

From: Table 2-1. Beneficial Uses of Inland Surface Waters. (CRWQCB, 1994)

Watershed[a]	Hydro Unit #	MUN	IND	PROC	AGR	GWR	FRSH	NAV	POW	REC1	REC2	COM	AQUA	WARM	COLD	SAL	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
SANTA CLARA RIVER WATERSHED																									
Santa Clara River Estuary c	403.11							E		E	E	E					E	E	E		Ee	Ef	Ef		E
Santa Clara River	403.11	P*	E	E	E	E	E			E	E			E	E				E		E	E			E
Santa Clara River	403.21	P*	E	E	E	E	E			Ed	E			E					E		E	E			E
Santa Clara River	403.31	P*	E	E	E	E	E			Ed	E			E					E		E	E			E
Santa Clara River	403.41	P*	E	E	E	E	E			E	E			E					E		E	E			E
Santa Clara River	403.51	P*	E	E	E	E	E			E	E			E					E		E				E
Santa Clara River (Soledad Cyn)	403.55	E*	E	E	E	E	E			E	E			E					E		Ei				E
Santa Paula Creek	403.21	P	E	E	E	E	E			E	E			E	E				E		E	E	E		
Sisar Creek	403.21	P	E	P	E	E				E	E			E	E				E		Eg		E		E
Sisar Creek	403.22	P	E	P	E	E				E	E			E	E				E		Eg		E		E
Sespe Creek	403.31	P	E	E	E	E				E	E			E	E				E	E	E	E	E		E
Sespe Creek	403.32	P	E	P	E	E				E	E			E	E				E	E	Eg	E	E		E
Timber Creek	403.32	P*				E				E	E				E				E	E	E	E	E		E
Bear Canyon	403.32	P*				E				E	E			E	P				E	E	E	E	E		E
Trout Creek	403.32	P*				E				E	E			E	E				E		E	E	E		E
Piedra Blanca Creek	403.32	P*				E				E	E				E				E		E	E	E		E
Lion Canyon	403.32	P*				E				E	E			E	E				E			E	E		E
Rose Valley Creek	403.32	P*				E				E	E			E	E				E				E		E
Howard Creek	403.32	P*				E				E	E				E				E	E	E	E	E		E
Tule Creek	403.32	P*				E				P	E				P				E	E	E	E	E		E
Potrero John Creek	403.32	P*				E				E	E				P				E		E	E	E		E
Hopper Creek	403.41	P*	E		E	E	E			E	E			E	E				E		Eg				E
Piru Creek	403.41	P	E	E	E	E	E			E	E			E	E				E		Eg	E	E		E
Piru Creek	403.42	P	E	E	E	E	E			E	E			E	E				E		Eg		E		E
Lake Piru	403.41	P	E	E	E	E	P			E	E			E	E				E		E		E		
Lake Piru	403.42	P	E	E	E	E	P		P	E	E			E	E				E		E		E		
Pyramid Lake	403.42	E	E	E	E	E	P		E	E	E			E	E				E		E				
Cañada de los Alamos	403.43	I*			I	I	I			I	I			I	I				E		E				
Gorman Creek	403.43	I*			I	I				I	I			I	I				E		P				
Lockwood Creek	403.42	I*			I	I				I	I			I	I				E						
Lockwood Creek	403.44	I*			I	I	I			I	I			I	I				E						
Tapo Canyon	403.41	P*			P					P	E			E					E						
Castaic Creek	403.51	I	I	I	I	I	I			I	E			I					E		E				

From: Table 2-1. Beneficial Uses of Inland Surface Waters. (CRWQCB, 1994)

Watershed[a]	**Hydro Unit #**	**MUN**	**IND**	**PROC**	**AGR**	**GWR**	**FRSH**	**NAV**	**POW**	**REC1**	**REC2**	**COM**	**AQUA**	**WARM**	**COLD**	**SAL**	**EST**	**MAR**	**WILD**	**BIOL**	**RARE**	**MIGR**	**SPWN**	**SHELL**	**WETb**
Castaic Lagoon	403.51	E*	E	E	E	E	E			E	E			E					E						
Castaic Lake	403.51	E	E	E	E	E	E		E	E	E			E					E		E		E		
Elderberry Forebay	403.51	E	E	E	E	E	E		E	Ek	E			E					E		E		E		
Elizabeth Lake Canyon	403.51	I	I	I	I	I	I			I	E			I					E						
San Francisquito Canyon l	403.51	I	I	I	I	I	I			I	I			I					E		E		I		E
South Fork (Santa Clara River)	403.51	I*	I	I	I	I	I			I	I			I					E						
Drinkwater Reservoir	403.51	P*				E				Pk	E			P					E		E				E
Bouquet Canyon	403.51	E I	E I	P I	P I	E	P			Em	E			E	E				E				P		E
Bouquet Canyon	403.52	P	P	P	E	E	P			Em	E			E	E				E		E				E
Dry Canyon Creek	403.51	I	I	I	I	I	I			I	I			I					E						
Dry Canyon Reservoir j	403.51	E	E	E	E	P	P		P	Pk	E			E					E						
Bouquet Reservoir	403.52	E	E	E	E	E	E		P	Pk	E			E					E						
Mint Canyon Creek	403.51	I	I	I	I	I	I			Im	I			I					E						
Mint Canyon Creek	403.53	I*	I	I	I	I	I			Im	I			I					E						
Agua Dulce Canyon Creek	403.54	I*	I	I	I	I	I			I	I			I					E		E				
Agua Dulce Canyon Creek	403.55	I*			I	I	I			I	I			I					E						
Aliso Canyon Creek	403.55	P*			P	E				E	E			E					E						E
Lake Hughes	403.51	P	P	P	P	P	P			E	E			E					E						
Munz Lake	403.51	P*	P	P	P	E	P			E	E			E					E						
Lake Elizabeth	403.51	P	P	P	P	P	P			E	E			E					E		E				

E: Existing beneficial use
P: Potential beneficial use
I: Intermittent beneficial use
E, P, and I shall be protected as required
* Asterixed MUN designations are designated under SB 88-63 and RB 89-03 Some designations may still be considered for exemptions at a later date. (See pages 2-3, 4 for details).

Footnotes are consistent on all beneficial use tables.
a Waterbodies are listed multiple times if they cross hydrologic area or sub area boundaries Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
b Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory action would require a detailed analysis of the area.
c Coastal waterbodies which are also listed in Coastal Features Table (2-3) or in Wetlands Table (2-4).
d Limited public access precludes full utilization.
e One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting.

f Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs.
m Access prohibited by Los Angeles County DPW in the concrete-channelized areas.
n Area is currently under control of the Navy: swimming is prohibited.
o Marine habitats of the Channel Islands and Mugu Lagoon serve as pinneped haul-out areas for one or more species (i.e., sea lions).
p Habitat of the Clapper Rail.
q Whenever flow conditions are suitable.
r Public access prohibited by Calleguas MWD

Beneficial Use Definitions

Beneficial uses in the Los Angeles Basin are listed as defined below. The uses are listed in no preferential order.

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH)
Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW)
Uses of water for hydropower generation.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA)
Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Inland Saline Water Habitat (SAL)
Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as **Areas of Special Biological Significance (ASBS),** established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

Stakeholder Groups

The term “stakeholder group” is subject to many different definitions. For the purposes of this document, the term is considered to include those groups consisting of individuals and agencies who meet on a fairly regular basis to address holistic watershed issues or who otherwise have contributed as a group to the knowledge of the watershed. It is acknowledged that many other groups address more focused activities relating to, in particular, water quality improvement and invasive plants removal.

Santa Clara River Enhancement and Management Plan (SCREMP) Steering Committee This group no longer actively meets but its 26-member Project Steering Committee completed an Enhancement and Management Plan during the 1990s. The Committee consisted of representatives of the following individuals and agencies:

Acton Town Council *
Aggregate Producers
Agriculture/Private Land Ownership
Beach Erosion Authority for Operations & Nourishment *
Castaic Lake Water Agency
Cities of Fillmore/Santa Paula *
City of Oxnard
City of San Buenaventura *
City of Santa Clarita *
County of Ventura – Resource Management Agency *
Friends of the Santa Clara River *
  (environmental organization umbrella group)
Los Angeles County Flood Control District *
Los Angeles County Sanitation District
Los Angeles Department of Regional Planning – APIS
Newhall Land & Farming Company
Santa Clara Valley Property Owners Association
State of California Coastal Conservancy *
State of California Department of Fish and Game *
State of California Department of Parks and Recreation *
State of California Department of Transportation * - District 7
State of California Water Quality Control Board – L.A. Region *
United Water Conservation District
U.S. Army Corps of Engineers *
U.S. Fish & Wildlife Service *
Valley Advisory Committee
Ventura County Flood Control District *

- Additionally indicated support for the river study by signing a Memorandum of Cooperation

Six subcommittees worked with a consultant to collect the information necessary for a river management plan; they focused on agriculture, flood control, water resources, aggregate industry, recreation, and biology. These subcommittees worked on determining river dynamics and areas where the interests of diverse groups overlap along the river; the critical issues areas were identified. Reports were developed by the subcommittees that provide background information, goals, and recommendations for the river on the issue areas. A series of computer-based maps have been produced, which are currently being used in a GIS overlay process to identify conflicts and opportunities and facilitate decisions regarding use of the river floodplain. The SCREMP addresses management of the 500-year floodplain of the main river corridor. The SCREMP Water Resources Subcommittee also oversaw the development of a coordinated watershed monitoring plan which was finalized in Spring 2006. Copies of both the enhancement and monitoring plans are available at http://www.vcwatershed.org/Watersheds_SantaClara.html. The results of the SCREMP effort have been incorporated into Ventura County's Integrated Watershed Protection Plan which can be found at http://www.vcwatershed.org/Projects_IWPP.html . Additionally, a Santa Clara River Watershed Feasibility Study sponsored by the U.S. Army Corps of Engineers in conjunction with the Los Angeles County Department of Public Works and the Ventura County Watershed Protection District has begun to identify flooding and regional flood control solutions, erosion and sedimentation problems, opportunities to improve water quality, and riparian habitats that would benefit from restoration. Federal funding, however, may not be available in the immediate future. More information may be found at http://www.spl.usace.army.mil/santaclara/santaclarariverwatershed.htm.

Friends of the Santa Clara River This non-profit stakeholder group has been involved with watershed activities along the length of the river with a focus on the protection, enhancement, and management of the river's resources. More information about this group may be found at their website http://www.FSCR.org.

Southern California Wetlands Recovery Project (WRP) – Ventura County Task Force The WRP is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the International border with Mexico. Using a non-regulatory approach and an ecosystem perspective, the WRP works to identify wetland acquisition and restoration priorities, prepare plans for these priority sites, pool funds to undertake these projects, implement priority plans, and oversee post-project maintenance and monitoring. The five County Task Forces help solicit projects for consideration for WRP funding by the Managers Group and Board of Governors. The Ventura County Task Force also serves as an active forum for presentations on the many technical studies currently underway including the Santa Clara River Parkway Floodplain Restoration Feasibility Study. More information about the WRP may be found on their webpage at http://www.scwrp.org and about the parkway project at http://www.santaclarariverparkway.org/wkb/projects/scrfeasibility.

Santa Clarita Organization for Planning the Environment (SCOPE) This group has been involved with educating the public about planning and environmental issues, including those involving the river, particularly in the area around the Santa Clarita Valley. More information about this group may be found at their website http://www.scope.org.

Santa Clara Estuary Work Group This group includes staff from the Regional Board, California Department of Fish and Game, California State Parks - Channel Coast District, and the Ventura Water Reclamation Plant. A Natural Resources Management Plan is being prepared for the State Parks land in and around the estuary.

Land Use Characteristics

The majority of the watershed is open space (Figure 5), most of which is National Forest or condor sanctuary. Large numbers of waterfalls or springs are shown on topographic maps in the upper Sespe. Along the mainstem of the river on the Ventura County portion (lower and middle sections of the river), agriculture predominates interspersed with residential and some industrial development. Besides the predominant open space, the upper portion of the watershed is characterized by a mix of residential, mixed urban, and industrial land uses with low density residential more common in the uppermost areas of the watershed while high density is more prevalent elsewhere. There are a number of cities and communities in the Santa Clarita Valley, in the upper watershed, including the city of Santa Clarita (which includes the communities of Valencia, Saugus, Canyon Country, and Newhall). Communities outside of the city limits include Castaic, Porter Ranch, Acton, Agua Dulce, Val Verde, and areas in unincorporated Los Angeles County. The cities and communities of the Santa Clara River Valley in Ventura County are, progressing westward, Piru, Fillmore, Santa Paula, Saticoy, and Ventura. A very large development of new homes has been proposed to be built on land owned by Newhall Land and Farming Company on the east side of the county line in unincorporated Los Angeles and Ventura Counties. A large number of new homes are also being constructed in the city of Fillmore along the river and in the city of Oxnard along the southern bank of the river.

Oil production is now a small part of the industrial land use compared to decades ago. Oil production in the watershed began in the late 1880s and only began to lag in the 1970s. Many oil production structures remain in place and are represented on topographic maps. These oil-producing sites, whether as natural seeps or as disused production wells, may be sources of visible oil and releases of brine. The eastern parts of the Sespe Creek Subwatershed, particularly Little Sespe and Tar Creeks, show oil wells and tanks on the topographic maps. Maps of the Santa Paula Creek Subwatershed also show large number of oil wells. Both Sespe and Santa Paula also show sulfur springs. The South Fork and its tributaries show a great many oil wells. Adams Canyon, just west of Santa Paula, also was known for its prolific oil production. Interestingly, a side canyon to Adams is called Salt Marsh Canyon. There is also a Salt Creek flowing into Castaic Creek. Hopper Canyon and Piru Creek are a few subwatersheds that do not show oil wells on topographic maps.

Piru Creek supports a variety of land uses and vegetation types. Several campgrounds occur along the drainage in the upper subwatershed that provide limited access and recreational opportunities. Cattle grazing occurs in certain areas immediately adjacent to Lake Piru. The lower portion of the drainage near the Santa Clara River valley contains urban and agricultural development along the creek and adjacent foothills (SCWRP website).

The Santa Clara River Valley continues to support one of California's major citrus grove areas. Other crops and land uses in this valley include avocado, pasture, small grains, alfalfa, and industries related to agriculture such as packing, processing, and trucking (SCWRP website).

The 500-year floodplain of the river has been the primary source of sand and gravel (aggregate) for several decades. The sand and gravel deposits are extracted for use as aggregate in the process that in California is generally referred to as surface mining. The last in-river mining activity on the Los Angeles County side had occurred in 1993, but which is now active, and the majority of the in-river mining in its Ventura County segment ceased in the late 1980s (AMEC, 2005). However, large-scale gravel mining operations have been proposed recently in the Santa Clarita area.

Discharges into the Watershed

Historical Discharges/Permits Timeline

1950s/1960s large amounts of brine discharges from oil fields
1957 first waste discharge requirements (WDRs) issued for Saticoy Sanitation District Wastewater Treatment Plant (WWTP)
1971 first WDRs issued for Piru WWTP
1977 first NPDES permit issued for Fillmore WWTP
1979 first WDRs issued for Montalvo WWTP
1979 first NPDES permit issued for Saugus WWRP
1979 first NPDES permit issued for Valencia WWRP
1980 first NPDES permit issued for Santa Paula WWRP
1980 first NPDES permit issued for Ventura Wastewater Reclamation Plant (WWRP)
1997 water softener ban lifted
2003 June-Sept nitrification/denitrification requirements go into effect at Valencia and Saugus WRPs and modifications are implemented
2003 residential water softener ban reinstated in Santa Clarita
2004 residential water softener ban enacted in Fillmore

NPDES Permits (not general construction or industrial stormwater-related)(CRWQCB, 2004)

There are four major discharges (all POTWs), 11 minor discharges, and 15 discharges covered by general permits. Of the five POTWs discharging to surface waters, one discharges into the estuary (San Buenaventura at 14 MGD design flow), two into Reach 3 (Santa Paula at 2.55 MGD design flow and Fillmore at 1.33 MGD design flow), one into Reach 5 (Valencia at 21.6 MGD design flow), and one into Reach 6 (Saugus at 6.5 MGD design flow).

Major discharges are defined as POTWs with a yearly average flow of over 0.5 MGD or an industrial source with a yearly average flow of over 0.1 MGD and those with lesser flows but with acute or potential adverse environmental impacts.

Minor discharges are defined as all other discharges that are not categorized as a Major. Minor discharges may be covered by a general permit, which are issued administratively, for those that meet the conditions specified by the particular general permit.

Twenty of the 30 NPDES discharges are to the mainstem of the Santa Clara River while the rest discharge to various tributaries or lakes.

Of the NPDES discharges under general permits:

- 10 are for miscellaneous wastes (dewatering, rec. lake overflow, swimming pool wastes, water ride wastewater, or groundwater seepage) that were nonhazardous prior to treatment,
- 5 are for domestic sewage and industrial wastes that were nonhazardous prior to treatment,
- 4 are for contaminated groundwater that were nonhazardous prior to treatment,
- 3 are for miscellaneous wastes that were inert prior to treatment,
- 2 are for process waste (produced as part of industrial/manufacturing process) that were nonhazardous prior to treatment, and
- One each are for stormwater runoff (nonhazardous before treatment), miscellaneous wastes (inert before treatment), contaminated groundwater (hazardous before treatment), and noncontact cooling water (nonhazardous before treatment).
- 4 are covered by NPDES Permit No. CAG994004 – for discharges of groundwater (treated or untreated) from construction and project dewatering to surface waters (threat/complexity rating to be determined)
- 3 each are covered by NPDES Permit No. CAG994005 – for discharges of groundwater from potable water supply wells to surface waters (threat/complexity rating to be determined) and NPDES Permit No. CAG994001 (being replaced by CAG994004) – for groundwater discharges from construction and project dewatering to surface waters (threat/complexity rating 3C)
- 2 are covered by NPDES Permit No. CAG914001 – for discharges of volatile organic compound contaminated groundwater to surface waters (threat/complexity rating 2B), and
- One each are covered by NPDES Permit No. CAG674001 – for discharges of hydrostatic test water to surface waters (threat/complexity rating 3C), NPDES Permit No. CAG834001 – for treated groundwater and other wastewaters from investigation and/or cleanup of petroleum fuel pollution to surface waters (threat/complexity rating 2B), and NPDES Permit No. CAG994003 – for discharges of nonprocess wastewaters not requiring treatment systems to surface waters (threat/complexity rating 3C).

NPDES Permits (general construction or industrial stormwater-related) (CRWQCB, 2004)

Of the 114 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Santa Clarita and Santa Paula. There is a wide array of businesses represented with many being involved with auto wrecking and food packing. A similar number of sites are located in the upper and lower watershed.

There are approximately 300 sites enrolled under the construction storm water permit; the majority of these sites are located in the upper watershed, especially within the city of Santa Clarita and surrounding unincorporated Los Angeles County. About one-half of the sites are residential and about two-thirds are five acres or greater in size with six sites being at least 1,000 acres.

Non-NPDES Discharges (Chapter 15 and Non-Chapter 15) (CRWQCB, 2004)

There are eight facilities with Chapter 15 requirements (mostly landfills, some closed) while there are 54 facilities with non-Chapter 15 waste discharge requirements. Included in the latter facilities are POTWs which discharge to percolation or evaporation ponds. The Montalvo plant has a design capacity of 0.36 MGD and is located in Reach 1. The Saticoy plant has a design capacity of 0.3 MGD and is located in Reach 2. The Piru facility has a design capacity of 0.2 MGD and is located in Reach 5.

The following series of tables is a list of the facilities which discharge into the watershed.

Los Angeles Regional Water Quality Control Board
Santa Clara River Watershed Wastewater Permits - NPDES

Discharger's Name*	Facility Name	City	NPDES #	WDID #	CI #	Rating		Order #	Exp. or Review Date	Design Q (MGD)	Baseline Q (MGD)	Waste Type	Receiving Water
Majors													
LA Co Sanitation Districts	Valencia WRP	VALENCIA	CA0054216	4A190107023	4993	1	A	03-145	10/10/08	21.60	8.22	DDOMIND	SANTA CLARA RIVER
LA Co Sanitation Districts	Saugus WRP	SAUGUS	CA0054313	4A190107021	2960	1	A	03-143	11/6/08	6.50	6.50	DDOMIND	SANTA CLARA RIVER
San Buenaventura, City of	Ventura WWRP	VENTURA (CORPORATE NAME SAN BUENAVENTURA)	CA0053651	4A560107001	1822	1	A	00-143	9/10/05	14.00	10.50	DDOMIND	SANTA CLARA RIVER
Santa Paula, City of/OMI	Santa Paula WWRP	SANTA PAULA	CA0054224	4A560108001	1759	1	A	97-041	3/10/02	2.55	1.89	DDOMIND	SANTA CLARA RIVER
Minors													
Castaic Lake Water Agency	Earl Schmidt Filtration Plant	CASTAIC	CA0059030	4A190116001	6544	3	C	97-030	3/10/02	25.00	12.50	DMISCEL	CASTAIC LAKE
Dept of Water Resources	William E. Warne Power Plant	PYRAMID LAKE	CA0059188	4A190805002	6610	3	C	99-015	4/10/04	1.75	1.75	DPROCES	PYRAMID LAKE
Fillmore, City of	Fillmore WWTP	FILLMORE	CA0059021	4A560101002	6523	2	A	03-136	9/10/08	1.33	0.11	DDOMIND	SANTA CLARA RIVER
HR Textron Inc.	Valencia Facility	SANTA CLARITA	CA0003271	4A192332001	6024	3	C	96-066	9/10/01	0.10	0.07	DMISCEL	SANTA CLARA RIVER
Keysor-Century Corp	Pvc-Pva Copolymer Mfg, Saugus	SAUGUS	CA0057126	4A192000001	1954	2	C	98-032	5/10/03	0.10	0.05	DSTORMS	SOUTH FORK SANTA CLARA RIVER
LA Co Dept of Parks &Recreation	Val Verde Co. Park Swim Pool	SAUGUS	CA0062561	4A190107086	7140	3	C	97-062	3/10/02	0.01	0.00	DMISCEL	SANTA CLARA RIVER
Los Angeles City of DWP	Castaic Power Plant	CASTAIC	CA0055824	4A193500005	6112	2	B	98-020	2/10/03	13.20	13.40	DPROCES	ELDERBERRY FOREBAY
Los Angeles City of DWP	Tunnel No. 104	SANTA CLARITA	CA0058432	4B190106061	6313	3	B	03-089	6/10/08	0.02	0.02	DCNWTRS	NEWHALL CREEK
Metropolitan Water Dist. Of SC	Foothill Feeder Power Plant	CASTAIC	CA0059641	4A190115006	6743	3	C	98-066	9/10/03	0.07	0.07	DNONCON	CASTAIC LAKE
Santa Clarita, City of	Drainage Ben. Assess Area 6&18	SANTA CLARITA	CA0061638	4A191142001	6945	3	C	03-099	6/10/08	0.05	0.05	DMISCEL	SANTA CLARA RIVER
Six Flags Magic Mountain	Amusement Park, Valencia	VALENCIA	CA0003352	4A199002002	6045	2	B	98-005	1/10/03	1.00	0.10	DMISCEL	SANTA CLARA RIVER
General													
Augeas Corporation	Former Just Gas	OXNARD	CAG834001	4A566600184	8557	2	B	02-125	7/11/07	0.02	0.02	HCNWTRS	SANTA CLARA RIVER
Caltrans	Santa Clarita River Bridge Exp	VENTURA	CAG994004	4A566100092	8374			03-111	8/7/08	0.10	0.10	DCNWTRS	SANTA CLARA RIVER
Castaic Lake Water Agency	Three Prod. Well Aquifer Test	SANTA CLARITA	CAG914001	4B196800043	8440	2	B	02-107	5/23/07	0.43	0.43	DCNWTRS	SOUTH FORK SANTA CLARA RIVER
CH2M Hill	SCLLC Porta Bella Dev. Project	SANTA CLARITA	CAG914001	4A196800044	8455	2	B	02-107	5/23/07	0.07	0.07	DCNWTRS	SANTA CLARA RIVER
DOKKEN ENGINEERING	Bouquet Canyon Bridge Widening	SANTA CLARITA	CAG994004	4A197500007	8649			03-111	8/7/08	0.40	0.40	DMISCEL	SANTA CLARA RIVER
LA Co Sanitation Districts	Valencia WWRP	VALENCIA	CAG994004	4A196000102	7296			03-111	8/7/08	0.60	0.60	DMISCEL	SANTA CLARA RIVER
McDonald's Restaurant	Mcdonald's Restaurant	GORMAN	CAG994001	4A196000160	7464	3	C	97-045	4/10/02	0.01	0.01	DMISCEL	PYRAMID LAKE

Los Angeles Regional Water Quality Control Board
Santa Clara River Watershed Wastewater Permits - NPDES (cont'd)

Discharger's Name*	Facility Name	City	NPDES #	WDID #	CI #	Rating		Order #	Exp. or Review Date	Design Q (MGD)	Baseline Q (MGD)	Waste Type	Receiving Water
Newhall County Water District	Well Nos. 7 & 10	SANTA CLARITA	CAG994005	4A196000636	8603			03-108	8/7/08	0.49	0.49	NMISCEL	NEWHALL CREEK
Newhall Land and Farming Co.	Hart/Pony Baseball & Auto Mall	VALENCIA	CAG994004	4A197500001	8648			03-111	8/7/08	1.00	1.00		SANTA CLARA RIVER
Ogden Constructors	Santa Paula Improvement,Reach2	SANTA PAULA	CAG994001	4A566000472	8002	3	C	97-045	4/10/02	0.01	0.01	IMISCEL	SANTA CLARA RIVER
Santa Clarita Community College	College Of The Canyons	SANTA CLARITA	CAG994003	4A196400040	7324	3	C	98-055	5/10/03	0.28	0.00	DMISCEL	SANTA CLARA RIVER
Santa Paula, City of/OMI	Well #11	SANTA PAULA	CAG994005	4A566000580	8292			03-108	8/7/08	2.90	2.90	NMISCEL	SANTA CLARA RIVER
Southern California Gas Co.	Fair Oaks Ranch-Phase II	SANTA CLARITA	CAG674001	4A196300155	8593	3	C	97-047	4/10/02	0.00	0.00		SANTA CLARA RIVER
The Painted Turtle Camp	The Painted Turtle Camp	LAKE HUGHES	CAG994001	4A196000624	8468	3	C	97-045	4/10/02	0.01	0.01	DMISCEL	LAKE ELIZABETH
Valencia Water Company	Valencia Water Co. Well #206	CASTAIC	CAG994005	4A196000622	8476			03-108	8/7/08	4.00	4.00	NMISCEL	SANTA CLARA RIVER

***General permit dischargers will be reviewed and may not be "renewed" but allowed to continue with enrollment**

DCNWTRS	4
DDOMIND	5
DMISCEL	10
DNONCON	1
DPROCES	2
DSTORMS	1
HCNWTRS	1
IMISCEL	1
NMISCEL	3

CAG674001	1
CAG834001	1
CAG914001	2
CAG994001	3
CAG994003	1
CAG994004	4
CAG994005	3

30 total

Los Angeles Regional Water Quality Control Board
Santa Clara River Watershed Wastewater Permits – Non-Chapter 15

Discharger's Name	Facility Name	City	WDID #	CI #	Rating		Order #	Expiration	Design Q (MGD)	Baseline Q (MGD)	Waste Type
LA Co Sanitation Districts	Saugus WRP	SAUGUS	4A190107083	6188	1	A	87-049	4/27/90	5.00	5.00	DDOMIND
LA Co Sanitation Districts	Valencia WRP	VALENCIA	4A190107084	6186	1	A	87-048	4/27/90	4.50	4.50	DDOMIND
Newhall Land and Farming Co.	Natural River Management Plan	SANTA CLARITA	4A191290001	8099	1	A	99-104	10/28/14	0.00	0.00	IMISCEL
San Buenaventura, City of	Ventura WWRP	VENTURA	4A560107002	6190	1	A	87-045	4/27/90	14.00	0.45	DDOMIND
Fillmore, City of	Fillmore WWTP	FILLMORE	4A560101001	1076	2	A	97-038	4/5/07	1.33	0.73	DDOMIND
LA Co Dept of Public Works	Lake Hughes Community WWTP	LAKE HUGHES	4B190134001	6798	2	A	95-045	3/31/05	0.09	0.04	DDOMEST
Saticoy Food Corp	Vegetable Proc, Santa Paula	SANTA PAULA	4A562408001	5372	2	A	95-130	9/14/10	0.33	0.21	DWSHWTR
Ventura Co Water Works Dist. 1	Todd Road Jail Facility	SANTA PAULA	4A560121001	7418	2	A	94-084	8/21/99	0.09	0.09	DDOMEST
Ventura Regional San District	Saticoy S.D. WWTP	SATICOY	4A560109001	1761	2	A	01-155	10/25/06	0.30	0.12	DDOMIND
Golden Valley Muni. Water Dist	Gorman WWTP	GORMAN	4A190107001	1845	2	B	94-087	8/19/04	0.06	0.02	DDOMIND
LA Co Health Dept	Acton Rehabilitation Center	ACTON	4A190107024	5802	2	B	95-103	7/14/05	0.15	0.02	DDOMEST
LA Co Health Dept	Warm Springs Rehabilition Ctr.	CASTAIC	4A190107005	4242	2	B	94-017	2/26/04	0.03	0.03	DDOMEST
LA Co Probation Dept	Mendenhall-Munz Boys Camp WWTP	LAKE HUGHES	4A190107076	4759	2	B	94-101	9/23/04	0.02	0.02	DDOMEST
San Buenaventura, City of	Ventura WWRP	VENTURA	4A560311001	6190	2	B	80-03402	7/26/90	0.00	0.00	HSLDWST
Santiago Associates LLC	Paradise Ranch	CASTAIC	4A191030001	5671	2	B	89-029	3/27/99	0.10	0.04	DDOMEST
Thomas Aquinas College	Santa Paula College	SANTA PAULA	4A561000001	6410	2	B	94-018	2/28/99	0.03	0.01	DDOMEST
Ventura Co Water Works Dist. 1	Piru WWTP	FILLMORE	4A560114006	5714	2	B	04-032	1/30/07	0.20	0.09	DDOMEST
Ventura Regional San District	Montalvo WWTP	VENTURA	4A560102001	5068	2	B	97-037	4/5/07	0.36	0.27	DDOMIND
Acton Crescent Bay Development	Tract 52883	ACTON	4A196500020	8114	2	C	91-094	7/22/06	0.02	0.02	DDOMEST
Acton Plaza Shopping Center	Acton Plaza Shopping Center	ACTON	4A191149001	7266	2	C	93-022	4/4/03	0.01	0.00	DDOMEST
B & C Land and Water, LLC	Tract 50385	AGUA DULCE	4A196500013	7185	2	C	91-094	7/22/06	0.00	0.00	DDOMEST
Christopher Anthony, Inc	Discount Furniture Store	SAUGUS	4A192404002	6280C	2	C	P 8081	8/21/86	0.00	0.00	DMISCEL
Crown Valley Community Church	Crown Valley Community Church	ACTON	4A191147001	7172	2	C	92-041	5/30/02	0.00	0.00	DDOMEST
Curtis Sand and Gravel	Lang Station	CANYON COUNTRY	4A192030001	1955C	2	C	P 1945	5/21/87	0.00	0.25	DDREDGS
Forecast Homes, Inc.	Tract 49601	ACTON	4B196500022	8270	2	C	91-094	7/22/06	0.01	0.01	DDOMEST
Forecast Homes, Inc.	Tract 49601	ACTON	4B196500023	8271	2	C	91-094	7/22/06	0.00	0.00	DDOMEST
Forecast Homes, Inc.	Tract 49601	ACTON	4B196500024	8272	2	C	91-094	7/22/06	0.01	0.01	DDOMEST
Forecast Homes, Inc.	Tract 49240	ACTON	4B196500026	8273	2	C	91-094	7/22/06	0.01	0.01	DDOMEST
Forecast Homes, Inc.	Tract 49240	ACTON	4B196500027	8274	2	C	91-094	7/22/06	0.00	0.00	DDOMEST

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Santa Clara River Watershed Wastewater Permits – Non-Chapter 15 (cont'd)

Discharger's Name	Facility Name	City	WDID #	CI #	Rating		Order #	Expiration	Design Q (MGD)	Baseline Q (MGD)	Waste Type
Forecast Homes, Inc.	Tract 47788	ACTON	4B196500028	8275	2	C	91-094	7/22/06	0.01	0.01	DDOMEST
Forecast Homes, Inc.	Tract 49240	ACTON	4A196500025	8276	2	C	91-094	7/22/06	0.02	0.02	DDOMEST
Hale & Associates	22284/Todd Landis	ACTON	4A196500015	7256	2	C	91-094	7/22/06	0.00	0.00	DDOMEST
Hasa Chemicals, Inc	Swim Pool Chem Packing, Saugus	SAUGUS	4A199015001	6385C	2	C	P 8143	1/21/88	0.00	0.01	DMISCEL
Keysor-Century Corp	Pvc-Pva Copolymer Mfg, Saugus	SAUGUS	4A192000002	6485C	2	C	P 8230	10/19/89	0.00	0.00	DPROCES
Legacy Partners	Legacy Partners	SAUGUS	4A192066002	6656C	2	C	P 8461	2/25/93	0.00	0.03	DNONCON
Lubrication Company Of America	Blended Petro Products, Saugus	SAUGUS	4A192158001	6596C	2	C	P 8371	9/26/91	0.00	0.00	DSTORMS
Myron Wolter	Tt48818	ACTON	4A196500001	7083	2	C	91-094	7/22/06	0.00	0.00	DDOMEST
Newhall Refining Co., Inc	Process Water Hauling, Coper	NEWHALL	4A192473002	6442C	2	C	P 0994	10/20/88	0.00	0.03	DPROCES
Nova Development Company	Tract 52882	ACTON	4A196500019	8113	2	C	91-094	7/22/06	0.02	0.02	DDOMEST
Peter J. Alfieri	Tract 46647	ACTON	4A196500030	8308	2	C	91-094	7/22/06	0.00	0.00	ISLDWST
Sierra View Center	Commercial Development	ACTON	4A191148001	7213	2	C	92-078	10/17/02	0.00	0.00	DDOMEST
Triangle Rock Co.	L.A. Regional Soledad Plant	CANYON COUNTRY	4A192027001	6333C	2	C	P 4998	5/21/87	0.00	0.30	DDREDGS
Watt Enterprises LP Ltd.	Tract#46205	ACTON	4A196500031	8448	2	C	91-094	7/22/06	0.00	0.00	DDOMIND
Weary & Associates	Tract 52637	ACTON	4A196500021	8118	2	C	91-094	7/22/06	0.00	0.00	DDOMEST
Caltrans	5/126 Inter@Santa Clar Bridge	SANTA CLARITA	4A566700017	8636	3	A	93-010	1/25/08			
Greystone Homes	River Street Property	FILLMORE	4A566700013	8154	3	A	93-010	1/25/08	1.00	1.00	IMISCEL
River Park Legacy LLC	River Park Project	OXNARD	4A566700015	8441	3	A	93-010	1/25/08			
Shell Oil Products US	Shell Oil Co.	ACTON	4A192108021	7527	3	A	95-057	5/11/10	0.00	0.00	DDOMEST
Texaco Group Inc.	Pacific Coast Pipeline Site	FILLMORE	4A567200015	8510	3	A	02-030	1/24/07	0.01	0.48	
Valencia Water Company	Replacement well U6	SANTA CLARITA	4A196700016	8617	3	A	93-010	1/25/08			
Cen Fed Bank	Tract 49240	ACTON	4A561051001	7044	3	B	91-059	4/18/06	0.00	0.00	DDOMEST
Limoneira Co.	Limoneira&Olivelands Sewer Frm	SANTA PAULA	4A565014002	5322	3	B	02-139	8/29/07	0.11	0.11	DDOMEST
OXNARD UNION HIGH SCHOOL DIST	Rio Mesa High School	OXNARD	4A567400015	8645	3	B	97-10DWQ	11/18/03			DDOMEST
Pan American Seed Co.	Pan American Seed, Santa Paula	SANTA PAULA	4A565015001	4246	3	B	87-093	6/18/02	0.00	0.01	DPROCES
Sierra Height Mobile Home Est.	Mobile Home Estate	CANYON COUNTRY	4A561036001	6803	3	B	03-058	4/3/18	0.03	0.03	DDOMEST
Trans Technology Corp.	Placerita Canyon Facility	CANYON COUNTRY	4A192528002	6857	3	B	89-016	2/24/04	0.21	0.21	DCNWTRS
AES Placerita Oil Co.	Placerita Canyon	NEWHALL	4A192072001	6621C	3	C	P 8423	3/18/97	0.00	0.00	DDRIBRI
Alan Berman Trucking	Alan Berman Trucking	VALENCIA	4B199066001	6696C	3	C	P 8584	3/21/00	0.00	0.00	DMISCEL

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Santa Clara River Watershed Wastewater Permits – Non-Chapter 15 (cont'd)

Discharger's Name	Facility Name	City	WDID #	CI #	Rating		Order #	Expiration	Design Q (MGD)	Baseline Q (MGD)	Waste Type
Albert, Jacob	Placerita Oil Field Coper	NEWHALL	4A192316001	6123C	3	C	P 2896	1/23/90	0.00	0.01	DDRIBRI
Arco Petroleum Products Co.	Placerita Oil Field,Coper	NEWHALL	4A192010013	0773C	3	C	P 1209	7/25/69	0.00	0.00	DDRIBRI
Arco Petroleum Products Co.	Newhall, Coper	NEWHALL	4A192010010	4377C	3	C	P 3086	4/13/78	0.00	0.00	DDRIBRI
Arco Petroleum Products Co.	Saugus Svc Station, Coper 8079	SAUGUS	4A192010007	6279C	3	C	P 8076	8/20/91	0.00	0.00	DWSHWTR
Black Hawk Resources Corp	Haul Oil Brines, Newhall Lease	DEL VALLE	4A192190001	6644C	3	C	P 8442	10/21/97	0.00	0.00	DDRIBRI
Briggs School District	Olivelands Elem. School	SANTA PAULA	4A567000042	8667	3	C	01-031	2/22/06	0.00	0.00	
California Dept of Parks & Rec	Hungry Valley SVRA	LEBEC	4A197000032	8527	3	C	01-031	2/22/06			DDOMEST
CALMAT Co.	Saticoy Facility	OXNARD	4A562003001	5135	3	C	88-130	11/25/03	0.55	0.55	DMISCEL
Chevron U.S.A. Inc.	Pico Cyn Field,Newhall	NEWHALL	4A192113022	2659C	3	C	P 2224	6/27/75	0.00	0.00	DDRIBRI
Chevron U.S.A. Inc.	Haul, Placerita-Elsmere Area	NEWHALL	4A192113024	6654C	3	C	P 8460	2/24/98	0.00	0.02	DDRIBRI
Corwin, Wilson T.	Newhall Field, Hammon	NEWHALL	4A192142001	1719C	3	C	P 1820	6/23/72	0.00	0.00	DDRIBRI
Crown Central Petroleum Corp	Placerita Field,I-1480-7	NEWHALL	4A192449001	2208C	3	C	P 0234	6/13/89	0.00	0.00	DDRIBRI
Crown Valley Bldg. Supply	Crown Valley Bldg. Supply	ACTON	4A561052001	7087	3	C	91-097	9/5/06	0.00	0.00	DDOMEST
Curtis Sand and Gravel	Lang Station	CANYON COUNTRY	4A192030002	6332C	3	C	P 8093	5/19/92	0.00	0.00	DWSHWTR
Curtis Sand and Gravel	12101 Soledad Cyn Rd, Coper	SAUGUS	4A192438001	2016C	3	C	P 1958	5/19/92	0.00	0.19	DDREDGS
Exxon Co., U.S.A.	Castaic Junction Field	LOS ANGELES	4A192181008	1921C	3	C	P 1921	2/2/73	0.00	0.00	DDRIBRI
Fm H Partnerships L.P.	E Z Burger	ACTON	4A191145001	7040	3	C	91-055	4/18/06	0.00	0.00	DDOMEST
Foodmaker Inc.	Jack In The Box # 3304	ACTON	4A567000004	8311	3	C	01-031	2/22/06	0.00	0.00	DDOMEST
Freeway Chevron-Mr. Zsmat	Freeway Chevron-Mr. Zsmat	NEWHALL	4A191015003	6345C	3	C	P 8085	5/19/92	0.00	0.00	DWSHWTR
Gate King Properties Inc	Needham #1, Newhall Of	NEWHALL	4A192148001	6606C	3	C	P 8397	11/19/96	0.00	0.00	DDRIBRI
Goodyear Tire	Goodyear Tire	NEWHALL	4A192344002	6400C	3	C	P 8055	1/19/93	0.00	0.00	DWSHWTR
Grace Petroleum Corp	Placerita Oil Field	NEWHALL	4A192118001	6514C	3	C	P 8264	3/21/95	0.00	0.13	DDRIBRI
HR Textron Inc.	Valencia Facility	SANTA CLARITA	4A192332004	8029	3	C	99-055	6/30/04	0.01	0.00	NCNWTRS
ISCO Machinery	ISCO Machinery	ACTON	4A197000007	8367	3	C	01-031	2/22/06			
Jay Rabadi	Jay's Shell	CASTAIC	4A191029001	6349C	3	C	P 4752	5/19/92	0.00	0.00	DWSHWTR
JMT Oil Co	Placerita Oil Field	NEWHALL	4A192025002	6124C	3	C	P 1728	1/23/90	0.00	0.00	DDRIBRI
LA Co Fire Dept	Fire Camp #11, Acton	ACTON	4A190107079	5710	3	C	93-039	6/10/08	0.02	0.01	DDOMEST
LA Co Probation Dept	Joe Scott Boys Camp,Saugus Cop	SAUGUS	4A190107058	2157C	3	C	P 2026	12/14/73	0.00	0.00	DMISCEL
LA Co Probation Dept	Mendenhall-Munz,Co-Per 3433	LOS ANGELES	4A190107077	4756C	3	C	P 3433	11/15/79	0.00	0.00	DFILBRI

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Santa Clara River Watershed Wastewater Permits – Non-Chapter 15 (cont'd)

Discharger's Name	Facility Name	City	WDID #	CI #	Rating		Order #	Expiration	Design Q (MGD)	Baseline Q (MGD)	Waste Type
LA Co Sheriff Dept	Wayside, Brine Disp, Per 3573	CASTAIC	4A190107081	6151C	3	C	P 3573	7/17/90	0.00	0.01	DFILBRI
Liquor Store	Liquor Store	CASTAIC	4A191122006	6350C	3	C	P 8091	5/19/92	0.00	0.00	DMISCEL
Long Beach Oil Development Co.	Castaic & Hasely Cyn Fields	CASTAIC	4A192146001	6577C	3	C	P 8333	7/23/96	0.00	0.00	DDRIBRI
Long Beach Oil Development Co.	Haul, Hasley Cyn Oil Field	CASTAIC	4A192168001	6603C	3	C	P 8393	11/19/96	0.00	0.00	DDRIBRI
Matt Azizi	Unocal	CASTAIC	4A191037003	6509C	3	C	P 8249	3/21/95	0.00	0.00	DWSHWTR
Mcdonalds Coporation	McDonalds Restaurant	ACTON	4B197000003	8309	3	C	01-031	2/22/06			DDOMEST
Napa Auto Parts/CB Sales-Serv	Napa Auto Parts	SAUGUS	4A191013001	6337C	3	C	P 8115	5/19/92	0.00	0.00	DMISCEL
National Ready Mixed Concrete	Saugus Concrete Dealer	CANYON COUNTRY	4A191140001	6630C	3	C	P 8421	3/18/97	0.00	0.00	DWSHWTR
Newhall Refining Co., Inc	Inj Refinery Wastes,Deep Well	NEWHALL	4A192473003	6597C	3	C	P 8372	9/24/96	0.00	0.13	DPROCES
Rio Cafe	Rio Cafe	SANTA CLARITA	4A197000002	8284	3	C	01-031	2/22/06	0.00	0.00	NDOMEST
River Park A LLC	River Park A, LLC	VENTURA	4A567700004	8692	3	C	03-03DWQ	4/30/13			
SAM Entreprises	Tapia Cyn Field, Newhall	NEWHALL	4A192449002	6607C	3	C	P 8398	11/19/96	0.00	0.01	DDRIBRI
Sand Canyon Mobil	Sand Canyon Mobil	CANYON COUNTRY	4A191028001	6348C	3	C	P 8105	5/19/92	0.00	0.00	DWSHWTR
Sun Production Co	Newhall	NEWHALL	4A192310003	1920C	3	C	P 0197	5/19/92	0.00	0.11	DDRIBRI
Sweetwater Veterinary Clinic	Sweetwater Veterinary Clinic	AGUA DULCE	4A197000024	8489	3	C	01-031	2/22/06	0.00	0.00	DDOMEST
Termo Comany	Oak Canyon Field	CASTAIC	4A192162003	0014C	3	C	P 9110	1/7/66	0.00	0.00	DDRIBRI
The Master's College	The Master's College	SANTA CLARITA	4A197000027	8429	3	C	01-031	2/22/06	0.01	0.01	
The Village Church	The Village Church	NEWHALL	4B567000031	8526	3	C	01-031	2/22/06			DDOMEST
Thompson Oil Company	Thompson Oil Co.	SAUGUS	4A192439002	6646C	3	C	P 8449	10/21/97	0.00	0.00	DDRIBRI
Thousand Trails Inc.	Car Wash, Acton Coper	ACTON	4B199068001	6693C	3	C	P 8587	3/21/00	0.00	0.00	DWSHWTR
Truck & RV Sales	Truck & RV Sales	CANYON COUNTRY	4B197000005	8321	3	C	01-031	2/22/06	0.00	200.00	IDOMEST
Unocal Corp.	Sand Canyon Unocal 76	SAUGUS	4A192131006	6253C	3	C	P 8053	6/25/91	0.00	0.00	DWSHWTR
Ventura Regional San District	Toland Road Landfill	SANTA PAULA	4A567000008	8446	3	C	01-031	2/22/06			DDOMEST
Veterans of Foreign of the U.S	Veterans of Foreign Wars	CANYON COUNTRY	4A197000001	8264	3	C	01-031	2/22/06	0.00	0.00	DDOMEST
Watt Enterprises LP Ltd.	Building A, Santiago Square	ACTON	4A191144001	7039	3	C	91-054	4/18/06	0.01	0.01	DDOMEST

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Discharger's Name	Facility Name	City	Status	Order #	CI #	WDID #	Waste Type	Rating		Adoption Date	Expiration
Ventura Regional San District	Bailard Landfill	OXNARD	Closed	02-190	4035	4A560300001	NSLDWST	1	B	12/12/02	12/12/07
Ventura Regional San District	Toland Road Landfill	SANTA PAULA		02-023	5644	4A560306002	NSLDWST	1	B	1/24/02	1/24/07
Oxnard, City Of	Santa Clara Disp Site, Oxnard	OXNARD	Closed	02-191	5664	4A560306005	NSLDWST	1	B	12/12/02	12/12/07
A Republic Waste Services Co.	Chiquita Canyon Landfill	VALENCIA		98-086	6231	4A190359001	NSLDWST	1	B	11/2/98	11/2/03
Ventura Regional San District	Coastal Landfill	OXNARD	Closed	02-191	6548	4A560306004	NSLDWST	1	B	12/12/02	12/12/07
LA Co Sheriff Dept	Peter Pitches Landfill	SAUGUS	Closed	01-133	6198	4A190322001	NSLDWST	2	B	9/19/01	9/19/11
North Star Minerals, Inc.	Acton Clay Quarries	ACTON		02-189	8516	4B192624001		3	C	12/12/02	12/12/07
Agri Service, Inc	Agri Service, Newhall	NEWHALL		03-125	8642	4A191292001		3	C	9/11/03	9/11/08

Waste Types Categories (prior to treatment or disposal)

CNSOIL – contaminated soil
CNWTRS – contaminated groundwater
CONTAC – contact cooling water
DOMEST – domestic sewage
DOMIND – domestic sewage & industrial waste
DRILLS – drilling muds
FILBRI – filter backwash brine waters
MISCEL – dewatering, rec. lake overflow, swimming pool wastes, water ride wastewater, or groundwater seepage
NONCON – noncontact cooling water
PROCES – process waste (produced as part of industrial/manufacturing process)
STORMS – stormwater runoff
WSHWTR – washwater waste (photo reuse washwater, vegetable washwater)

Hazardous – influent or solid wastes that contain toxic, corrosive, ignitable, or reactive substances (prior to treatment or disposal) managed according to applicable Department of Health Services standards
Designated – influent or solid wastes that contain **nonhazardous wastes** (prior to treatment or disposal) that pose a significant threat to water quality because of their high concentrations (e.g., BOD, hardness, chloride). Manageable hazardous wastes (e.g., inorganic salts and heavy metals) are included in this category.
Nonhazardous – influent or solid wastes that contain putrescible and nonputrescible solid, semisolid, and liquid wastes (e.g., garbage, trash, refuse, paper, demolition and construction wastes, manure, vegetable or animal solid and semisolid wastes) (prior to treatment or disposal) and have little adverse impact on water quality
Inert – influent or solid wastes that do not contain soluble pollutants or organic wastes (prior to treatment or disposal) and have little adverse impact on water quality. Such wastes could cause turbidity and siltation. Uncontaminated soils, rubble and concrete are examples of this category.

Discharge "Ratings" are alphanumeric codes where:

"A" = Any major NPDES facility or any small-volume complex facility
"B" = Any facility having a physical, chemical, or biological waste treatment system (except for septic systems with subsurface disposal)
"C" = Any facility not included in "A" or "B"
"1" = Major threat to water quality
"2" = Moderate threat to water quality
"3" = Minor threat to water quality

Non-Chapter 15 WDRs were revised in 1993 to reflect 40 CFR

Water Quality Impairments

IMPAIRMENTS: The current list of impaired waters (Section 303(d) of the Clean Water Act) is from 2002. The 2006 list is close to being finalized and may include a large number of changes, particularly relating to adopted TMDLs. However, as of the date this report was finalized, the Santa Clara River Estuary and Beach is on the 303(d) list for coliform while a portion of the river upstream of the estuary is listed for ammonia and coliform. Portions of the river also have chloride exceedances. The Estuary is also listed for toxaphene and residual amounts of other legacy pesticides (ChemA) in fish tissue. Three small lakes in the watershed are also on the 303(d) list for eutrophication, trash, DO, and/or pH problems. Two major spills of crude oil into the river have occurred in the early 1990s although recovery has been helped somewhat by winter flooding events. Natural oil seeps discharge significant amounts of oil into Santa Paula Creek (CRWQCB, 2004).

The table below gives examples of typical data ranges which led to the 2002 303(d) listings; however a few TMDLs have been adopted since 2002 and implementation of them has begun so some of these data ranges may not be reflective of current conditions.

Impairments	**Applicable Objective/Criteria**	**Typical Data Ranges Resulting in Impairment**	**303(d) Listed Waters/Reaches**
chloride	Basin Plan numeric objective: 80 – 100 mg/l	10 – 138 mg/l (mean of 105 ± 21)	Sespe Creek (tributary to Santa Clara River Reach 3) Santa Clara River Reach 8 (W Pier Hwy 99 to Bouquet Cyn Rd Bridge) Santa Clara River Reach 7 (Blue Cut to West Pier Hwy 99) Santa Clara River Reach 3 (Freeman Diversion to A Street)
ammonia	Basin Plan narrative objective Basin Plan numeric objective: varies depending on pH and temperature but the general range is 0.53 – 2.7 mg/l of total ammonia (at average pH and temp.) in waters designated as WARM to protect against chronic toxicity and 2.3 – 28.0 mg/l to protect against acute toxicity	ND – 4.9 mg/l (mean of 1.4 ± 1.3)	Santa Clara River Reach 3 (Freeman Diversion to A Street)
nitrate + nitrite	Basin Plan numeric objective: no greater than 10 mg/l	0.3 – 15.4 mg/l (mean of 5.7 ± 2.4)	Wheeler Canyon/Todd Barranca Torrey Canyon Creek Brown Barranca/Long Canyon Mint Canyon Creek Reach 1 Santa Clara River Reach 7 (Blue Cut to West Pier Hwy 99)
org. enrichment/ low DO	Basin Plan narrative objective Basin Plan numeric objective: annual mean greater than 7.0 mg/l no single sample less than 5.0 mg/l	0.8 – 11.0 mg/l (mean of 7.7 ± 2.5)	Elizabeth Lake
pH	Basin Plan numeric objective: 6.5 – 8.5 pH units	7.3 – 9.6 pH units (mean of 8.5 ± 0.7)	Elizabeth Lake Piru Creek (tributary to Santa Clara River Reach 4) Sespe Creek (tributary to Santa Clara River Reach 3)
odors	Basin Plan narrative objective		Lake Hughes
coliform	Basin Plan numeric objective: Inland: fecal coliform not to exceed log mean of 200 mpn/100ml in 30-day period and not more than 10% of samples exceed 400 MPN/100ml Beaches: total coliform not to exceed 1,000 MPN/100ml in more than 20% of samples in 30 days and not more than 10,000 MPN/100ml at any time	20 – 24000 MPN/100ml	Santa Clara River Reach 8 (W Pier Hwy 99 to Bouquet Cyn Rd Bridge) Santa Clara River Estuary Santa Clara River Reach 7 (Blue Cut to West Pier Hwy 99) Santa Clara River Reach 9 (Bouquet Cyn Rd to abv Lang Gaging)

Impairments	**Applicable Objective/Criteria**	**Typical Data Ranges Resulting in Impairment**	**303(d) Listed Waters/Reaches**
sulfate	Basin Plan numeric objective: 600 mg/l	310 – 850 mg/l	Hopper Creek Pole Creek (tributary to Santa Clara River Reach 3) Wheeler Canyon/Todd Barranca
Total dissolved solids	Basin Plan numeric objective: 1300	630 – 1700 mg/l	Wheeler Canyon/Todd Barranca Hopper Creek Pole Creek (tributary to Santa Clara River Reach 3) Santa Clara River Reach 3 (Freeman Diversion to A Street)
Eutrophication	Basin Plan narrative objective		Elizabeth Lake Lake Hughes Munz Lake
algae	Basin Plan narrative objective		Lake Hughes
fish kills	Basin Plan narrative objective		Lake Hughes
trash	Basin Plan narrative objective		Elizabeth Lake Munz Lake Lake Hughes
ChemA*	National Academy of Science Guideline (tissue): 100 ng/g		Santa Clara River Estuary
toxaphene	State Board numeric objective (tissue): Max. Tissue Residue Level 9.8 ng/g		Santa Clara River Estuary

ChemA refers to the sum of the chemicals aldrin, dieldrin. Chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

COMPLETED TMDLS

- Chlorides (upper river) (2005)
- Nitrogen compounds (2004)

Surface Water Quality Data Summaries from Previous Reports

Note: Brief summaries of previous reports are included since often these reports provide very useful analyses based on data that are not, at times, available electronically; however, it should not be construed that these reflect current conditions. Reference to reports of groundwater quality is made due to the close linkage in this watershed between surface water and groundwater quality.

Concentrations of nitrates in wells within the Mint Canyon subarea and particularly the Sierra Pelona subarea in the upper watershed have frequently exceeded Basin Plan objectives. This is an area that uses onsite septic systems for waste disposal. The now closed Space Ordnance Systems facility was located in the Mint Canyon subarea and is now undergoing cleanup (CDWR, 1993).

There are borates that occur in association with the Vasquez Formation near Lang in the upper watershed that would produce high boron concentrations during runoff periods. Pico Creek (leading to South Fork) and other tributaries draining the Santa Susana Mountains are a source of the poor quality waters (sulfate and TDS) in the South Fork watershed due to the local geology. Drainage from the San Gabriel Mountains improves the quality of the South Fork surface waters which is reflected by data from Placerita Creek although the latter is an area of historic oilfields with which elevated boron may be associated. Tick Canyon, in particular, and Oak Springs Canyon contribute flows to the Santa Clara River that are high in boron concentrations (CDWR, 1993).

Tributary inflows that drain the gypsum-rich Tertiary marine sediments of the Ventura Basin, west of the San Gabriel fault, impact the river above Old Highway bridge in the Santa Clarita Valley. Flows from Potrero Canyon and San Martinez Grande Canyon have high TDS (up to

10,000 mg/l) and sulfate (up to 6,000 mg/l) and sodium, fluoride, and boron concentrations are also high (CDWR, 1993). *Author's note: However, volumes of these inflows are likely relatively low since sampling results for many decades at the Old Highway Bridge do not reveal high or even greatly variable concentrations of salts (see later discussion on results at long-term stations).*

Elizabeth and Hugh Lakes are essentially closed basin lakes subject to seasonal variations in runoff; they may dry up during droughts and their quality may be very saline at times (CDWR, 1993).

Castaic Lake and Lagoon has thermal stratification and biochemical process that strongly influence the water chemistry. Castaic receives State Water Project water and is sodium chloride in chemical character. Bouquet and Dry Canyon Reservoirs both receive imported waters from the Los Angeles Aqueduct (Mono-Owens water). Dry Canyon is operated as a flow-through reservoir and local sources are insignificant. Bouquet has ranged from sodium-calcium bicarbonate to sodium bicarbonate in character (CDWR, 1993).

Generally, the chemical character of Piru Creek waters has been calcium-magnesium sulfate. As in the Santa Clara River, with some low flows, the predominant cation becomes sodium and calcium become secondary. The high boron concentrations in the Piru Creek watershed are thought to be mainly from colemanite (a calcium borate mineral) deposits in Lockwood Valley and from Agua Blanca Creek. The boron in Agua Blanca Creek may come from the Agua Blanca thrust fault. The high sulfate concentrations are the result of the solution of sulfate minerals found in the sedimentary rocks that form the subarea (CDWR, 1989).

Further downstream near Gold Hill Road (Upper Piru HSA), concentrations of boron and sulfate continue to increase. Below Lake Piru, surface water quality within Piru Creek is affected by both releases from the dam and local runoff. Historically, concentrations of TDS ranged from 548 to 1,610 mg/l); sulfate ranged from 211 to 924 mg/l, and boron ranged from 0.24 to 1.07 mg/l. These values represent an improvement in water quality as a result of inflows of the SWP flows into Lake Piru. However, the concentrations of sulfate, boron, and TDS sometimes exceed state water quality criteria for beneficial uses. The high sulfate concentrations are attributed to the minerals found in the sedimentary rocks of the subwatershed. Minor tributaries within the subwatershed that flow only during and after rains contribute additional calcium sulfate waters (SCWRP website).

The chemical character of Sespe Creek is typically calcium-magnesium-sodium sulfate to calcium-sodium-magnesium sulfate. A distinctive feature of the Sespe HA is the Sespe Formation which contain petroleum resources. The source of boron in Sespe Creek appears to be, in part, inflows from Hot Springs Creek in the Topatopa HSA. The past practice of direct discharge of oilfield brines to Sespe and Tar Creeks may also be a continuing source of boron and chloride. There is poor water quality in Little Sespe Creek which flows in an area of oilfields (CDWR, 1989). Overall, surface water quality is usually of good quality and provides significant increases to the Santa Clara River flows and recharge to the basin's groundwater (SCWRP website). *Author's note: In fact, review of data from a long-term sampling site on the lower Sespe Creek (see later discussion on long-term stations) shows considerable variability in boron and chloride concentrations over the decades-long dataset.*

Nitrate is absent or occurs in very low concentrations in the undeveloped drainages north of the Santa Clara River. At the Freeman Diversion, nitrate concentrations are consistently low, with a range of 1-11 mg/l (as NO_3) measured during 2000. Unlike a number of other constituents, nitrate concentration correlates poorly with the rate of flow in the river. Elevated nitrate concentrations are observed at a number of surface-water sampling sites downstream of developed areas within the watershed. Samples ranged from 9-35 mg/l nitrate at Blue Cut near the Los Angeles County line. During dry periods, effluent from the Saugus and Valencia WRPs are two consistent sources of surface flow in the Santa Clara River east of the County line. *Author's note: In 2003, nitrification/denitrification requirements were implemented at the Saugus and Valencia WRPs which have reduced nitrogen concentrations in the effluent and receiving water.* Elevated nitrate concentrations were again documented in Todd Barranca, which converges with the Santa Clara River just downstream of the Freeman Diversion. Mixed land uses exist in the Todd Barranca/ Wheeler Canyon watershed, including citrus orchards, cattle and horses, and residences with septic tanks (UWCD, 2001).

As with nitrate, chloride concentrations tend to be relatively low in undeveloped portions of the watershed and elevated in other places due to human activities. Water reclamation plants are perhaps the best-documented source of chloride in the area. Water softeners, which are common to the area, elevate chloride concentrations considerably, loading approximately 6 to 20 pounds of salt per unit per week to wastewater. The County Sanitation Districts of Los Angeles County operate the Saugus and Valencia WRPs in Los Angeles County. The water supply in this area is a blend of local water and State Water Project supplies. The chloride concentration of water from the State Water Project is commonly higher than in local groundwater basins, and after beneficial use and treatment, the effluent discharged to the river may be considerably higher in chloride than local waters. Average chloride concentrations of effluent from the Saugus and Valencia WRPs during the 2000 water year were 148 and 170 mg/l, respectively. Chloride concentrations ranging from 80 to 137 mg/l were observed at Blue Cut during the water year 2000. *Author's note: Average chloride concentrations in the effluent from the Saugus and Valencia WRPs during the 2005 water year were 135 and 154 mg/l, respectively. Lower chloride concentrations have been observed at Blue Cut in recent years.* High chloride concentrations were observed downstream of the Santa Paula WRP during low flows of the Santa Clara River. Santa Paula uses local groundwater for its water supply, but water softeners in private homes are believed to be a significant source of the chloride arriving at the City's water reclamation plant. The average concentration of chloride in the city's effluent was 154 mg/l, and concentrations ranging from 30 to 122 mg/l were observed during the 2000 water year a short distance downstream of the plant's point of discharge (UWCD, 2001).

TDS is a measure of the total mineral content of a unit of water, and is commonly used to provide a general indication of the quality of water. There is often a strong correlation between TDS and sulfate concentrations. Sulfate is often the dominant anion in local waters due in part to the prevalence of marine sediments within the watershed. In general, up to half the TDS of local waters is from sulfate ions. Elevated TDS was observed in several of the smaller drainages that are monitored during water year 2000, such as Hopper Creek, Pole Creek and Todd Barranca. The relative TDS contribution from natural sources versus the influence of agriculture and other practices in these small watersheds is undetermined. Water flowing from the larger drainages of Piru, Sespe and Santa Paula Creeks have relatively low TDS concentrations (UWCD, 2001). *Author's note: TDS concentrations in Santa Paula Creek are at times a problem – see later discussion of dataset reviewed for this report.* Factors that may contribute to the lower water quality at times in Santa Paula Creek include high amounts of suspended clays, presence of natural oil and sulphur seeps (Sulphur Springs HSA), and high biological oxygen demand believed to originate from anthropogenic sources (septic system leacheate and recreational uses at Steckel Park) (SCWRP website). A summer 2000 sample from Santa Paula Creek was collected under low-flow conditions, and recorded a TDS value (1520 mg/l) higher than previously documented in this water body. Total mineral content of surface water generally increases as water flows down the Santa Clara River. However, the hydrology of the Santa Clara River is complex which complicates surface water quality analysis. Surface water recharges the upstream portions of the groundwater basins of the Santa Clara River Valley, and older, more-mineralized rising groundwater commonly discharges to the river near the downstream boundaries of the basins (UWCD, 2001).

Mud Creek introduces a significant amount of suspended solids to Santa Paula Creek. Flow through the porous, sedimentary rock substrate characteristic of Mud Creek results in year-round turbidity within Santa Paula Creek downstream of the confluence with Mud Creek. Land is also in agricultural use within the lower subwatershed (SCWRP website).

Thirty sites sampled under the State's Surface Water Ambient Monitoring Program (SWAMP), were randomly selected to provide a broad baseline of the overall health of the watershed. Additionally, to evaluate the condition of specific tributaries, directed sampling was conducted at the base of each tributary above its confluence with the mainstem of the river. A total of 38 sites were sampled, comprised of 30 randomly selected sites and 8 directed sites. Sampling began in 2001 with a second round in 2003. Some sites were sampled multiple times. The 30 random sites were sampled for field measurements (DO, pH, depth, temperature, velocity, conductivity, and turbidity), conventional water chemistry: nutrients (ammonia, chlorophyll a, nitrate, nitrite, and phosphate), salts (sulfate, chloride, TDS, and boron), as well as, toxicity, and bioassessment. The directed sites were sampled for the previous parameters as well as trace organics, bioaccumulation, water column and sediment metals, sediment grain size, and enzyme-linked immunosorbent assays (ELISAs) for chlorpyrifos and diazinon. One of the directed sites, Bouquet Canyon Creek, was sampled bi-weekly from August 2002 through August 2003 for chlorpyrifos and diazinon using ELISA (Kamer, 2005).

Concerns with conventional water quality parameters were seen at some sites. DO saturation was <90% at 15 of 38 sites, which were distributed throughout the watershed. pH was high at four sites. Inorganic N concentrations exceeded Basin Plan objectives at 7 sites, total and un-ionized NH3-N at 3 sites, total NH3-N at one site, un-ionized NH3-N at one site, and NO3-N at two sites. Four of the 5 sites where NH3-N exceeded Basin Plan objectives were clustered along the mainstem of the river; NO3-N concentrations exceeded 1 mg/l in the same area. ***Author's note: as mentioned previously, the Saugus and Valencia WRPs started nitrification/denitrification treatment which has resulted in reduced levels of nitrogen within the river at Reaches 5 and 6.*** PO4-P concentrations exceeded USEPA recommended concentrations at 13 sites. TDS concentrations exceeded Basin Plan objectives at 12 sites, many of which were in the Santa Paula and Piru subwatersheds. Sulfate exceeded Basin Plan objectives at 10 of the 12 sites where TDS was elevated. Chloride was elevated at 7 sites in the eastern half of the watershed and boron was elevated at three sites on Piru Creek (Kamer, 2005).

Metals in sediment, tissue and water were only measured at the tributary sites. However, if metals are found in these matrices at the bottom of subwatersheds sites at levels exceeding criteria or guidelines, it suggests that metals pollution may occur throughout the subwatershed. Water column aluminum concentrations exceeded USEPA criteria for toxicity to aquatic life at 4 sites but aluminum was not present at elevated levels in sediments or tissues. Tissue samples showed bioaccumulation of arsenic at levels exceeding Office of Environmental Health Hazard Assessment (OEHHA) screening values and USFWS guidelines at seven sites, and copper was also elevated at one of these sites (in Bouquet Canyon). Sediment metals were elevated above sediment quality guidelines at three sites: cadmium in Piru Creek, copper and lead in Castaic Creek, and a suite of metals in San Francisquito Canyon. Compared to other samples and sediment quality guidelines, sediment metals were very high in San Francisquito Canyon, which is downstream of a reservoir treated with metals to control biofouling. Sediment, tissue and water samples each indicated different metals that may be of concern (Kamer, 2005).

Organic compounds were also only measured at tributary sites. Similar to metals, the presence of organic compounds in water samples from tributary sites at levels exceeding established objectives suggests that organics pollution also occurs throughout the subwatershed. DDT and PCBs exceeded established criteria at all the integrator sites. Chlordane was elevated at three sites. Chlorpyrifos and diazinon were elevated Bouquet Canyon along with azinphos methyl, and they were elevated in Castaic Creek along with mirex. Chlorpyrifos was elevated at the estuary site, and diazinon and PAHs were elevated at Blue Cut. Sediments were analyzed for organics at only two sites: none were found in Bouquet Canyon, but DDE (p,p’) and DDT (p,p’) were elevated relative to sediment quality guidelines in the estuary. No organics in tissues were elevated above OEHHA screening values (Kamer, 2005).

Toxicity occurred at thirteen of the randomly-selected sites in the watershed and was primarily limited to two areas: the mainstem of the river and the northern portion of the Piru Creek subwatershed. The cause of toxicity at many of these sites is unknown because metals and organics were not sampled at the random sites. Toxicity was detected in samples from only two subwatershed sites: Bouquet Canyon and estuary. A number of factors could have contributed to toxicity at Bouquet Canyon but the toxicity identification evaluation (TIE) indicated that diazinon was the probable cause of toxicity. At the estuary, toxicity may have been caused by DDT, PCBs, chlorpyrifos, or arsenic (Kamer, 2005).

The bioassessment data indicate that ecological condition was at least fair at about half of the sites, with the condition at the other half being poor or very poor. Index of Biological Integrity (IBI) scores were Good at 6 sites, Fair at 13 sites, Poor at 11 sites and Very Poor at 7 sites. One site was not sampled for benthic invertebrates. At 41% of sites where IBI scores were low, chronic or acute toxicity was detected, however, toxicity was also detected at 37% of sites with Fair and Good IBI scores. Toxicity is not a likely cause of poor benthic community condition at the subwatershed sites, many of which had Very Poor or Poor IBI scores, because samples from only two of these 8 sites indicated toxicity. Other influences on benthic community structure throughout much of the watershed are unknown because metals and organics were not sampled at the random sites. It is also unlikely that decreased DO availability contributed to poor benthic community structure because 6 of the randomly selected sites with DO < 90 % saturation had fair or good IBI scores (Kamer, 2005). *Author’s note: Some of the bioassessment sampling occurred soon after major winter storms which likely had some impact on the results. Additionally, some researchers have found a link between poor benthic community condition and invasive plants such as Arundo and Tamarisk which are found in abundance within the mainstem of the river.*

Los Angeles County sampled the benthic community in November 2003 in the unlined portion of the Santa Clara River at The Old Road as part of their stormwater monitoring program. The IBI score for the site rated it as a poor site which is the same result found at the nearest SWAMP station sampled both in spring of 2001 and 2003 (BonTerra Consulting, 2004).

Discussion of Combined Surface Water Quality Dataset

Note: This discussion is based on all readily available electronic data that could be acquired with a reasonable amount of effort and that included locational information, preferably latitude and longitude, rather than simply descriptive station names. In some cases it includes datasets upon which some of the above report summaries were based, but in most cases the data are not necessarily associated with formal reports. As is discussed further below, some datasets go back to the 1920s for a few constituents at a few sites (mostly collected by water districts) while others are sporadic over a shorter period of time. Some of the more consistent and widespread data were collected by the California Department of Water Resources but, presumably due to budget cuts, these data end at most sites in the late 1980s/early 1990s. The Regional Board also had an extensive network of sampling locations in this watershed maintained into the early 1990s when budget shortfalls resulted in similar reductions in sampling (eventually replaced by the Surface Water Ambient Monitoring Program which rotates between watersheds on a five-year cycle). Water districts and sanitation agencies have maintained focused sampling in their areas' of interest for many years. This data collection effort co-occurred with that being conducted for development of the Santa Clara River Comprehensive Monitoring Plan. The two efforts resulted in databases that are similar but not the same; however, since each effort was undertaken with different products as a desired end-point, the efforts should be viewed as complementary and additive.

Graph scales were set to display ranges of concentrations in a similar manner among graphs displaying the same constituent (generally ranging around concentrations of interest such as water quality objectives) within a particular Reach or at a long-term sampling station. Since some graphs are based on data exhibiting extreme variability, this has resulted in occasional excursions of graph lines outside of the main body of the graph. Not all of the graphs created are referenced in this report; they are, however, in the Excel data files which are available. All nitrate as NO3 data were converted to nitrate as N data using a multiplier of 0.226.

General Discussion

It is clear that the mainstem of the Santa Clara River has lower quality water than most of its large tributaries. For many constituents, concentrations increase from the top to the bottom of the mainstem. Figure 6 shows the trend with sulfate as an example. The reverse is occurring, however with chloride and nitrate (Figures 7 And 8). Additionally, almost all of the SWAMP bioassessment sites in the mainstem exhibited poor quality benthic invertebrate communities (low Index of Biological Integrity (IBI) scores) while tributary sites were generally marginal or good with a few exceptions (Figure 9). However, some of the SWAMP sampling took place after a major storm event and the benthic invertebrate communities may not have had a chance to recover, particularly in the mainstem which carries very large flows during storms. Limited sampling has taken place in Todd Barranca, a smaller tributary, but what little data there are indicates potentially serious water quality problems (see Figure 6).

As mentioned previously, the groundwater component in the river can be quite large which results in a major presence of sulfate in surface waters in areas of rising groundwater; these occur above Santa Paula Creek (Reach 9) and near Todd Barranca (Reach 2, downstream of Freeman Diversion) and may help explain the high TDS values and correspondingly high sulfate numbers in these areas, at times exceeding Basin Plan objectives (Figure 10).

Despite their comparatively good overall water quality, there are elevated levels of salts in some large tributaries which may be in some cases from natural sources or in others may be remnant discharges of brine from abandoned oilfields. Chlorides are elevated in Sespe (Reach 10), for example, and Sespe Creek is 303(d)-listed as impaired for chloride (Figure 11).

The SWAMP sampling found water column toxicity at sites sampled in the mainstem of the river during 2001 and 2003, the northern portion of the Piru Creek subwatershed, Bouquet Canyon, and in the estuary. Toxicity identification evaluations found that diazinon was the probable cause of toxicity in Bouquet Canyon while toxicity in the estuary may have been caused by DDT, PCBs, chlorpyrifos, or arsenic. DDT and PCBs would have been used historically in the watershed but they are very persistent chemicals and the estuary will be a site of some deposition after storms so their presence at that site would not be considered unusual. Diazinon and chlorpyrifos are both water-soluble pesticides used for ant/termite control around residential and agricultural areas; as of the end of 2004, diazinon can no longer be sold for residential use. Both aluminum and arsenic may have anthropogenic sources but they are also natural in origin and are found in the soil.

Although somewhat variable throughout the watershed, pH levels do not appear to be a problem. Supersaturation of oxygen may be occurring at some locations which may cause respiratory problems in aquatic organisms. Dissolved oxygen results are highly dependent on the time of day sampling occurs so results may be quite variable due to the sampling approach. On the other hand, it is clear that nitrate concentrations in the mainstem are higher than a USEPA guideline for unimpacted streams of 1.0 mg/l (NOAA, 1988) (Figure 12).

Discussion of Dataset by Basin Plan Reach

Mineral objectives are established by Reach and are a reflection of local geologic conditions. Data collected in each Reach since 1990 were evaluated against the objectives utilizing however many sample locations happened to be in each Reach. Some Reaches had much less data than others (for the most part, no sampling programs collected data with the goal of evaluating water quality by Reach). Data available over a longer period of time were used to evaluate long-term trends in Reaches. This, however, is not an official Water Quality Assessment, merely a point of discussion. It should be noted that the Reach designations described here are as they appear in the Basin Plan; some Reaches may be described differently in the current 303(d) list.

- Reach 2; includes Todd Barranca and mainstem below Freeman Diversion down to Highway 101 bridge
    - Sulfate (BP objective 600 mg/l)
        - 1997 to 2000 – all above objective; this Reach is currently listed as impaired for sulfate
    - TDS (BP objective 1200 mg/l)
        - 1997 to 2000 – all above objective; this Reach is currently listed as impaired for TDS
    - Nitrate (as N) (BP objective 10 mg/l)
        - 1993 to 2000 – highly variable with some samples over 10 mg/l; this Reach is currently listed as impaired for nitrate + nitrite

- Reach 3; includes the mainstem from above Freeman Diversion to just above Sespe Creek as well as the lower stretches of Santa Paula and Sespe Creeks
    - Chloride (BP objective 100 mg/l)
        - 1990 to present – underlying trend line is below 100 mg/l but multiple spikes over 100 mg/l in late 1990s and early 2000s; this Reach is currently listed as impaired for chloride
        - Longer-term – early 1980s below objective then generally an increasing trend
    - Sulfate (BP objective 650 mg/l)
        - 1990 to present – highly variable but mostly below objective; exceedances mostly in summer; this Reach is currently listed as impaired for sulfate
    - TDS (BP objective 1300 mg/l)
        - 1990 to present – highly variable; many above objective (Figure 13); this Reach is currently listed as impaired for TDS
    - Nitrate (as N) (BP objective 5 mg/l)
        - 1990 to present - some high spikes over 5 mg/l in early 2000s, all in the lower stretch of Santa Paula Creek (Figure 14)
        - Longer-term – underlying trend is gradual increase from 1950s to 1970s then gradual decrease (mostly under 5 mg/l)

- Reach 4; includes the mainstem from just above Sespe Creek to just before the County Line as well as Hopper Canyon Creek and the lower stretch of Piru Creek
    - Chloride (BP objective 100 mg/l)
        - 1990 to present – some exceedances in early 1990s then low concentrations until 2004 (Figure 15)
        - Longer-term - data exist from 1929; high concentrations start in 1950s

    - Sulfate (BP objective 600 mg/l)
        - 1990 to present – highly variable but generally below objective; Hopper Cyn Creek in this Reach is currently listed as impaired for sulfate
    - TDS (BP objective 1300 mg/l)
        - 1990 to present – variable with a few over the objective; Hopper Cyn Creek in this Reach is currently listed as impaired for TDS
    - Nitrate (as N) (BP objective 5 mg/l)
        - 1990 to present - low concentrations until higher spikes close to 5 mg/l beginning in 2003 (Figure 16); Torrey Cyn Creek in this Reach is currently listed as impaired for nitrate + nitrite
        - Longer-term – data exist from 1952; consistently low concentrations (mostly below 1 mg/l) throughout until 2003

- Reach 5; includes the mainstem from just west of the County Line to the I-5 freeway bridge as well as the Castaic Creek subwatershed
    - Chloride (BP objective 100 mg/l)
        - 1990 to present – gradual increase from some exceedances to mostly all exceeding; this Reach is currently listed as impaired for chloride
    - Sulfate (BP objective 400 mg/l)
        - 1990 to present – variable but generally below objective
    - TDS (BP objective 1000 mg/l)
        - 1990 to present – variable with a few over the objective
    - Nitrate (as N) (BP objective 5 mg/l)
        - 1990 to present – highly variable with many spikes over 5 mg/l; the more recent concentrations have been much lower (below 5 mg/l); this Reach is currently on the 2002 303(d) list for nitrate + nitrite
        - Longer-term – data exist from 1951; highly variable, underlying trend is gradual increase starting in early 1960s until decrease starting in early 2000s; many high spikes in later years of over 5 mg/l

- Reach 6; includes a short section of the mainstem between San Francisquito and Bouquet Canyon Creeks as well as those subwatersheds and the South Fork
    - Chloride (BP objective 100 mg/l)
        - 1990 to present – gradual increase over time; now mostly exceedances (Figure 17); this Reach is on the 2002 303(d) list as impaired for chloride
    - Sulfate (BP objective 300 mg/l)
        - 1990 to present – mostly below objective; more variable recently (past year) and more exceedances
    - TDS (BP objective 1000 mg/l)
        - 1990 to present – mostly below objective
    - Nitrate (as N) (BP objective 10 mg/l)
        - 1990 to present – all below 10 mg/l
        - Longer-term – data exist from 1951; gradual increase from 1950s into 1970s when results became extremely variable, then gradual decrease beginning in early 1980s; many samples over 10 mg/l in 1970s but below 10 mg/l beginning in 1990s

- Reach 7; includes the mainstem from Bouquet Canyon Creek to the Lang gauging station as well as Mint and Pole Canyon Creeks
    - Sulfate (BP objective 150 mg/l)
        - 1997 to present – mainstem sites all exceed the objective while Pole Creek sites are below objective
    - TDS (BP objective 800 mg/l)
        - 1997 to present – mainstem stations mostly over objective while Pole Creek below objective

- Reach 9; includes the upper stretches of the Santa Paula Creek subwatershed
  - Chloride (BP objective 45 mg/l)
    - 1990 to 1999 – few data, some exceedances
    - Longer-term – data exist from 1963; a lot of variability with many exceedances
  - TDS (BP objective 600 mg/l)
    - 1990 to present – few samples; gradual decreasing trend but most samples over 600 mg/l (Figure 18)
  - Nitrate (as N) (BP objective 5 mg/l)
    - 1990 – 1999 – low concentrations throughout
    - Longer-term – data exist from 1963; low concentrations throughout, generally below 1 mg/l

- Reach 10; includes the upper stretches of the Sespe Creek subwatershed
  - Chloride (BP objective 60 mg/l)
    - 1990 to 2000 – few data, about half exceedances
    - Longer-term – data exist from 1962; a lot of variability, about half exceedances
  - TDS (BP objective 800 mg/l)
    - 2001, 2003 – very few samples, some over 800 mg/l
  - Nitrate (as N) (BP objective 5 mg/l)
    - 1990 to 2000 – very low concentrations throughout (below 1 mg/l) (Figure 19)

- Reach 11; includes the Piru Creek subwatershed above Santa Felicia Dam
  - Chloride (BP objective 60 mg/l)
    - 1990 to present – few data points; decrease over time, few recent exceedances (Figure 20)
  - Sulfate (BP objective 400 mg/l)
    - 1990 to present – variable and mostly below objective except for some samples upstream of Pyramid Lake
  - TDS (BP objective 800 mg/l)
    - 1990 to present – mostly below objective except for some samples at sites above Pyramid Lake
  - Nitrate (as N) (BP objective 5 mg/l)
    - 1990 to 2000 – generally low concentrations throughout (below 1 mg/l) except for a few spikes

Discussion of Historical Trends in Constituents at Long-Term Stations

"Long-term" is generally defined here as a site started in the 1970s (or earlier) and sampled at least yearly until present day or at least into the late 1990s. Some long-term sites were only sampled for certain constituents long-term and the frequency may have been quite variable. Some mainstem sites appeared to be popular multi-agency sites due to jurisdictional boundaries, geologic conditions, or easy access (although with little apparent coordination between agencies). Data from these multi-agency sites were grouped together. DWR and UCWD maintained the longest record of data at a very few long-term sites (some starting as early as the 1920s). A caveat is that this analysis likely does not include all the electronically available data; in addition, it is possible considerable amounts of older data are only available in paper copy; no attempt was made to locate any non-electronic copies of data. There are only about 9-10 stations in the watershed that can be termed “long-term” as defined above. Many long-term stations are located adjacent to water diversions or at reservoir release points and, as might be expected, many constituents sampled are related to water supply protection. This positioning of sample sites could of course skew the results due to a predominance of imported water in these areas. A number of these long-term stations are on the mainstem while a few are adjacent to water facilities on Piru and one each is on lower Sespe and Santa Paula. Only DWR and the Regional Board had sites in the upper parts of the subwatersheds and none of these were long-term or consistent over time. Looking at long-term stations can be useful for gathering trend information, particularly with regards to salts and nutrients, and possibly establish some historical baselines but it is infeasible for comparing against water quality objectives due to the age of the data. However, looking at these results and the pattern of sampling may serve to demonstrate the extremely uncoordinated nature of sampling in this watershed over the years and the opportunity to assemble a more effective dataset in the future as is now being pursued through the development and implementation of a comprehensive monitoring plan for the watershed..

With regards to nitrates, it’s clear the major tributaries have maintained consistently low concentrations over the long-term with little variability; higher concentrations and considerable variability are common to the mainstem stations. The salts in the watershed, however, have been much more variable both in the tributaries and in the mainstem. This widespread variability appeared to decrease beginning in the late 1960s/early 1970s following the prohibition of the surface discharge of industrial brines and passage of the federal Clean Water Act in 1972.

Nitrate (as N)

- At Old Highway 99 Bridge DWR Site Z2170200
    - Sampled from 1967 – 1998; monthly, then quarterly, and later semiannually
    - Extremely variable (many high spikes) in mid to late 1970s
    - Much less variable and lower concentrations (below 10 mg/l) after early 1980s; concentrations drop greatly in late 1990s (Figure 21)

- At County Line DWR Site Z3113500 and UWCD Site 4N17W29SW1 (04N17W29SW1)
    - Sampled from 1951 – 2005, mostly monthly
    - Low concentrations early on then general increasing trend starting in early 1960s with a decreasing trend beginning around 2002
    - A few high spikes close to 10 mg/l

- Above Lake Piru DWR Site Z2348000 and UWCD Site 5N18W10SW1 (but below Pyramid Lake)
    - Sampled from 1957 – present, quarterly
    - Generally low concentrations (below 1 mg/l) with little variability except for a few high spikes in summer

- At Lake Piru DWR Site Z2337500 and UWCD Site 4N18W03SW1
    - Sampled from 1957 – 1998, monthly then quarterly
    - Very low concentrations (below 1 mg/l) with little variability

- Below Lake Piru DWR Site Z2324000 and UWCD Site 4N18W03SW2
    - Sampled from 1952 – 2000, monthly
    - Low concentrations (generally below 1 mg/l) with little variability

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000 and UWCD Site 4N20W24SW1
    - Sampled from 1951 – present, monthly to quarterly
    - Low concentrations (generally below 1 mg/l) with little variability

- Santa Paula Creek at Gage DWR Site Z2130000
    - Sampled from 1963 – 1991, monthly or quarterly until early 1970s then infrequently
    - Low concentrations (generally below 1 mg/l) with little variability

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010 and UWCD Site 3N21W14SW1 (latter site sampled by City of Santa Paula for NPDES permit)
    - Sampled from 1951 – present, generally monthly
    - Variable with concentrations increasing from the 1950s into the 1970s then decreasing in the 1990s
    - Mostly 1 – 4 mg/l

- At Freeman Diversion UWCD Site 3N21W32SW1 (03N21W32SW1)
    - Sampled from 1936 –present; biweekly, monthly, or quarterly
    - Data mostly clumped in 1930s, 1960s, and 1990s to present
    - Concentrations trend somewhat higher over time but generally below 3 mg/l

Boron

- At Old Highway 99 Bridge DWR Site Z2170200
    - Sampled from 1967 – 2000, quarterly into early 1990s then semiannually
    - Somewhat variable but generally below 1.0 mg/l in recent years

- At County Line DWR Site Z3113500, UWCD Site 4N17W29SW1 (04N17W29SW1), and Regional Board Site 403SC76000
    - Sampled from 1951 – 2005, monthly initially then quarterly
    - Highly variable up to early 1970s with many samples over 1.0 mg/l, thereafter below 1.0 mg/l

- Below Lake Piru DWR Site Z2324000
    - Sampled from 1961 – 2000, quarterly
    - Quite variable but in later years generally below 1.0 mg/l

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000 and UWCD Site 4N20W24SW1
    - Sampled from 1951 – 2001, monthly to quarterly
    - Very variable (near zero to over 3 mg/l) with no pattern

- Santa Paula Creek near gage DWR Site Z2130000 and UCWD Site 4N21W34SW1
    - Sampled from 1963 – 2003 (mostly in 1960s), monthly through early 1970s, then infrequently
    - Less variable in recent years and below 0.5 mg/l

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010
    - Sampled from 1951 – 2000, monthly then quarterly through 1991, then infrequent
    - Somewhat variable but generally below 1.0 mg/l

- At Freeman Diversion UWCD Site 3N21W32SW1 (03N21W32SW1)
    - Sampled from 1984 – 2005, quarterly
    - Some variability but lower concentrations recently (below 1.0 mg/l)

Total Dissolved Solids

- At Old Highway 99 Bridge DWR Site Z2170200 and Regional Board Site 403SC76000
    - Sampled from 1967 – 2000, quarterly until mid-1990s then infrequent
    - Quite variable until early 1980s then in 750 mg/l range

- At County Line DWR Site Z3113500 and UWCD Site 4N17W29SW1 (04N17W29SW1)
    - Sampled from 1953 – 2005, monthly or quarterly at times
    - Extremely variable until early 1970s then gradual downward trend of mostly below 1,000 mg/l (Figure 22)

- Below Lake Piru DWR Site Z2324000
    - Sampled from 1961 – 2000, quarterly
    - Some variability but generally below 1,000 mg/l

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000 and UWCD Site 4N20W24SW1
    - Sampled from 1951 – present, monthly to quarterly
    - Variable in 1960s then less so (under 1000 mg/l generally)

- Santa Paula Creek near Gage DWR Site Z2130000 and UCWD Site 4N21W34SW1
    - Sampled from 1963 – 2000, quarterly
    - Low variability; generally below 1000 mg/l

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010 and UCWD Site 3N21W14SW1 (latter site sampled by City of Santa Paula for NPDES permit)
    - Sampled from 1951 –present, quarterly
    - Extremely variable until early 1970s
    - Then less variable and generally below 1500 mg/l

- At Freeman Diversion UWCD Site 3N21W32SW1 (03N21W32SW1)
    - Sampled from 1925 – present; biweekly, monthly, or quarterly
    - Quite variable with no trend; concentrations tied to flows
    - Generally below 1500 mg/l

Sulfate

- At Old Highway 99 Bridge DWR Site Z2170200 and Regional Board Site 403SC76000
    - Sampled from 1967 – 2000 (one sample from 1951), monthly then quarterly to infrequent in later years
    - Quite variable until early 1980s then generally around 200 mg/l

- At County Line DWR Site Z3113500 and UCWD Site 4N17W29SW1 (04N17W29SW1)
  - Sampled from 1951 – 2005, monthly then quarterly
  - Extremely variable until early 1970s
  - Trending downward somewhat since then
  - Recently mostly below 400 mg/l

- Below Lake Piru DWR Site Z2324000 and UWCD Site 4N18W03SW2
  - Sampled from 1961 – 2000, monthly then quarterly
  - Some variability but mostly below 300 mg/l
  - Downward trend (slight) since 1960s

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000 and UWCD Site 4N20W24SW1
  - Sampled from 1951 – present, monthly to quarterly
  - Fairly variable until early 1970s then below 400 mg/l

- Santa Paula Creek near Gage DWR Site Z2130000 and UWCD Site 4N21W34SW1
  - Sampled from 1963 – 2000, monthly then quarterly to semiannually
  - Low variability; generally around 300 mg/l

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010 and UWCD Site 3N21W14SW1 (03N21W12SW1) (latter site sampled by City of Santa Paula for NPDES permit)
  - Sampled from 1951 – present, generally monthly
  - High variability with slight downward trend
  - Mostly 300 – 600 mg/l

- At Freeman Diversion UCWD Site 3N21W32SW1 (03N21W32SW1)
  - Sampled from 1925 – present, biweekly, monthly, or quarterly
  - Data mostly clumped in 1930s, 1960s, and 1990s to present
  - High variability with slight downward trend
  - Mostly 300 – 600 mg/l

Chloride

- At Old Highway 99 Bridge DWR Site Z2170200
  - Sampled from 1967 – 2000, monthly then quarterly
  - High variability until early 1980s
  - Upward trend into early 1990s, then downward trend
  - Now mostly below 100 mg/l (Figure 23)

- At County Line and Near Blue Cut DWR Site Z3113500 and UCWD Site 4N17W29SW1 (04N17W29SW1)
  - Sampled from 1951 – 2005, mostly monthly
  - Extreme variability and very high concentrations (over 300 mg/l) until early 1970s
  - Upward trend since then; now mostly over 100 mg/l (Figure 24)

- Below Lake Piru DWR Site Z2324000 and UWCD Site 4N18W03SW2
  - Sampled from 1961 – 2000, monthly or quarterly
  - Some variability over the long-term with a major peak in late 1980s/early 1990s
  - Except for peak, generally below 50 mg/l

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000 and UCWD Site 4N20W24SW1
  - Sampled from 1951 – present, quarterly
  - High variability with no trend
  - From 20 – 200 mg/l (Figure 25)

- Santa Paula Creek near Gage Paula DWR Site Z2130000 and UWCD Site 4N21W34SW1
  - Sampled from 1963 – 2000, quarterly
  - Some variability but generally below 50 mg/l

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010 and UWCD Site 3N21W14SW1 (03N21W12SW1) (latter site sampled by City of Santa Paula for NPDES permit)
  - Sampled from 1951 – present, generally monthly
  - Some variability; mostly between 50 – 100 mg/l

- At Freeman Diversion
  - Sampled from 1925 – present; biweekly, monthly, or quarterly
  - Data in clumps mostly from 1930s, 1960s, and 1990s to present
  - Slight upward trend over time with considerable variability
  - Mostly below 100 mg/l

Hardness

- At Old Highway Bridge 99 DWR Site Z2170200
  - Sampled from 1971 – 2000, monthly then quarterly
  - High variability until early 1980s then mostly below 400 mg/l

- At County Line DWR Site Z3113500 and UCWD Site 4N17W29SW1 (04N17W29SW1)
  - Sampled from 1970 – 2000, quarterly
  - High variability but mostly downward trend to a little above 400 mg/l

- Below Lake Piru DWR Site Z2324000
  - Sampled from 1970 – 2000, quarterly
  - Some early variability but mostly around 400 mg/l

- Sespe Creek at Gage (Fillmore) DWR Site Z2215000
  - Sampled from 1970 – present
  - Little variability; around 400 mg/l

- Santa Paula Creek near Gage DWR Site Z2130000
  - Sampled from 1970 – 2000
  - Some variability; mostly around 300 mg/l

- Mainstem at Santa Paula 12th St Bridge DWR Site Z2136010
    - Sampled from 1970 – 2000, quarterly
    - Considerable variability around 600 mg/l

- At Freeman Diversion UWCD Site 3N21W32SW1 (03N21W32SW1)
    - Sampled from 1984 – present, quarterly
    - Considerable variability around 600 mg/l

Recommendations for Future Water Quality Monitoring

Figure 26 shows the sampling sites of multiple agencies. It is clear that sampling sites over the years have been highly clumped in certain locations of the mainstem. Until recently, sampling sites have rarely been located in the tributaries except near water diversions. As mentioned previously, this is partly due to the greatly differing goals of the monitoring agencies, ranging from evaluating raw surface water destined to become drinking water after infiltration, to the need to follow receiving water monitoring programs developed by the Regional Board that focus on compliance. The Regional Board had at one time a widespread network of fixed sites used to evaluate support of beneficial uses; the random sampling approach being taken by SWAMP now takes its place, albeit on a five-year rotating schedule.

A report prepared by AMEC Earth & Environmental, Inc. in March 2006 describes the spatial clustering of recent sampling locations largely due to requirements of various permits. Although not utilizing exactly the same dataset as this report (since the purposes of the report were somewhat different, including setting the stage for a recommended comprehensive monitoring program through identification of data gaps), the AMEC report also notes the widely disparate types, locations, and frequencies of data collected and similarly cautions against the dataset's use in a detailed analysis. A preliminary sampling design of monthly sampling at 38 sites is presented in the report which encourages the distribution of monitoring costs among a number of agencies currently conducting monitoring. A group of agencies and organizations is currently meeting to develop a final sample design. It is hoped by combining the resources of multiple agencies to develop a monitoring program with agreed-upon goals, while eliminating duplicative monitoring sites, the result will be a combined dataset more easily utilized for assessment and protection of the watershed's water resources (AMEC, 2006).

A tremendous amount of time and effort was needed to track down and consolidate electronically-available data for this report and present it in such a way that surface water quality trends could be characterized despite the differing monitoring goals associated with the data. This effort has been only partially successful but clearly points out the great need for the coordinated monitoring and consolidated reporting work which is underway.

As finalization of this report was occurring during September and into early October, a large part of the watershed in the Los Padres National Forest was burning from a massive brushfire. Water quality will likely be dramatically altered in the near-term following storms. It is hoped coordinated monitoring by the watershed's interested parties will document what changes do occur.

Regional Board Activities Addressing Water Quality Issues

Conditional Waiver for Irrigated Lands

The California Water Code authorizes State and Regional Water Quality Control Boards to conditionally waive waste discharge requirements (WDRs) if this is in the public interest. Over the years, the Regional Water Boards issued waivers for over 40 categories of discharges. Although waivers are always conditional, the historic waivers had few conditions. In general, they required that discharges not cause violations of water quality objectives, but did not require water quality monitoring. Senate Bill 390, signed into law on October 6, 1999, required the Regional Water Boards to review their existing waivers and to renew them or replace them with WDRs. Under SB 390, waivers not reissued automatically expired on January 1, 2003. To comply with SB 390, the Regional Water Boards adopted revised waivers.

The Los Angeles Regional Water Quality Control Board adopted the Conditional Waiver for Irrigated Lands at its November 3, 2005, Board meeting.

Statewide monitoring has shown the presence of chemicals associated with agriculture operations in waters of the state. And, in Ventura County, the Regional Board has observed water quality impairments related to agriculture. Under Section 13269 of the Porter Cologne Water Quality Control Act, waivers are appropriate when they are consistent with other water quality control plans and are in the public interest and are not to exceed 5 years in duration. The overall goal of the Conditional Waiver program is to improve and protect water quality in the Region through extensive water quality monitoring and implementation of Best Management Practices (BMPs). If the monitoring results show an exceedance of a water quality benchmark, development of a Water Quality Management Plan (WQMP) is triggered which will include the implementation of BMPs to mitigate the impairment.

The first year has focused on enrollment and initiation of the program and identified the location of the Dischargers and monitoring sites. Once enrollment documents are reviewed, the Regional Board's Executive Officer will issue the Notice of Applicability (NOA), which is the formal notice that the enrollment documents are approved. The NOA will be issued to enrollees by December 31, 2006 and water quality monitoring will start in January 2007.

Dischargers can enroll in the program as an Individual or as a member of a Discharger Group. The majority of growers have enrolled as members of a Discharger group. The waiver program also requires 8 hours of educational training for growers.

There are currently two established Discharger Groups participating in the Conditional Waiver program. The Group representing growers in Ventura County is the Ventura County Agriculture Irrigated Lands group which consists of 1,080 landowner members representing 73,697 acres. There are 27,000 acres enrolled in the Santa Clara River Watershed.

Seven monitoring sites have been selected to characterize agriculture inputs in the watershed within Ventura County. The monitoring locations are generally located at the lower end of mainstem tributaries or agricultural drainages and were selected in areas that were primarily influenced by irrigated agriculture and unlikely to receive inputs from other land uses.

The Nursery Growers Association – Los Angeles County Irrigated Lands Group is the Discharger Group formed to represent growers in Los Angeles County.

TMDLs

- Upper Santa Clara River Chloride TMDL – implementation plan underway
- Nutrient (nitrogen compounds) TMDL - identified wastewater treatment facilities as the major contributor of nitrogen compounds loadings with nonpoint sources and minor point sources contributing a much smaller fraction of these loads.
- For more information see http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/tmdl_ws_santa_clara.html

Permits

- Fillmore Wastewater Treatment Plant – Administrative civil liability assessed for violations, some of which may go toward development of a constructed wetland using effluent from the facility. Surface water discharge will phase out by 2008 and become a groundwater discharge (percolation) or a reclamation plant treating nitrates to 3 ppm.
- Santa Paula Wastewater Reclamation Plant – Will become Title 22 compliant and go to full reclamation some time after 2008, in the meantime, there is ongoing enforcement action toward a consent decree.
- San Buenaventura Wastewater Reclamation Plant – Administrative civil liability assessed for metals and coliform effluent violations; cleanup and abatement order in place. Reduced problem metals by 50% and now treats to tertiary standards. Facility discharges to the estuary, in the late 1970s the City demonstrated enhancement as required under the Bays and Estuaries Policy based on an original 5 MGD discharge. The facility now discharges 10 MGD and the City has been asked to re-evaluate the enhancement issue.
- Valencia Water Reclamation Plant – Administrative civil liability assessed in 2006 for cyanide, nitrate plus nitrite (as nitrogen), and chloride effluent violations. The matter will be heard before the Regional Board at a future meeting in 2007.

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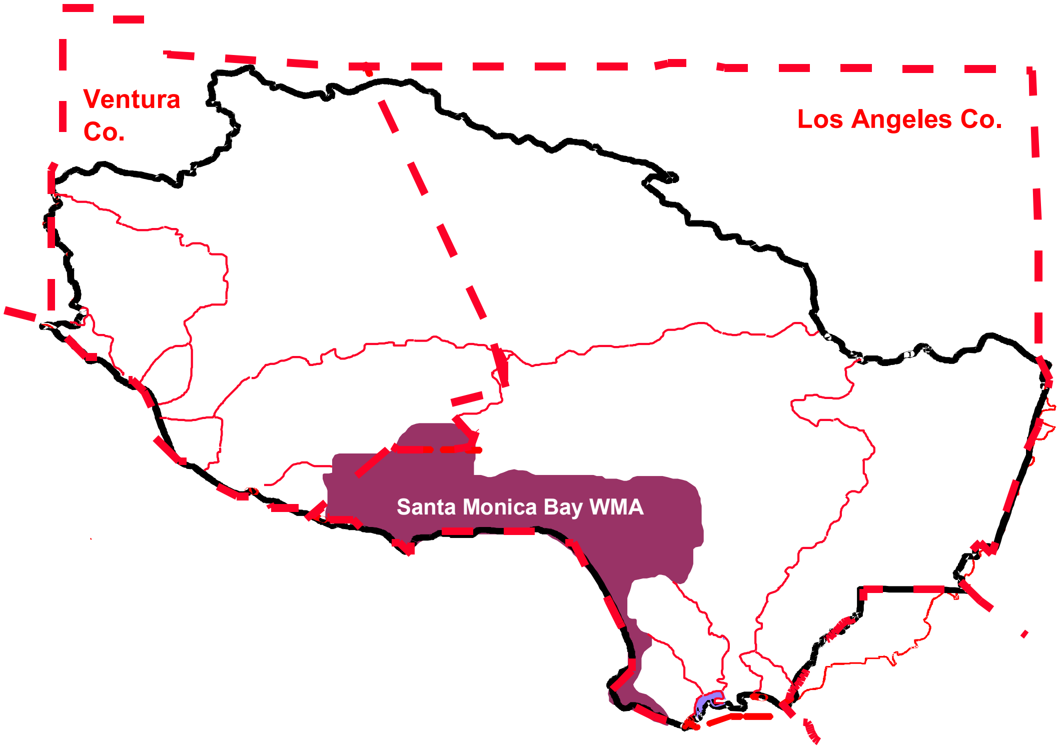
STATE OF THE WATERSHED – Report on Water Quality

The Santa Monica Bay Watershed Management Area
2nd edition



November 2011

California Regional Water Quality Control Board – Los Angeles Region
Shirley Birosik, Watershed Coordinator

PREFACE

This report is one in a series written by the Regional Board's watershed coordinator which summarizes and characterizes surface water or sediment quality data for the Region's watersheds; no policy or regulation is either expressed or intended. The Regional Board is often asked very basic questions about its watersheds and water quality and, in many instances, State of Watershed reports answer these questions. The reports are also helpful in showing how effectively or ineffectively we are all collectively doing monitoring and sharing data/information by going through the process of acquiring and merging data from different sources and making these data/information accessible.

There is some discussion of the watershed's biological resources due to their widespread occurrence and since there are many aquatic life-related beneficial uses sensitive to water and sediment quality problems; however, this report is not meant to be a complete documentation of these resources and instead the reader is encouraged to consult the references cited.

This report is the first in the watershed series to be an update of the original report produced in 1997 (hence, 2nd edition). The first edition was built upon the 1993 *Santa Monica Bay State of the Bay* report produced by the Santa Monica Bay Restoration Project with an emphasis on information available that related to the Santa Monica Bay watershed (land area) as opposed to the Bay alone. In 1997, a team approach was utilized when producing watershed reports whereas now it is primarily the responsibility of the watershed coordinator to complete. The format of these watershed reports has changed considerably since 1997 but there is every intention to both provide new data and reference findings from the previous report for comparison purposes. Use of the Internet was minimal to non-existent in 1997 whereas now virtually every reference is readily available through hyperlinks with the Internet; as a result, often reports cited are only briefly summarized and the reader can consult the full report at his/her leisure.

It became apparent during preparation of this report that tremendous changes have occurred in this Watershed Management Area since the first edition was produced. While much data are available, the amount and extent of research that has occurred is also considerable. A multitude of activities to improve habitat and water quality are ongoing; some are strictly voluntary while others are the direct result of regulatory requirements. The cooperative nature of the work being done among such a diverse groups of stakeholders is to be commended.

Photos embedded in the report were taken by the author; maps were generated in ArcGIS 9.3 by the author.

Prior to release of the public draft, in-house comments were provided by Regional Board staff. An announcement of the public draft report's availability for review and comment was made to the Email lists of interested stakeholders and on the Regional Board's website. Major comments were submitted by Las Virgenes Municipal Water District and Los Angeles County Department of Public Works. The document was revised as appropriate.

November 2011

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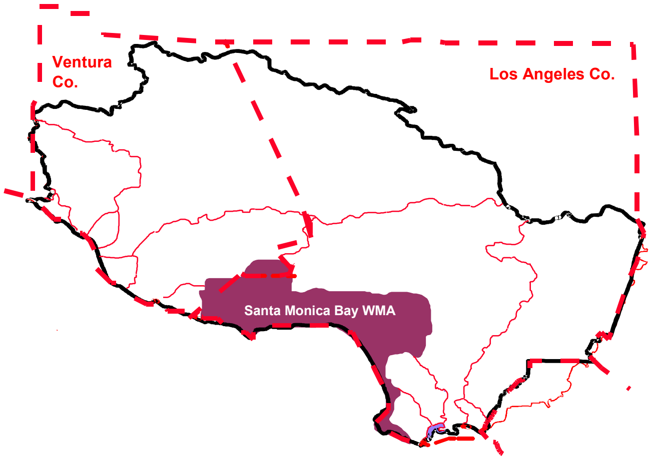
EXECUTIVE SUMMARY



The Santa Monica Bay Watershed Management Area (WMA), which encompasses an area of 414 square miles, is quite diverse. Its borders reach from the crest of the Santa Monica Mountains on the north and from the Ventura-Los Angeles County line to downtown Los Angeles. From there it extends south and west across the Los Angeles plain to include the area east of Ballona Creek and north of the Baldwin Hills. A narrow strip of land between Playa del Rey and Palos Verdes drains to the Bay south of Ballona Creek. The WMA includes several watersheds, the two largest being Malibu Creek to the north (west) and Ballona Creek to the south. The Malibu Creek area contains mostly undeveloped mountain areas, large acreage residential properties and many natural stream reaches while Ballona Creek is predominantly channelized, and highly developed with both residential and commercial properties (CRWQCB, 2007).

As a nationally significant water body, Santa Monica Bay was included in the National Estuary Program in 1988. It has been extensively studied by the Santa Monica Bay Restoration Project, formed in 1989, (now the Santa Monica Bay Restoration Commission or SMBRC) and the Bay Restoration Plan was approved by US EPA and the State of California in 1995. The SMBRC was established in 2004 to oversee implementation of the Plan (CRWQCB, 2007).

The Santa Monica Bay WMA embraces a high diversity in geological and hydrological characteristics, habitat features, and human activities. Almost every beneficial use defined in the Basin Plan is identified in water bodies somewhere in the WMA; however, many of these beneficial uses are impaired. While some of the impaired areas are showing signs of recovery, beneficial uses that are in relatively good condition still face the threat of degradation. Beneficial use impairment problems in the watershed fall into two major categories: human health risk and natural habitat degradation (CRWQCB, 2007).

Permitted discharges:

- MS4 permittees (84 cities, LA County, and LA County Flood Control District)
- 193 traditional NPDES discharges including: seven major NPDES permit discharges, three POTWs (two direct ocean discharges), one refinery, and three generating stations; 18 are minor discharges
- 175 dischargers covered under general permits
- 87 dischargers covered by an industrial storm water permit
- 401 dischargers covered by the construction storm water permit

Of the major non-stormwater NPDES dischargers in the Santa Monica Bay WMA, the three Publicly-Owned Treatment Works (POTWs), particularly the two direct ocean discharges, are the largest point sources of pollutants to Santa Monica Bay. Pollutants from the minor discharges have been estimated to contribute less than two percent of the total pollutants being discharged to the Bay (CRWQCB, 2007).

State of the Watershed

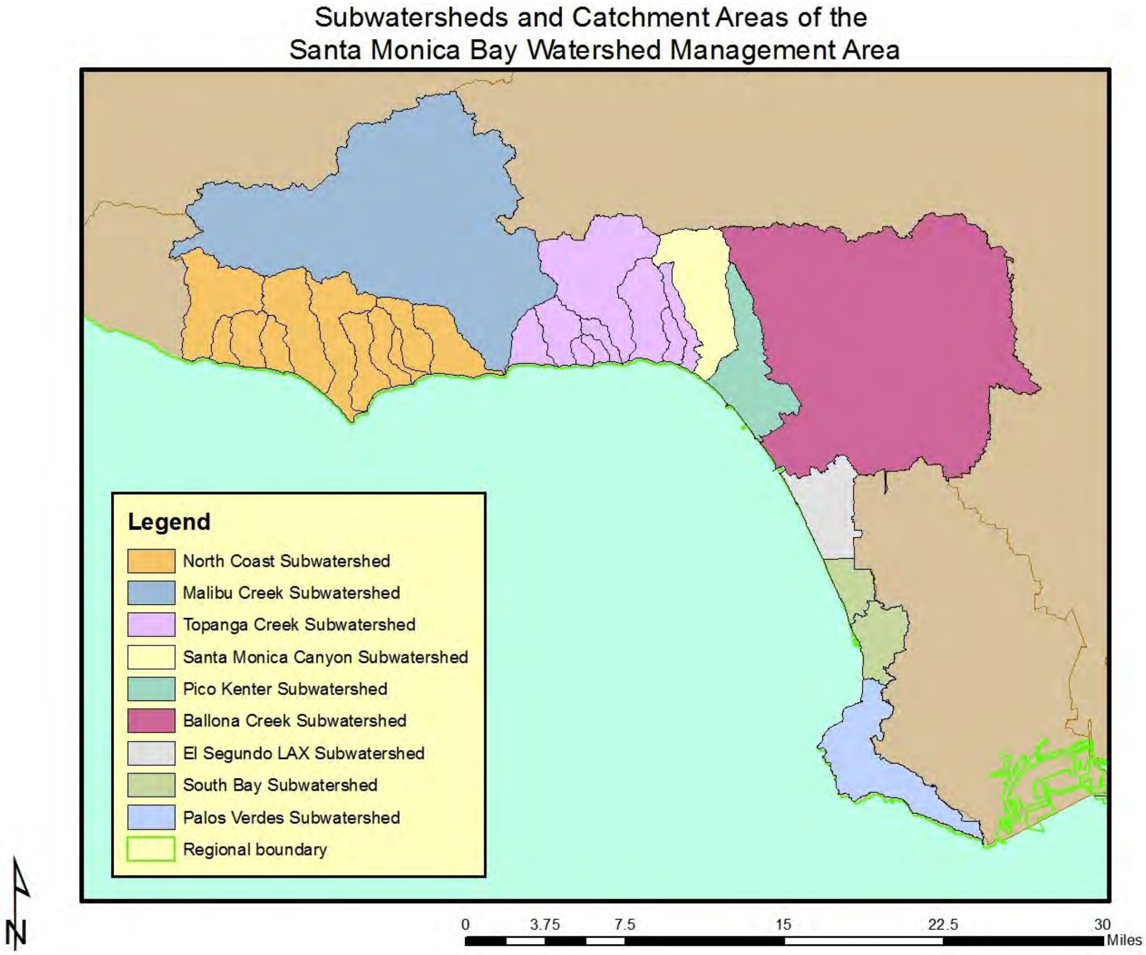
Description of Watershed

The Santa Monica Bay Watershed Management Area (WMA) includes the Santa Monica Bay and the land area that drains into the Bay. The boundary of the Santa Monica Bay, as defined for the National Estuary Program, extends from the Los Angeles/Ventura County line to the northwest, to Point Fermin on the Palos Verdes Peninsula to the southeast. The 414 square mile land area that drains into the Bay follows the crest of the Santa Monica Mountains on the north to Griffith Park. From there it extends south and west across the Los Angeles coastal plain to include the area east of Ballona Creek and north of the Baldwin Hills. South of Ballona Creek the natural drainage is a narrow coastal strip between Playa del Rey and Palos Verdes (CRWQCB, 1997).

The Santa Monica Bay WMA is located in the Los Angeles Coastal Plain. The Bay itself is part of the Southern California Bight, extending from Point Conception to Cape Colnett in Baja California, and with the California Current as its seaward boundary. The mountainous land forming the watershed's northern boundary is largely the results of the slow grind of the Pacific tectonic plate against the North American tectonic plate with the San Andreas fault marking the point of friction between the two. Sediments eroding from surrounding ranges filled the habitable portion of the Los Angeles Coastal Plain. The climate is Mediterranean, characterized by warm, dry summers and mild, wet winters. The average annual rainfall on the Coastal Plain is 12 to 13 inches but ranges from four to 25 inches. Rainfall also varies with elevation, with foothill areas receiving as much as 40 inches (CRWQCB, 1997).

Surface water flows into the Bay through 28 catchment basins that can be grouped into nine subwatershed areas based on their geographic characteristics as shown in the figure below. There are four major groundwater basins in the area, which correspond to geological features seen above the ground (CRWQCB, 1997).

Figure 1



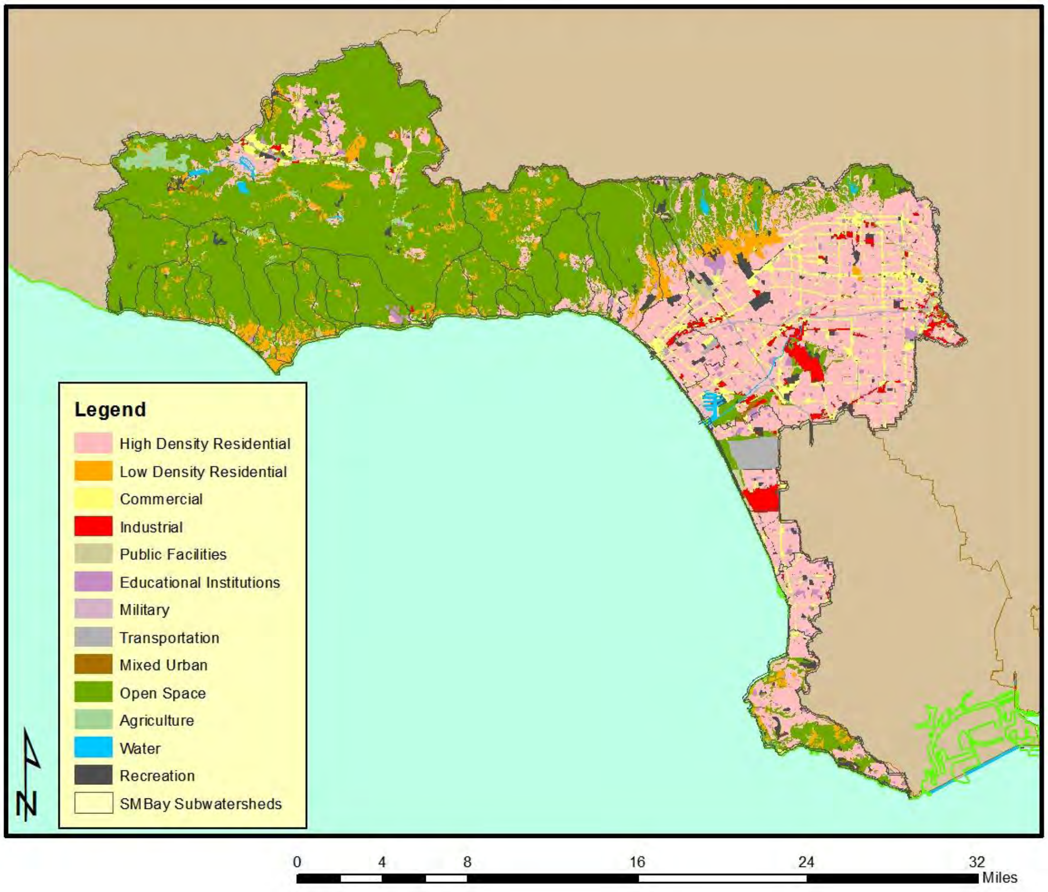
Subwatersheds and Catchment Areas of the Santa Monica Bay Watershed Management Area

Most land areas of the WMA are located in Los Angeles County, except for a small portion of eastern Ventura County. The cities of Los Angeles and Santa Monica, along with twenty other cities, are located either completed or partially within the watershed. There are also land areas under the jurisdiction of Los Angeles County as well as State and Federal jurisdictions (primarily park lands in the Santa Monica Mountain area) (CRWQCB, 1997).

Approximately 9.86 million people live in Los Angeles County (2008 U.S. Bureau of Census estimate). It is estimated that approximately 2.5 million live within the 414 square mile watershed. In addition, approximately 8.8 million live within the so-called "wasteshed", the area that is served by the large wastewater treatment plants that discharge into the Bay (CRWQCB, 1997).

SCAG land use data from 2005 shows 62% of the area is open space, high density residential is 17% of the area, and low density residential is 2.3% of the area. Commercial and industrial land uses total 6% of the area and are found in all but a handful of the subwatersheds. These land uses are shown in the following figure.

Figure 2



Land Use in the Santa Monica Bay Watershed Management Area

There are large industrial centers in El Segundo, Manhattan Beach, Redondo Beach, and Torrance, which serve as a base for aerospace and other high-tech manufacturing. Other concentrated commercial/ industrial areas in the watershed include Westchester-LAX-Playa del Rey (commercial), Santa Monica-West Los Angeles-Century City (commercial and light industry), Culver City (entertainment industry), Los Angeles Civic Center, and the Highway 101 corridor in Thousand Oaks-Westlake Village (light industry and commercial) (CRWQCB, 1997).

The southern coastal plain portion of the watershed is at or near build-out, therefore, future coastal development in this area will be restricted to scattered infill development, recycling and redevelopment activities. The future population and economic expansion in the area is likely to result in a more dense pattern of human activities and development (CRWQCB, 1997).

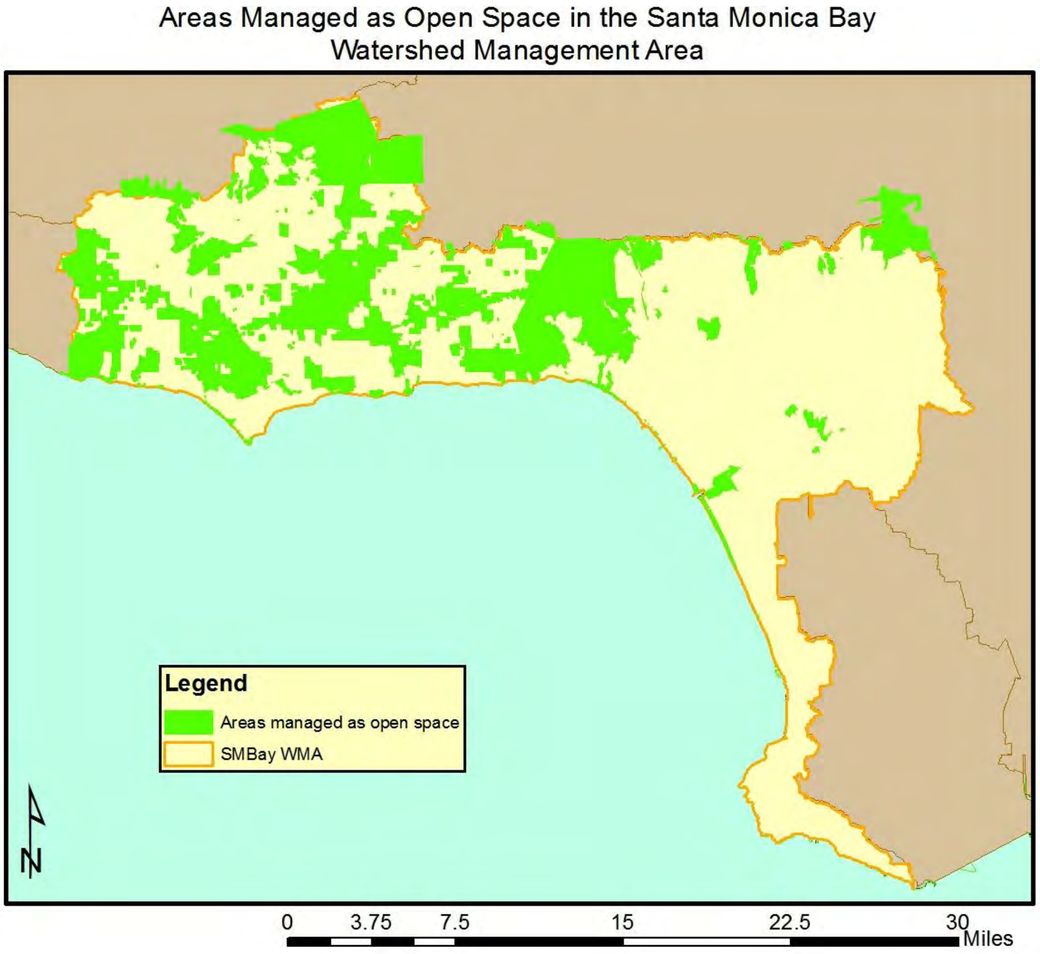
The narrow strip of coastal land in the northern Santa Monica Mountains portion of the watershed is also at or near build-out. Scattered and block new developments take place by encroaching on canyon slopes. New development and business expansion also takes place in the upper watershed, spreading from the Highway 101 corridor to the nearby foothills and even hill-top areas (CRWQCB, 1997).

Economic activities in the watershed are similar to those of Southern California as a whole. Major land-based economic activities include aerospace and other high-tech industries, tourism, entertainment industry, trade, and transportation (CRWQCB, 1997).

Impervious surfaces, which include buildings, roads, sidewalks, parking lots, storm drains and other paved surfaces are inherent to urbanized settings such as the Ballona Creek Watershed; however, these surfaces prevent the natural infiltration of water into the ground. As a result, the volume of storm water runoff increases and water quality deteriorates as polluted water flows to the receiving waters. Most research indicates that water quality is degraded as imperviousness increases; research conducted by Southern California Coastal Water Research Project (SCCWRP) has shown changes in stream channel morphology (which can impact the benthic invertebrate community) can occur at as little as 2-3% total impervious area (Coleman, et al., 2005).. Of the Santa Monica Bay's 414-square mile watershed, 121 square miles (29%) are impervious. The Ballona Creek subwatershed accounts for most of the impervious area, with 72 square miles of impervious surface, (which is 55% of the subwatershed and 17% of the total Bay watershed area). Even the Malibu Creek watershed, with its large expanse of open area, has almost 14 square miles of impervious surface, placing it well above the level of imperviousness at which water quality is impacted (SMBRC, 2004).

The biological and aesthetic resources of the Bay provide many economic benefits to the residents of the watershed. The abundant recreational facilities (including 22 public beaches, a 22-mile-long beach bike path, six piers, small craft harbors with 6,000+ slips, and nine artificial reefs) make the area attractive for a wide range of water-dependent activities. Over 55 million people visit Santa Monica Bay beaches each year to engage in sightseeing, sunbathing, swimming, surfing, and biking. Millions of fishing trips are made to the Bay and on fishing piers each year. The region, especially coastal jurisdictions, depend on tourism associated with these activities to generate jobs and revenues (CRWQCB, 1997). Areas managed as open space by the California Department of Parks and Recreations and the National Park Service, in addition to local agencies, are shown below.

Figure 3



WATER RESOURCES

As is the case for much of coastal Southern California, the Santa Monica Bay watershed is known for its Mediterranean climate – hot, dry summers and cool winters with highly variable amounts of rain influenced by climatic events known as El Nino and La Nina. However, heavy storms do occur and cause catastrophic flooding on occasion. During wet years, the annual total of rainfall can be as great as 40 inches. In addition, the region is rich in groundwater resources with several groundwater basins of large storage capacity. Finally, water imports from the east and north have fundamentally changed the water resources' balance equation and, in a sense, have dramatically expanded the boundary of the watershed (CRWQCB, 1997).

Surface Water

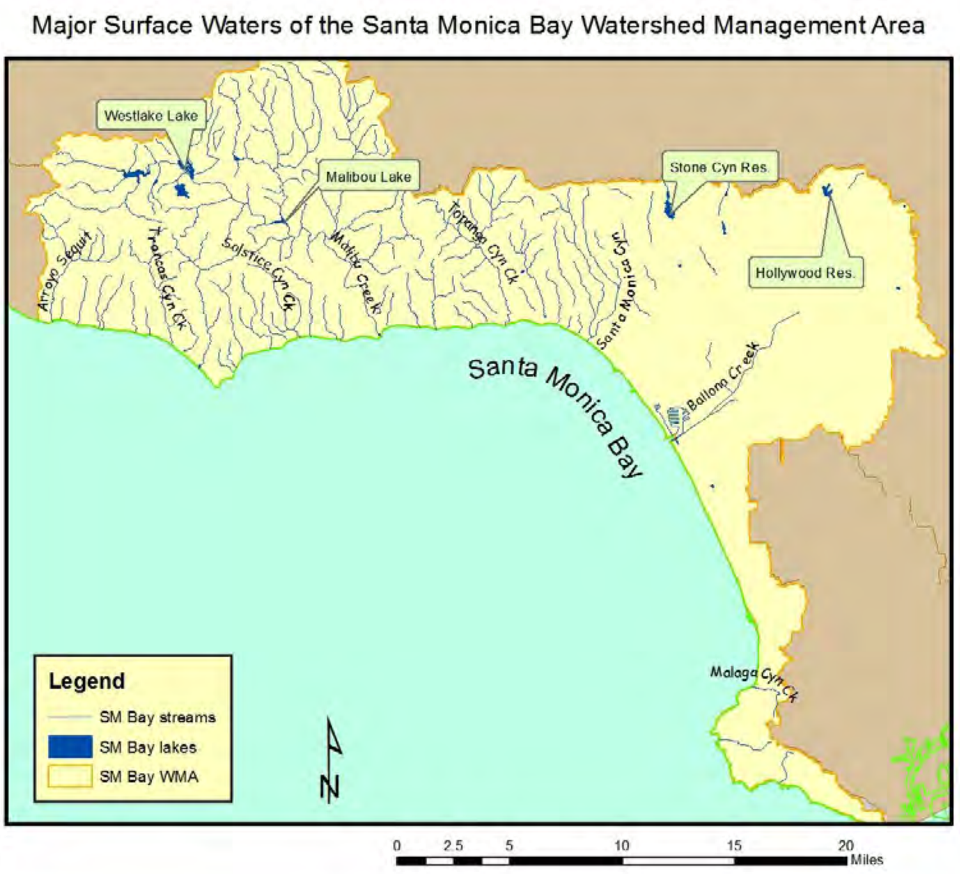
Until storms shifted its course in 1825, the Los Angeles River was the largest river system entering Santa Monica Bay. It once meandered through extensive swamp forests, marshes and lakes between the

Baldwin and Beverly Hills. Today, there is no major river system in the watershed but rather smaller perennial and intermittent streams; Ballona Creek in the Los Angeles Basin and Malibu Creek in the Santa Monica Mountains are the largest (CRWQCB, 1997).

Today, Ballona Creek and its tributaries, which drain a watershed of about 127 square miles, are mostly concrete-lined channels or covered culverts. Besides Ballona Creek, numerous reservoirs, channels, and debris basins have been constructed to control flooding and speed surface flows directly to the ocean (CRWQCB, 1997).

By contrast, Malibu Creek and its tributaries, which drain an area of 110 square miles, are for the most part not channelized. Relatively few tributaries in the upper portions of the Creek drainage have been dammed for recreational and water supply reservoirs. There are about 18 other smaller perennial or seasonal streams which flow through deep and narrow canyons to Santa Monica Bay. Most of these streams remain in their natural condition except for some fills and streambank stabilization due to road and house construction (CRWQCB, 1997). Major surface waters in the WMA are shown below.

Figure 4



Major Surface Waters of the Santa Monica Bay Watershed Management Area

Despite little or no rain throughout much of the year, about two dozen streams or storm drains (including Ballona and Malibu Creeks) have flow in the summer months. Several sources contribute to this phenomenon. Springs and seeps historically were common along the base of the Beverly Hills, Baldwin Hills, the hills above present-day Santa Monica, and in the various canyons in the mountainous area of the watershed. Some of these natural springs and seeps still exist today. Various point and nonpoint source discharges are also contributors to the summer low flow. The former are mostly from groundwater pumped from dewatering projects and from cooling tower discharges. The latter are from over-irrigation, or domestic/industrial illicit connections. Regardless of the sources, these are considered excessive flow because they result at least partly from water imported from outside the watershed (CRWQCB, 1997).

Groundwater

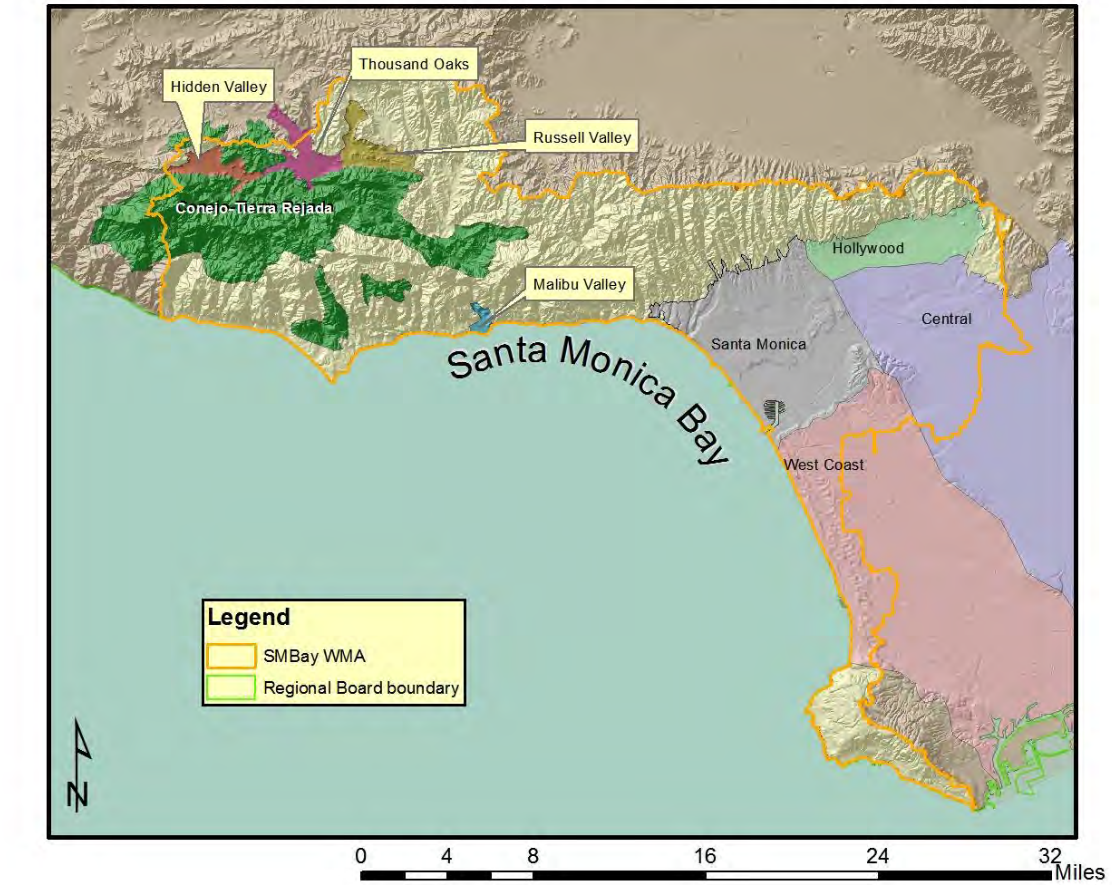
Water in the ground (groundwater) is present at varying depths below land surfaces everywhere. Aquifers, which are permeable units of soil and rock, store ground water that can be easily transmitted and pumped to provide water for uses such as drinking, irrigation and industrial processing. In the Santa Monica Bay watershed (as well as throughout all of southern California), groundwater accounts for most of the local (non-imported) supplies of fresh water (CRWQCB, 1997).

Of the four groundwater basins within the LA Coastal Plain, the Santa Monica Basin and parts of the West Coast, Hollywood, and Central Basins lie within the WMA. Additionally, limited groundwater resources exist in Malibu and Russell Valleys in the Malibu hydrologic area (CRWQCB, 1997). The Metropolitan Water District of Southern California (MWD) has reported that groundwater was once the primary source of drinking water in the Malibu area; with the introduction of imported water to the area in 1965, all known private and public water supply wells have since been abandoned (MWD, 2007). The Los Angeles County Waterworks District No. 29, which provides potable water to coastal areas in the Malibu area, has stated the geology below the District's service area lacks groundwater basins capable of producing an adequate supply of groundwater and, therefore, the District does not have plans to use groundwater sources for future water supply within the District service areas (LACDPW, 2005). Groundwater basins are depicted in Figure 5.

The West Coast Basin Barrier Project recharges aquifers in the West Coast Basin by direct injection into 153 wells of a blend of advanced-treated recycled water and potable water imported from other Regions. The barrier recharges aquifers and prevents seawater intrusion into the West Coast Basin (CRWQCB, 1997).

Figure 5

Groundwater Basins of Santa Monica Bay Watershed Management Area



Water Imports

Water has been imported into the Los Angeles Region from other areas since 1913 when the Los Angeles Aqueduct began delivering water from the Owens Valley. Since that time, southern California has developed a complex system of aqueducts to import water to a rapidly growing population and economy. Water imported to the Region presently meets approximately half of the demand for potable water (CRWQCB, 1997).

The principal systems for importing water are the Los Angeles Aqueduct, which diverts water from the Mono and Owens Rivers Basins; the California Aqueduct (State Water Project), which transports water from northern California; and the Colorado River Aqueduct, which carries water from Lake Havasu on the Colorado River. Importing these waters brings several problems as well as the obvious benefits. Water from the Owens Valley is usually treated for turbidity. Water from the Colorado River generally has a higher mineral content than either local waters or other imported waters although exceptions exist in those Santa Monica Bay watersheds with significant deposits of Tertiary age marine sedimentary rock of the Monterey Formation (Mundy, comm. ltr.). This hardness is the result of dissolved material from soil and rocks in that river's watershed. Water from northern California accumulates organic materials as it flows through the Sacramento-San Joaquin Delta. These organic materials when combined with the chlorine used during typical disinfection treatment processes can result in by-products called trihalomethanes (THMs). These substances have been linked to cancer. A 100 parts per billion (ppb) standard has been established to mitigate the occurrence of THMs in drinking water, while still allowing for adequate disinfection with chlorine (CRWQCB, 1997).

Chloride is one component of hardness in water and, during drought periods, water supplies from northern California often have higher than normal concentrations of chlorides. Excessive chlorides can impair the use of water for human consumption and application on crops. Currently, surface waters within the Santa Monica Bay watershed are not experiencing excessive chloride concentrations due to imported water (CRWQCB, 1997).

About half of the City of Los Angeles' water supply now comes from the Metropolitan Water District, imported water from northern California through the State Water Project (SWP), while about a third is imported from the Los Angeles Aqueduct. Local groundwater accounts for about 10% of the water supply. Another major water supplier in the WMA, the West Basin Municipal Water District, imports about 65% of its water. About 20% is from groundwater and 7% is from recycled water (SMBRC, 2010). The remainder of the water imported in the northern Santa Monica Bay area is provided by the Las Virgenes Municipal Water District (LVMWD) and consists of 100% SWP water. LVMWD also provides recycled water derived from SWP water to meet approximately 20% of total demand (Mundy, comm. ltr.).

Biological Setting

Santa Monica Bay is the submerged portion of the Los Angeles basin and is an integral part of the larger geographic region commonly known as the Southern California Bight. It has a gently sloping continental shelf which extends seaward to the shelf break about 265 feet underwater, then drops more steeply to the floor of the Santa Monica Basin, at about 2,630 feet (CRWQCB, 1997).

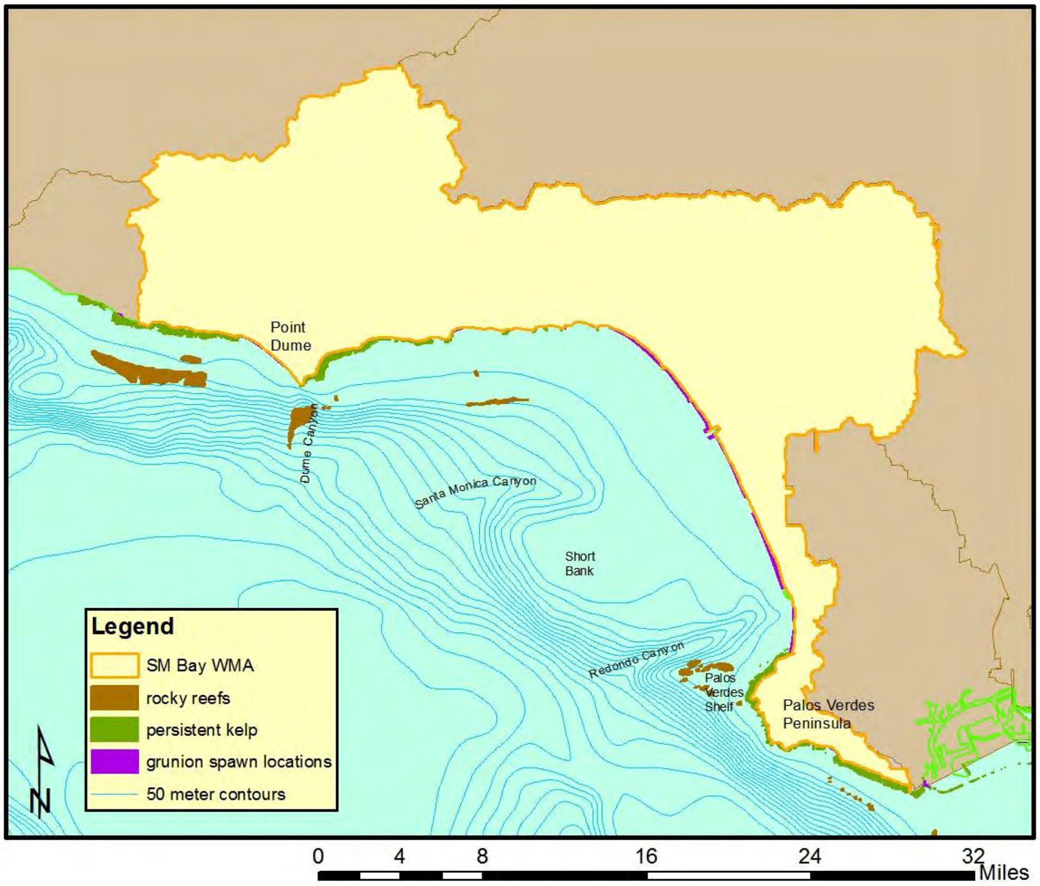
The shelf ranges in width from a few hundred yards to about 12 miles. It is broadest off El Segundo, narrowest off Redondo Beach, and is transected by three submarine canyons: Dume Submarine Canyon off Point Dume; Santa Monica Submarine Canyon seven miles offshore of Ballona Creek; and Redondo Submarine Canyon, a few hundred yards of King Harbor (CRWQCB, 1997).

MARINE HABITATS

The Bay provides a variety of habitats and homes for a highly diverse group of plants and animals, at least 5,000 at last count. The dominant *benthic habitat* in Santa Monica Bay is soft bottom which

Figure 6

Marine Habitat Areas of Santa Monica Bay Watershed Management Area



consists of fine to moderately coarse sediments. Few attached plants live in this habitat but invertebrates are abundant and diverse. Resident animals include crabs and shrimp, snails, worms and echinoderms. Hard bottom areas consist of seafloor covered with bedrock, gravel, and phosphorite. It also includes the deep-water plateau called Short Bank. Kelp beds will often be found in these hard bottom areas at depths of 20 to 70 feet in the subtidal regions west of Malibu and around the Palos Verdes Peninsula. Although far less in acreage than soft bottom, kelp beds in the Bay provide cover and protection, and thus habitat for more than 800 species of fishes and invertebrates, some of which are uniquely adapted for life in the beds. Consequently, kelp beds are important for sport fishing, commercial harvesting of abalone and sea urchins, and recreational diving (CRWQCB, 1997).

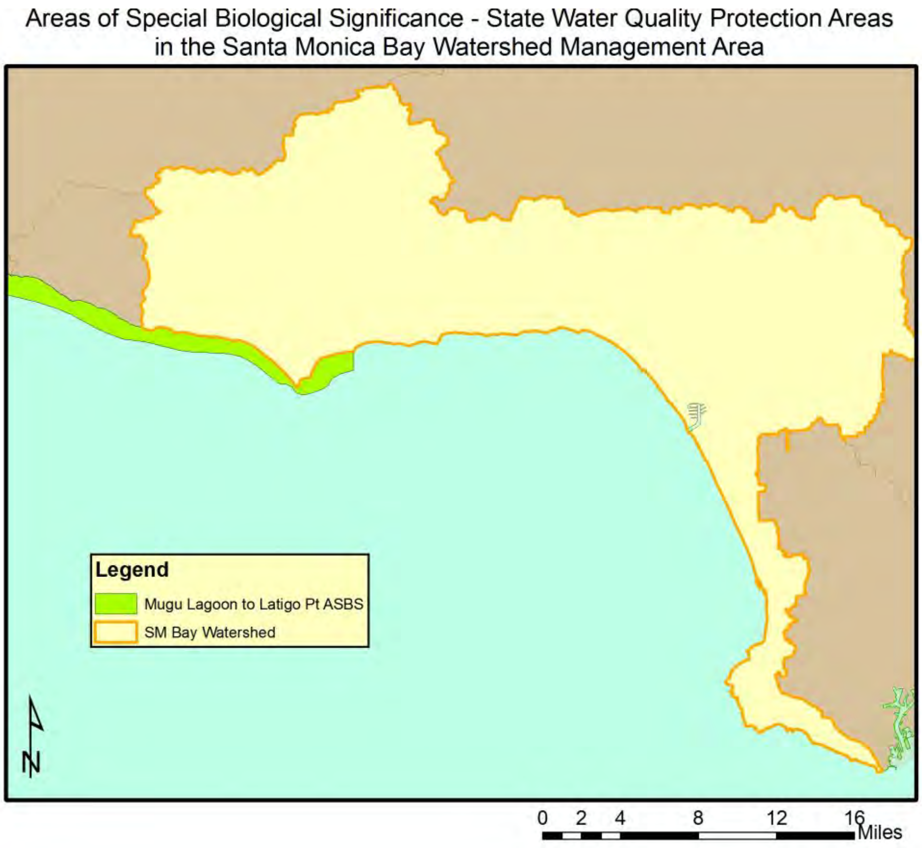
The *pelagic, or open-ocean habitat* is the primary home to fish such as Pacific sardine, northern anchovy, Pacific mackerel, and Pacific bonito; as well as marine mammals such as seals and sea lions. Many species of whales and dolphins are also observed in Bay waters during the winter/spring migration. The thin uppermost layer of the water column (microlayer) is also home to the eggs and larvae of many invertebrates. Phytoplankton are the dominant plant life in the pelagic environment. Red tides (which are typically dominated by dinoflagellates) sometimes develop in nearshore areas when warm temperatures, high light levels, abundant nutrients, and a shallow pycnocline (density gradient) occur together. Localized red tides occur almost every year; extensive ones occur less frequently (CRWQCB, 1997).

BEACH AND INTERTIDAL HABITATS

Sandy beaches are the most prominent and dominant habitat along the Santa Monica Bay shoreline, extending over fifty miles. Sandy beaches in southern California support species of macro invertebrates such as sand crabs and Pismo clams; they also support surf fish, such as California corbina, barred surfperch, and shovelnose guitarfish. Many sandy beaches along the Bay are important spawning grounds for California grunion (SMBRC, 2010). *Intertidal zones* include mud flats, tide pools, sandy beaches, and wave-swept rocks. They provide important habitat and breeding grounds for a variety of plants such as marine algae, fish such as grunion, and many invertebrates. Both beaches and other intertidal zones of Santa Monica Bay are important nesting and feeding grounds for migratory waterfowl and shore birds such as egrets, herons, gulls, terns, sanderlings, and plovers (CRWQCB, 1997).

Because of the existence of kelp beds, tidepools, and significant ecological diversity, the nearshore area between Ventura County line and Latigo Point was designated by the State Water Resources Control Board (SWRCB) an Area of Special Biological Significance (ASBS), now known as a State Water Quality Protection Area (SWQPA). A SWQPA is afforded special protection for marine life to the extent that waste discharge are prohibited within the areas. The same area and the nearshore area between Palos Verdes Point and Flat Rock Point is also designated a "significant ecological area" by the County of Los Angeles (CRWQCB, 1997).

Figure 7



COASTAL WETLANDS AND SHALLOW WATER HABITATS

Enclosed shallow water habitats are important features of the Santa Monica Bay coastline. These waterbodies are protected from rough seas and winter storms and provide a certain amount of stability in the physical environment and availability of food, and serve as important nurseries for local marine fishes (e.g., juvenile California halibut, juvenile white seabass). The relative complexity of the physical environment (piers, mudflats, sandy bottom) tends to allow for considerable diversity in the flora and fauna living there (CRWQCB, 1997).

The Santa Monica Bay WMA contains five estuaries/lagoons (Dume Lagoon, Malibu Lagoon, Topanga Lagoon, Ballona Lagoon and Del Rey Lagoon) and Ballona Wetlands. Lagoons may form at the mouths of rivers (the estuary) periodically when sand bars build up and close off the area. Considerable fluctuations in salinity often result. Coastal wetlands not part of a river system are often a mix of tidal influx and freshwater water inputs (including from urban runoff) which may result in fluctuations in salinity. Many of the species living in estuaries are either adapted to changing salinity *(*such as some species of pickleweed) or relocate to stay within the appropriate salinity range (such **as** tidewater goby).

Some estuarine fauna have adapted by producing large amounts of offspring with the likelihood that only some will survive. Lagoons are popular overwintering sites for migrating birds and are utilized by species nesting locally (such as the California least tern) during foraging. Many of the species found in estuaries are unique to that habitat and consequently are very sensitive to estuarine habitat loss (CRWQCB, 1997).

The enclosed waters of Marina del Rey and King Harbors also function to a large extent as shallow water habitats. Salinity in these areas is relatively constant and reflective of the nearby ocean waters. Many species of fish use these enclosed waters as nurseries. The mix of hard and soft bottoms yields a large array of organisms; many which might normally attach to rocks will also attach to piers in great abundance (mussels, tunicates). Organisms living in these waters are in constant contact with any pollutants found there (CRWQCB, 1997).

INLAND RIPARIAN HABITATS

Riparian habitat exists along each natural watercourse flowing to the ocean and around the lakes of the watershed. Riparian corridors include those found throughout the Malibu Creek watershed, in other Santa Monica Mountain watersheds such as Arroyo Sequit and Solstice Creek, and adjacent to lakes such as Westlake Lake, Lake Sherwood, and Malibou Lake. Riparian habitat generally consists of plants that need to be in close proximity to water at least for part of the year. Typical riparian vegetation includes sycamore trees, willows, mulefat, and cattails (near lakes). The generally large sycamore trees are used by birds for nesting and are particularly important to birds of prey since they give the height needed for these birds to hunt by sight. Shrubs will supply food and nesting habitat to a large variety of birds and rodents. Larger mammals such as coyote, gray fox, and the occasional bobcat are the common predators. Overhanging vegetation tends to minimize the water's temperature which can be very important to fish such as steelhead trout which migrate upstream to spawn. Continuous habitat along streams leads to the watercourse functioning as a wildlife corridor which allows movement of wildlife from one part of the watershed to another and opens up the amount of habitat available to them to use. Loss of this continuity, as occurs during development next to watercourses and when large roads cross them, can lead to excessive segmentation of the habitat and loss of overall species abundance and diversity (CRWQCB, 1997).

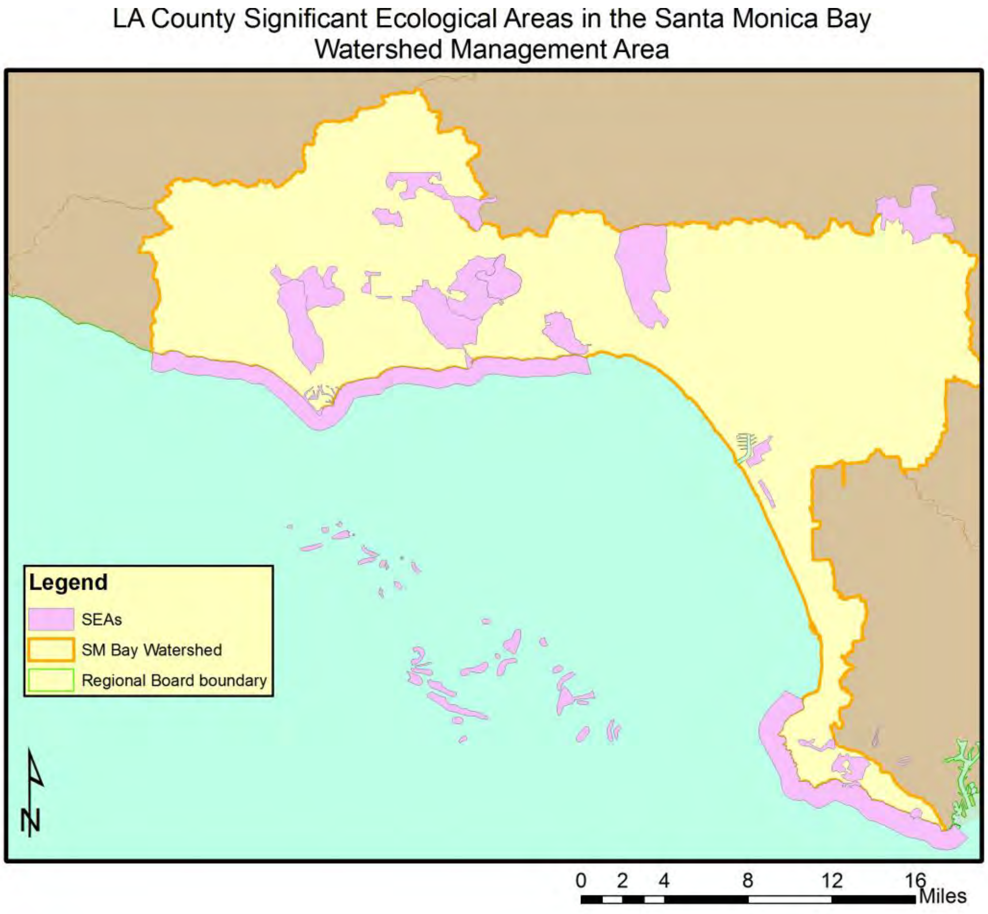
UPLAND HABITATS

Further inland the landscapes are primarily of two types: the Los Angeles coastal plain to the south and the Santa Monica Mountains to the north. Less than 300 years ago, much of the plain was rolling grassland scattered with oak trees. In low-lying areas between hills and bluffs, a major river and dozens of lesser streams meandered through broad valleys and wetlands to the sea. Two higher points of land were the peaks of the Baldwin and Palos Verdes hills where coastal scrubs grew, with chaparral vegetation covering the north-facing slopes and oak savannah blanketing the drier south-facing slopes (CRWQCB, 1997).

However, the grassland today has been replaced by human dwelling structures to become one of the most urbanized areas in the world. Only some coastal scrub habitat remains at the two higher points. Almost all natural waterways were channelized and/or converted to underground culverts. The largest drainage in the coastal plain is Ballona Creek; the Pico-Kenter drainage is second largest. Most others are small storm drains near the coast that extend only a short distance inland and receive no natural flow during summer months (CRWQCB, 1997).

The land in the Santa Monica Mountains to the north by contrast is still mostly open space and remains in a somewhat natural state, mostly free of alteration or development, but impacted by invasive species and mostly bacteria- and nutrient-related water quality issues. Besides coastal riparian, wetlands, grassland and scrub habitats, there are four habitats that are specific to the Santa Monica Mountains. The valley oak woodland occurs exclusively in the western part of the Santa Monica Mountains, particularly in the upper Malibu Creek drainage. It is dominated by valley oak, a deciduous oak 50-110 feet tall. The habitat usually merges with grassland or riparian vegetation near streams. Coastal oak woodland also occurs in the Santa Monica Mountains. This habitat is dominated by coast oak and California walnut.

Figure 8



The mixed chaparral generally occurs above the coastal scrub habitat predominantly on moist coastal or north- and east-facing slopes while the chamise-redshank chaparral predominates on drier, south- and west-facing slopes. The former is dominated by shrubs with stiff evergreen leaves such as scrub oak, ceanothus, and manzanita. The latter is almost exclusively dominated by chamise with some redshank occurring at higher elevations. Both habitat types are fire-adapted. These habitats are heavily used by small herbivores such as rodents and seed/insect-eating birds, as well as by large ones such as deer. Predators include owls, hawks, coyotes, and foxes (CRWQCB, 1997).

ENDANGERED SPECIES

Santa Monica Bay habitats (marine, aquatic, and terrestrial) are home to a number of rare, threatened or endangered species. Birds include California brown pelican, California least tern, western snowy plover, Belding's savannah sparrow, American peregrine falcon, and California gnatcatcher. Butterflies include the El Segundo blue, Palos Verdes blue, and wandering skipper. Endangered plants include Santa Monica Mountains dudleya, Lyon's pentachaeta, Conejo buckwheat, and Santa Susanna tarweed. Fish include tidewater goby and southern steelhead trout; amphibians include the Arroyo toad and the threatened California red-legged frog (CRWQCB, 1997).

Key Water Quality Issues

Though relatively small in size compared with watersheds for major rivers, lakes, or estuaries in other parts of the country, the Santa Monica Bay WMA includes a remarkably high diversity of geological and hydrological characteristics, habitat features, and human activities. Every beneficial use defined in the Basin Plan is identified in water bodies somewhere in the watershed. A complete list of beneficial uses are shown under the “The WMA’s Designated Beneficial Uses” section; those identified for each subwatershed area can be found in each Subwatershed section (CRWQCB, 1997).

Beneficial use impairment problems in the watershed fall into two broad categories: those relating to human health and those relating to aquatic life/habitat/wildlife. The former are issues primarily associated with recreational uses of the Santa Monica Bay. The latter are issues associated with terrestrial, aquatic, and marine environments. Pollutant loadings that originate from human activities are common causes of both human health risks and habitat degradation. Encroachment by human development is another major cause for disappearance or degradation of natural habitats (CRWQCB, 1997). General improvement strategies to reduce the risks and degradation are shown. More specific information on assessments conducted by the SMBRC in fulfillment of their mission as well as formal water quality assessments required by the Clean Water Act and conducted by the Regional Board are also shown. General improvement strategies are listed here; strategies specific to subwatersheds are listed in each Subwatershed section.

ADVERSE HUMAN HEALTH IMPACTS

Santa Monica Bay is heavily used by the public for fishing, swimming, surfing, and diving activities; these types of activities are classified as beneficial uses water contact recreation and commercial and sportfishing. However, the ability of people to enjoy these activities has been lost to a certain degree because of the acute health risks associated with swimming in runoff-contaminated surfzone waters, and the chronic (cancer) risk associated with consumption of certain sport fish species in areas impacted by DDT and PCB contamination (CRWQCB, 1997).

Swimming

The First Edition State of the Watershed Report described reports of swimmers increasingly complaining about ear, eye, wound and intestinal infections, skin rashes and other illnesses that allegedly occurred as a result of contact with Bay waters. In investigating sources of contaminants that could be responsible for possible adverse health effects, researchers found evidence that pointed to pathogens possibly carried by urban runoff through storm drains into the Bay. Review of shoreline monitoring data showed higher indicator bacteria (total coliform, fecal coliform, and enterococcus) in waters surrounding storm drain outlets. These are called "indicator" bacteria since their presence suggests pathogenic bacteria and viruses may be also present and do not themselves cause disease (CRWQCB, 1997).

Stronger evidence was found in SMBRP studies completed between 1989 and 1991, when enteric viruses were found in the storm drain effluent at three widely-dispersed locations during dry-weather periods (CRWQCB, 1997).

In summer 1995, the SMBRP conducted a landmark epidemiological study of possible adverse health effects of swimming in Santa Monica Bay. The study found solid evidence that (1) there was an increased risk of illness associated with swimming near flowing storm drain outlets in Santa Monica Bay; (2) there was an increased risk of illness associated with swimming in areas with high densities of bacterial indicators; (3) illnesses were reported more often on days when the samples were positive for enteric viruses; and (4) high densities of bacterial indicators were measured on a significant number of survey days, particularly in front of drains. The study also showed that the total coliform to fecal coliform ratio was one of the better indicators for predicting health risks (CRWQCB, 1997).

As will be seen below under the General Improvement Strategies section, what followed during the next decade was an intensive effort to divert dry-weather flows and, at times, portions of storm flows. With forty drains now diverted during dry-weather, the miles of beach area affected by bacterial indicators should be reduced. SCCWRP is currently conducting epidemiological studies to assess the risk of swimming-related illnesses following exposure to nonpoint source-contaminated waters at three beaches in southern California including Surfrider Beach in Malibu. These studies will examine several new techniques for measuring traditional fecal indicator bacteria, new species of bacteria, and viruses to determine whether they yield a better relationship to human health outcomes than the indicators presently used in California (SCCWRP Website #1).

General Improvement Strategies

- **Implement TMDLs** Adopted bacteria TMDLs include those for Santa Monica Bay Beaches Wet Weather and Dry Weather (2003); Ballona Creek, Ballona Estuary, and Sepulveda Channel (2007); Malibu Creek (2006); and Marina del Rey Back Basins (2004). The TMDLs, implementation plans, and related technical documents for these are available on the Regional Board website as follows:

  Santa Monica Bay Beaches Dry Weather

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

  http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

  http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

  Santa Monica Bay Beaches Wet Weather

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

  http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Ballona Creek, Ballona Estuary, and Sepulveda Channel

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_45_2006-011_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2006-011/2006-011_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2006-011/2006-011_RB_BPA.pdf

Malibu Creek

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_23_2004-019R_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2004-019R/05_0309/Resolution%202004-19R%20and%20Attachment%20A.pdf

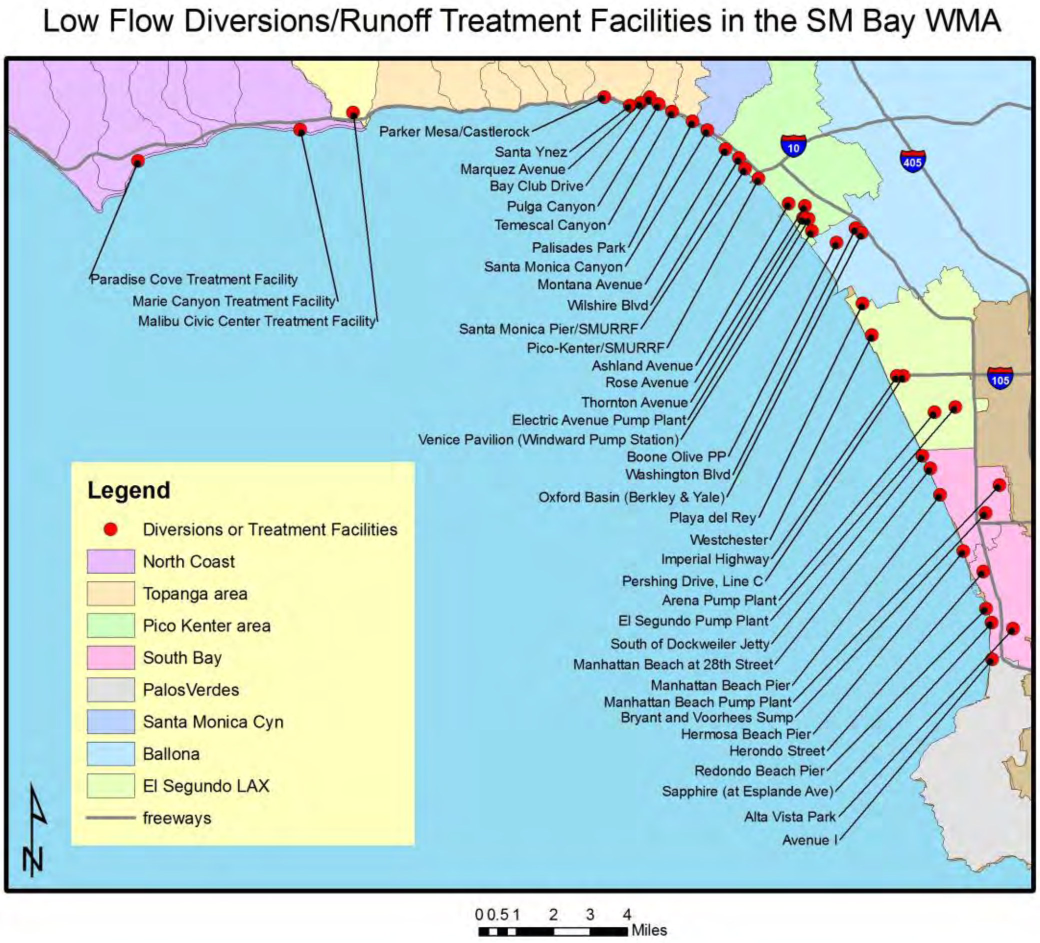
Marina del Rey Back Basins

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_19_2003-012_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_43_2006-009_td.shtml

- **Implement plans for low-flow diversions/treatment facilities** Forty low-flow diversions (LFDs) or runoff treatment facilities have thus far been installed at storm drains leading to Santa Monica Bay in order to reduce coliform levels and beach closures. Some of the LFDs have become full-time diversions. Of the twenty-seven high priority storm drains listed in the beaches dry weather bacteria TMDL, all have been diverted. Lead agencies on these projects include the cities of Los Angeles, Malibu, Manhattan Beach, Redondo Beach, Hermosa Beach, and Santa Monica, and the Los Angeles County Flood Control District (District). More information about LFDs may be found at http://www.lastormwater.org/Siteorg/program/poll_abate/lowflowdiv/lfdpage.htm. The locations of known diversion projects/treatment facilities are shown below.

Figure 9



Seafood Consumption

The general public has been concerned about potential health risks associated with the consumption of contaminated seafood from Santa Monica Bay for a number of years. Eating contaminated seafood is the primary pathway through which humans are exposed to toxic chemicals found in the marine environment. While studies have shown that health risks are limited to consumption of certain seafood species from certain locations, the public perception remains that all seafood in the Bay is contaminated (CRWQCB, 1997).

The most extensively studied contaminants in Santa Monica Bay are dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCBs), heavy metals, and their by-products. PCBs and DDT (and its derivatives DDD and DDE) present the greatest risk to individuals who consume seafood from Santa Monica Bay. Over the past 25 years, several species from contaminated areas have exhibited very high levels of PCBs and DDTs. After the discharge of these chemicals was stopped in the early 1970s, contaminant levels in fish tissues declined steeply, but additional decreases have been slower since about 1992. However, both PCBs and DDT degrade naturally at a very slow rate and the earlier sharp decline may have been reflective of the cessation of discharges and reduced bioavailability, while continued evidence of contamination today is a reflection of the slow degradation rate (CRWQCB, 1997).

A series of studies were conducted by the State Office of Environmental Health Hazard Assessment (OEHHA) and the SMBRP to assess the potential risk to humans associated with consumption of seafood species taken from the Bay. According to OEHHA's risk assessment, white croaker is generally considered to be the most contaminated fish in the Bay, especially individuals from areas such as the Palos Verdes Shelf (white croaker have naturally high lipid levels in which the organic pollutants accumulate). Other species found to be relatively contaminated at certain locations are California corbina, queenfish, surfperches and California scorpionfish (CRWQCB, 1997). The 1991 OEHHA study has been supplemented and updated by more recent SMBRP studies as well as by the Palos Verdes Shelf Superfund studies which has led to an updated health advisory by OEHHA released in 2009 which is discussed elsewhere in this document (OEHHA website).

General Improvement Strategies

- **Address consumption of contaminated fish** Implement the Fish Contamination Education Collaborative (FCEC) which is the public outreach and education component of the USEPA's program to protect the most vulnerable populations from the health effects of consuming contaminated fish related to the Palos Verdes Shelf Superfund Site. FCEC is a major part of USEPA's Institutional Controls program and works in conjunction with monitoring and enforcement efforts. More information on the FCEC can be found at http://www.pvsfish.org/.

- **Remediate contaminated sediments** USEPA signed an interim Record of Decision in September 2009 that selects a cleanup remedy for Palos Verdes Shelf. The selected remedy has three components: placing a cover of clean silty sand over the portion of the contaminated sediment deposit that has the highest contaminant surface concentrations and appears to be erosive; monitoring the natural recovery that is occurring in other areas of the Shelf; and continuing the Institutional Controls program that uses outreach and education, enforcement and monitoring to minimize consumption of fish that contain DDTs and PCBs. More information can be found at http://www.epa.gov/region09/superfund/pvshelf/.

- **Develop TMDLs** Specifically, develop TMDLs for the coastal waters impairments based on the fish consumption advisory for DDT and PCBs. These TMDLs are under development by USEPA.

Consumption of Inland Fish

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) released a technical report in 2009 which presented results from the first year of a two-year screening survey of the potential for human exposure and health risks from consuming contaminated sport fish from California lakes and reservoirs. This effort begins a new long-term, statewide, comprehensive bioaccumulation monitoring program for California surface waters. The results presented in this report provide a preliminary assessment of the statewide scope of the bioaccumulation problem in California lakes and reservoirs. The report also provides lake-specific information that can be used to establish priorities for cleanup actions, and identifies lakes where additional sampling may be needed to support fish consumption advisories (Davis, et al., 2009). A number of lakes in this WMA were sampled. Results from two of the pollutants of most concern, PCBs and mercury (the latter shown with the locations of historic gold mines, a potential source for mercury), are shown in the figures below.

Figure 10

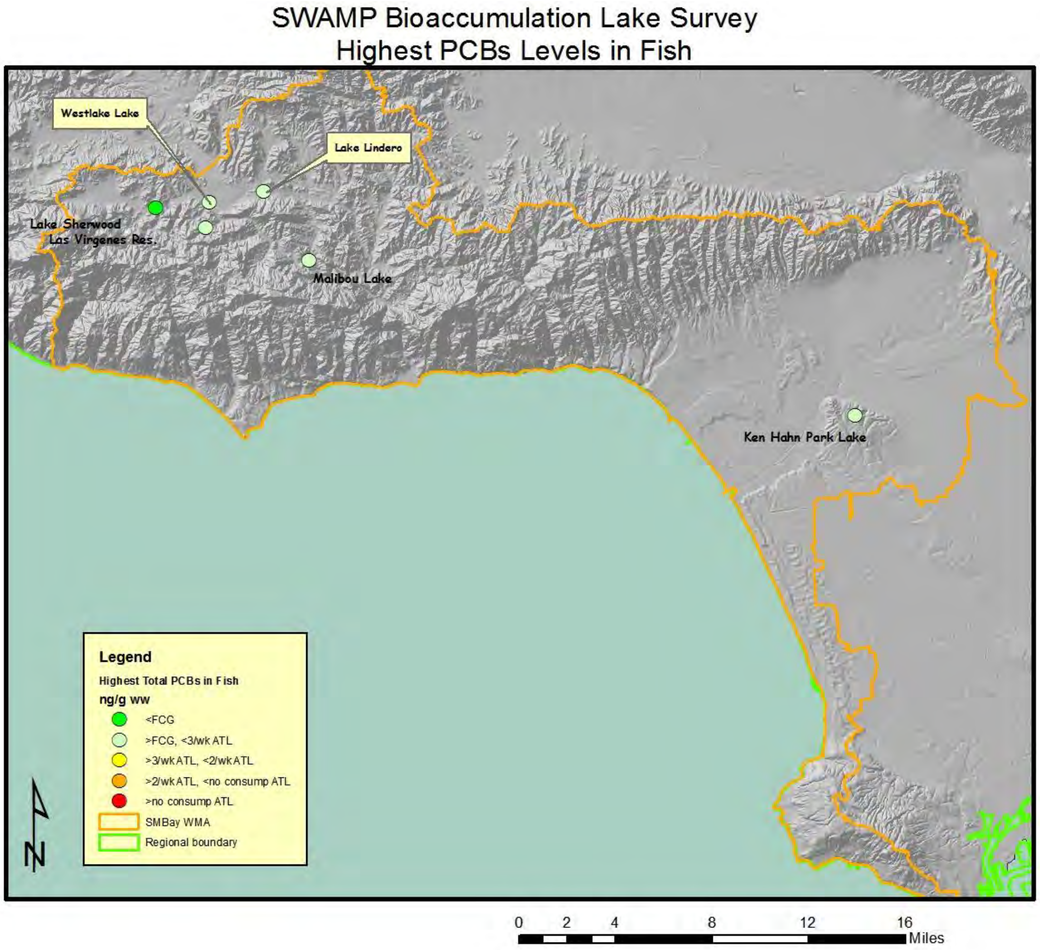
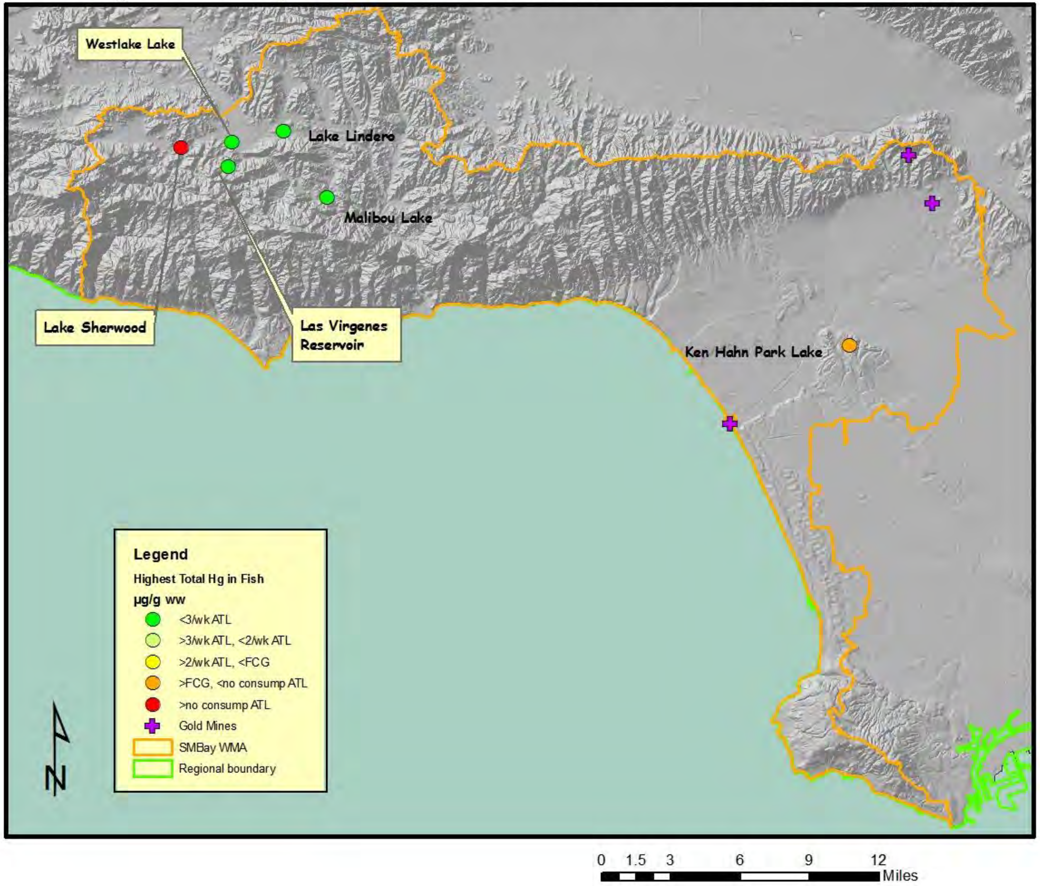


Figure 11

SWAMP Bioaccumulation Lake Survey
Highest Mercury Levels in Fish Plus Locations of Historic Gold Mines



Fish provide unique nutritional benefits while also serving as a significant exposure pathway for several chemicals of concern. Fish Contaminant Goals (FCGs) are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, over a lifetime and can provide a starting point for the California Office of Environmental Health Hazard Assessment (OEHHA) to assist other agencies that wish to develop fish tissue-based criteria with a goal toward pollution mitigation or elimination. FCGs prevent consumers from being exposed to more than the daily reference dose for non-carcinogens or to a risk level greater than 1x10-6 for carcinogens (not more than one additional cancer case in a population of 1,000,000 people consuming fish at the given consumption rate over a lifetime). FCGs are based solely on public health considerations without regard to economic considerations, technical feasibility, or the counterbalancing benefits of fish consumption (Klasing and Brodberg, 2008).

Advisory Tissue Levels (ATLs), while still conferring no significant health risk to individuals consuming sport fish in the quantities shown over a lifetime, were developed by OEHHA with the recognition that there are unique health benefits associated with fish consumption and that the advisory process should be expanded beyond conveying simple risk in order to best promote the overall health of the fish consumer. ATLs provide a number of recommended fish servings that correspond to the range of contaminant concentrations found in fish and are used to provide consumption advice to prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than 1x10-4 for carcinogens (not more than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime). ATLs are designed to encourage consumption of fish that can be eaten in quantities likely to provide significant health benefits, while discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be eaten in amounts recommended for improving overall health (eight ounces total, prior to cooking, per week). ATLs are one of the criteria that will be used by OEHHA for issuing fish consumption guidelines (Klasing and Brodberg, 2008).

The figures above indicate there is relatively little risk from PCBs in fish caught from the WMA's lakes but some caution needs to be exercised with regards to mercury in fish at Lake Sherwood and at Ken Hahn Park Lake. The figures show the worst-case results from several species collected and analyzed; large-mouth bass by far accumulated the most mercury while other species showed much lower concentrations.

The Southern California Coastal Water Research Project produced a report in 2008 which presented the results of a study into the extent of fishing and fish consumption by fishers in Ventura and Los Angeles County Watersheds in 2005 (Allen et al., 2008). Surveyed sites included both lakes and streams. There were relatively few fishers at Lake Sherwood, a private lake; it was unknown how many consumed fish that were caught. Many more fishers were seen at Ken Hahn Park Lake but only about a quarter of those were interviewed about consumption; most of those interviewed consumed the fish they caught.

General Improvement Strategy

- **Develop TMDLs** Specifically, develop TMDLs for those lakes listed as impaired for fish consumption, namely, Lake Sherwood. Development of these TMDLs by USEPA is underway.

HABITAT DEGRADATION AND WILDLIFE IMPACTS

Human activities such as farming, urbanization, and commercial and industrial development, have significantly changed or degraded the watershed's habitats since the era of Spanish missions and ranchos. The natural habitats have either disappeared or been reduced to a great degree to make space for man-made structures, and/or the flora and fauna have been degraded or altered by pollution, the encroachment of non-native species, or overharvesting. Water temperature changes brought on by El Nino events as well as by releases of pollutants following earthquakes and fires have also contributed to changes in the watershed's ecological community (CRWQCB, 1997).

Marine Habitats

One of the impacts most evident in marine habitats is sediment contamination, which also biologically affects the food web. Contaminant release may occur through natural sediment dynamics, or through disturbance of the sediment, e.g., following vigorous winter storms. Organic compounds such as DDT, PCBs, polynuclear aromatic hydrocarbons (PAHs), and tributyltin (TBT) are found in sediments in concentrations that are harmful to marine organisms at various locations in the Bay. Also found in Bay sediments are heavy metals such as cadmium, copper, chromium, nickel, silver, zinc, and lead. The major historic sources of sediment contamination have been wastewater treatment facilities, thus the accumulations are highest near treatment plant outfalls off of Palos Verdes and Playa del Rey (CRWQCB, 1997).

Bioaccumulation of DDT in white croaker, Dover sole, and California brown pelicans are well-known examples of the impacts caused by sediment contamination. Prior to the 1980s, high concentrations of DDT were found in muscle tissues and/or eggshells of these organisms. DDT in these organisms are implicated in fin erosion and other diseases in fish as well as eggshell thinning and subsequent species decline in the California brown pelican (CRWQCB, 1997).

In addition to tissue damage to individuals caused by contaminated sediment, the health of benthic communities has been affected by discharge of solids and contaminants by wastewater treatment plants. The assemblages of benthic fauna found in areas impacted by historical discharges (pre-1987) near the outfalls have relatively lower diversity compared with other areas in the Bay, and are dominated by several opportunistic species (CRWQCB, 1997).

While areas with high levels of contamination from DDT, PCBs, and lead still remain, the top layer of sediment over most of the Bay is now much cleaner than it was in the 1970s. Banning the use of the most toxic chemicals (DDT and PCBs in the 1970s), initiation of wastewater pretreatment programs (in the 1970s), and improved treatment technology have all contributed to this improvement. Since the early 1980s, contaminant concentrations both in sediment and in the tissues of organisms continue to decrease, though at a much slower rate (CRWQCB, 1997).

The Marine Life Protection Act (MLPA) Initiative is a public-private partnership designed to help the State of California implement the MLPA using the best readily available science. The MLPA requires the state to redesign existing state marine protected areas (MPAs), and to establish a cohesive network of MPAs to protect, among other things, marine life, habitats, and ecosystems such as those described above. More information may be found at http://www.dfg.ca.gov/mlpa (CDFG website).

According to the 2010 State of the Bay report, most of the soft bottom habitat can now be considered in fair to excellent condition because it supports healthy benthic infaunal communities similar to those present within reference areas (except for in the sediments around the JWPCP outfall on the Palos Verdes Shelf). The condition of nearshore rocky reef habitat varies greatly from location to location and ranges from critical to fair condition with some sign of improvement. The recovery of kelp canopy has been considerable but its current extent is still less than 25% of the highs recorded one hundred years ago. Rocky reefs considered in critical condition are those off the southeast end of Malibu and near the Portuguese Bend landslide on Palos Verdes, both of which have been affected by excessive sedimentation. The open ocean, or pelagic, habitat is the most extensive habitat in the Bay; its condition is considered fair to good based on limited data from studies of algal blooms, phytoplankton and zooplankton, fish and mammal assemblage and population, contaminant burdens, and commercial and sportfish catch efforts. Offshore areas appear in better shape than nearshore areas due to distance from human activities (SMBRC, 2010).

General Improvement Strategies

- **Implement the Marine Life Protection Act** The State is in the process of accomplishing this.
- **Remediate contaminated sediments** USEPA signed an interim Record of Decision in September 2009 that selects a cleanup remedy for Palos Verdes Shelf. The selected remedy has three components: placing a cover of clean silty sand over the portion of the contaminated sediment deposit that has the highest contaminant surface concentrations and appears to be erosive; monitoring the natural recovery that is occurring in other areas of the Shelf; and continuing the Institutional Controls program that uses outreach and education, enforcement and monitoring to minimize consumption of fish that contain DDTs and PCBs. More information can be found at http://www.epa.gov/region09/superfund/pvshelf/.
- **Develop TMDLs** Specifically, develop TMDLs for the Santa Monica Bay nearshore and offshore impairments of sediment toxicity and DDTs/PCBs in sediment and fish tissue. Development of these TMDLs by USEPA is underway.

Beach and Intertidal Habitats

Prior to development, the coast between Santa Monica and the Palos Verdes Peninsula consisted primarily of sand dunes and sandy beaches which shifted due to the action of air and water currents. The process of urban development over the years has greatly reduced the size of these dunes and beaches at many locations due to jetties and other man-made structures which increase beach erosion and interfere with sediment transport (CRWQCB, 1997).

Certain species are of particular concern specifically because of the loss or degradation of southern California beach habitat. These include the endangered California least tern, El Segundo blue butterfly and Western snowy plover. Oil spills are also a potential threat to beaches and intertidal habitats, especially to such species as the California grunion, which lays its eggs on sandy beaches. With intense and increasing human use of the beaches and waters of Santa Monica Bay, both trash and the need for beach clean-up have increased. In addition, beaches and rocky intertidal habitats are vulnerable to the contaminants often contained in urban runoff. Filter-feeding intertidal organisms have a particularly high potential for bioaccumulating toxic organic compounds or trace metals. This is demonstrated by the fact that elevated levels of trace metals such as lead and chromium have been found in the tissues of California mussels near Marina del Rey (CRWQCB, 1997).

The 2010 State of the Bay report states that most of the rocky intertidal habitats are considered to be in poor condition with only a few areas, such as Inspiration Point on the Palos Verdes Peninsula, being in fair condition. The poor condition determination is based on a dramatic decline in the population of rocky intertidal organisms and evidence of decreased biodiversity, percentage of plant cover, organism size, and density of species such as octopi and sea hares. The conditions of sandy beach habitats range from poor to fair depending on location and level of manipulation, such as beach grooming, beachfront development, beach infrastructure, and storm drain inputs. Santa Monica Bay beaches are managed primarily for recreation and human safety rather than for value as habitat. The coastal dunes and bluffs along the Bay and on the Palos Verdes Peninsula are considered to be in poor condition due to severe degradation from invasive plants, coastal development, and erosion. The largest remaining contiguous habitat, located near Los Angeles

International Airport, is considered in good condition, largely due to greatly restricted access to the public; a population of the El Segundo blue butterfly persists there (SMBRC, 2010).

General Improvement Strategies

Implement TMDLs Adopted toxics TMDLs include Ballona Creek Metals (2005), Ballona Creek Estuary Toxic Pollutants (2005), and Marina del Rey Harbor Toxics (2006). Implementation plans, where available, and other information for these are available on the Regional Board website as follows:

Ballona Creek Metals

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_28_2005-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_60_2007-015_td.shtml

Ballona Creek Estuary Toxic Pollutants

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_29_2005-008_td.shtml

Marina del Rey Harbor Toxics

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_32_2005-012_td.shtml

Malibu Creek Trash

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_63_2008-007_td.shtml

Ballona Creek Trash

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_7_2001-014_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_25_2004-023_td.shtml

Santa Monica Bay Marine Debris

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Implement species recovery plans Particularly related to dunes and beaches habitats are recovery plans for the El Segundo blue butterfly and the California least tern. Five-year reviews of the recovery plans can be found at http://www.fws.gov/cno/es/California%20least%20tern%205-year%20review.FINAL.pdf

(California least tern) and http://ecos.fws.gov/docs/five_year_review/doc1896.pdf (El Segundo blue butterfly).

Implement beach bluff restoration master plan As described in the 2010 State of Bay report, 38 acres of potential sites in the South Bay area have been identified (SMBRC, 2010).

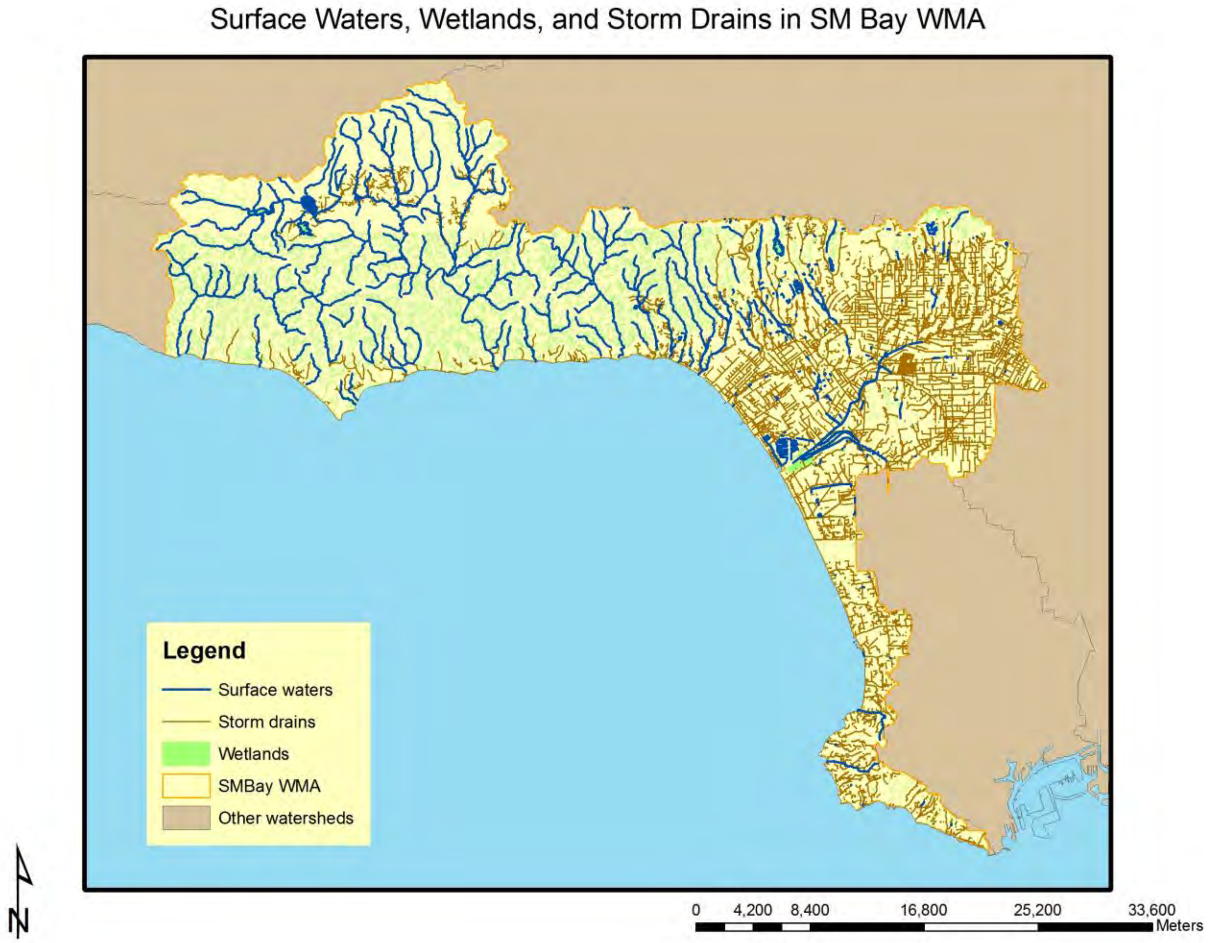
Coastal Wetlands and Riparian Habitats

Wetlands in southern California include freshwater, saltwater and brackish water marshes, swamps and mud flats. Wetlands help mitigate flooding, filter and recharge groundwater, and provide feeding and breeding habitat for fish and waterfowl. Urbanization has had a significant impact on the riparian and wetland resources of the watershed, primarily through filling, alteration of flows, and decrease in water quality. It is estimated that 90% of the historic wetlands of the Santa Monica Bay watershed have been eliminated, with the remaining wetlands significantly degraded (CRWQCB, 1997).

A number of brackish wetlands occur along the edge of Santa Monica Bay; the largest are the Ballona Wetlands Complex (Ballona Wetlands, Ballona Lagoon, Del Rey Lagoon, Oxford Flood Control Basin, and Venice Canals) and Malibu Lagoon. At one time, the Ballona Complex was 2,100 acres of coastal estuary and wetlands. But due to the development of Marina del Rey, the Venice canals, and other residential and commercial properties, as well as the drainage of wetlands for agricultural use and to control insects, and finally, channelization of Ballona Creek, the Ballona Complex had been reduced to approximately 430 acres until a recent acquisition by the State increased it to 600 acres. The site is a mixture of habitats dominated by coastal salt marsh. The 16-acre Ballona Lagoon is an artificially confined tidal channel that connects the Venice Canals to the Pacific Ocean. The 40-acre Malibu Lagoon, at the mouth of Malibu Creek, is also a remnant of a large system (CRWQCB, 1997).

The map below, utilizing a mix of draft and final wetlands data from the National Wetlands Inventory and a recent effort by the State to map coastal wetlands (not mapped for regulatory purposes), shows the much more extensive networks of wetlands remaining within the northern Santa Monica Bay area as compared to the more urbanized southern Santa Monica Bay watersheds. It also shows the dense network of storm drains which have replaced many of the wetlands in the southern Santa Monica Bay area.

Figure 12



The shrinking local wetlands support less biological diversity and are less productive because of their degraded condition. Restricted water flow, which results in poor water quality (high levels of nutrients and/or contaminants), and the actual loss of wetlands are major concerns at most sites. Additional adverse impacts include the lack of shallow water habitat, disruption of upstream flow, introduction of non-native plants and animals, debris and bacteria from urban runoff, and recreational over-use (CRWQCB, 1997).

The 2010 State of the Bay report describes the status of various habitat types and states the condition of the Bay's remaining coastal wetlands and lagoons is poor due to poor tidal exchange, polluted runoff, and the presence of invasive plants and animals; the one exception is considered to be Zuma Lagoon which is in good condition after completion of a restoration project. The report also states that the condition of most of the streams in coastal plain of the WMA is considered to be critical to poor due to the complete or nearly complete loss of their ecological functions, for instance, the almost complete channelization of the Ballona Creek and its tributaries. In the Santa Monica Mountains, streams such as Arroyo Sequit, Cold Creek, and Solstice Creek remain in relatively natural states and their condition is considered to be good to excellent. However, in the rest of the WMA, many streams can only be considered in fair to poor condition due to water quality problems, impacts from non-native species, and disruptions to natural stream flows (SMBRC, 2010).

General Improvement Strategies

Implement TMDLs Adopted toxics TMDLs which may affect wetlands include Ballona Creek Metals (2005), Ballona Creek Estuary Toxic Pollutants (2005), and Marina del Rey Harbor Toxics (2006). Implementation plans, where available, and other information for these are available on the Regional Board website as follows:

Ballona Creek Metals

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_28_2005-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_60_2007-015_td.shtml

Ballona Creek Estuary Toxic Pollutants

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_29_2005-008_td.shtml

Marina del Rey Harbor Toxics

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_32_2005-012_td.shtml

Implement the Bay Restoration Plan recommendations and the Wetlands Recovery Project's Regional Strategy The strategy for improving the WMA's wetlands focuses on restoration of priority wetlands and employs a local approach to improving protection. The restoration of the Ballona Wetlands is one of the highest priorities of both the Bay Restoration Commission and the Wetlands Recovery Project. Strategies on restoration, protection, and management of wetlands listed in the Bay Restoration Plan and Wetlands Recovery Project Regional Strategy include:

- Preserve and restore coastal wetland ecosystems
- Preserve and restore stream corridors and wetland ecosystems in coastal watersheds
- Recover native habitat and species diversity
- Integrate wetlands recovery with other public objectives
- Promote education and compatible access related to coastal wetlands and watersheds
- Advance the science of wetlands restoration and management in Southern California
- Protect existing wetlands through improved local regulations and policies.
- Enhance inter-agency coordination.
- Acquire private-owned wetlands.

- Ensure long-term management and monitoring for wetlands.
- Develop and implement a long-term education program focusing on wetlands (CRWQCB, 1997; SMBRC, 2010; SCWRP website #1).

Review applications for 401 water quality certifications The strategy for improving the WMA's wetlands focuses on protection of beneficial uses and implementation of appropriate monitoring. Specific activities include:

- Review of 401 water quality certification applications
- Evaluation of cumulative impacts from dredge and fill activities
- Oversight of compensatory mitigation
- Oversight of 401-certified activities

Upland Habitats

While most of the upland habitat in the coastal plain area of the WMA is now in an urbanized state, a much greater portion of the remaining upland habitat in the Santa Monica Mountains area is in public or non-profit ownership. Acquisition of parcels for their habitat or passive recreational value continues; for instance, the Santa Monica Mountains Conservancy works together with many government and nonprofit agencies to achieve the mutual goal of an interlinking network of parks, trails, and open space for public use and wildlife habitat surrounding the metropolitan areas of Los Angeles and Ventura Counties. The Conservancy works together with the National Park Service and the California Department of Recreation and Parks to cooperatively acquire and manage the parks in the Santa Monica Mountains National Recreation Area (SMMC website).

General Improvement Strategy

Implement the Wetlands Recovery Project's Regional Strategy The strategy for improving the WMA's wetlands includes recognition of the need for buffer areas between coastal wetlands and developed lands.

ASSESSING WATER QUALITY

The watershed's identified problems can be categorized in general as those caused by excessive pollutant loads and those caused by loss of sensitive habitats. Monitoring and special studies conducted over the years by the SMBRC, the Regional Board, dischargers, researchers, and citizen groups have mostly been geared toward evaluating problems associated with pollutants and contaminants although in recent years an increased emphasis on monitoring habitat quality has begun. This section concentrates on that aspect of the watershed's problems (CRWQCB, 1997).

Pollutant loading is the generation and dispersal of pollutants into the environment; a byproduct of the millions of people who reside or undertake activities in the Santa Monica Bay watershed. Pollutant loads have contributed to the impairment of beneficial uses of the Bay watershed. The SMBRP (now SMBRC) spent eight years participating in a multi-agency/stakeholder process which led to identifying the watershed's priority problems and the nineteen constituents that are identified as "pollutants of concern," as well as how these pollutants affect beneficial uses; these were presented in the ***1995 Bay Restoration Plan***. The nineteen pollutants of concern were identified because they presented the greatest problems to the Bay. Specifically, these pollutants met one of the following three criteria:

- Current loadings or historic deposits of the pollutant are impacting the beneficial uses in the watershed.
- Elevated levels of the pollutant are found in sediments of waterbodies in the watershed, or the pollutants have the potential to bioaccumulate.
- The detectable inputs of the pollutant are at a level high enough to be considered potentially toxic to humans and aquatic/marine life (CRWQCB, 1997).

The nineteen pollutants of concern identified were: DDT, PCBs, PAHs, chlordane, tributyltin (TBT), cadmium, chromium, copper, lead, nickel, silver, zinc, bacteria/viruses, total suspended solids, nutrients, trash, chlorine, oxygen demand, and oil & grease. It is important to recognize that not all pollutants of concern are applicable throughout the Bay and its watersheds. In many cases, the sources and the receiving water areas impacted by pollutant loading are restricted to a specific area of the region, as discussed in subsequent sections (CRWQCB, 1997).

Of these pollutants of concern, the organic pollutants DDT, PCBs, PAHs, and chlordane have the highest potential to bioaccumulate in living tissue and accumulate in sediments. The attributes of these chemicals are such that they are hydrophobic (do not mix well in water) and will adsorb onto particles that settle to the bottom or are incorporated into the fatty tissues of organisms living in the water or sediment. People will generally only be at risk should they consistently consume organisms such as fish which may have already bioaccumulated large amounts of these pollutants. DDT, chlordane, and PCBs are manmade chemicals; the first two are banned pesticides while PCBs are a class of chemicals formerly used in hydraulic fluids, paints, and transformers. PAHs are naturally occurring substances found in petroleum hydrocarbons and released through anthropogenic activities such as oil dripping from cars or spills during transport. Storm drains ultimately carry the material to sensitive coastal estuaries or to the ocean. Excessive concentrations of these chemicals in living tissue can lead to problems such as impaired reproduction and pre-cancerous lesions in marine organisms, and may raise the cancer risk in humans who consume these organisms (CRWQCB, 1997).

The metals cadmium, chromium, copper, lead, nickel, silver, and zinc can bioaccumulate in living tissue and accumulate in the sediment, but not to the degree of organic pollutant accumulation. On the other hand, metals can dissolve in the water column to some extent and occur at high enough concentrations to be toxic to aquatic organisms. Thus organisms may be impacted through both bioaccumulation and direct exposure in the sediment and water column. For example, copper is a component of anti-fouling paints applied to boats because it is very toxic to the fouling organisms which would normally attach to any available surface exposed under water. These metals are generally not a human health problem since metals concentrations in fish tissue are generally not high enough to impact humans and the amount of water a person may swallow while swimming is not enough to pose a risk (CRWQCB, 1997).

TBT is an organo-metal previously used extensively in anti-fouling paints. It is highly toxic to aquatic organisms and can be acutely toxic to humans applying the paint without proper safety equipment. It dissolves fairly easily in water but also degrades quickly. It can bioaccumulate in organisms to high concentrations and has been implicated in growth abnormalities in shellfish. Its high toxicity led to a ban in 1987 on its use except on boats of over 82 feet in length or on those with aluminum hulls. The rationale for the length restriction was that most boats moored in the water on a semi-continuous basis were smaller ones and the toxic components of paint leach out during that time (CRWQCB, 1997).

The impacts associated with bacteria and viruses primarily center on human health concerns (CRWQCB, 1997).

Suspended solids can convey organic pollutants to other locations. These solids also create turbidity in the water column and may impact plants such as kelp since light penetration may be reduced. Suspended solids are contributed by urban runoff and discharges from POTWs (CRWQCB, 1997).

Nutrients such as ammonia, nitrates, and phosphates can pose a variety of problems. In the Santa Monica Bay WMA, a major concern is their contribution to excessive growth of algae in streams and enclosed coastal lagoons. Nutrients are both naturally-occurring and produced by anthropogenic activities. Degradation of plant material will contribute nutrients but runoff from over-fertilized lawns and effluent resulting from the treatment of human waste will also contribute. While some algae should be expected, excessive amounts of nutrients added to shallow waters warmed during a summer day can result in a large explosion in algal growth. This growth can be considered a nuisance but may also be harmful if, during algal die-off, oxygen levels drop dramatically and kill fish (CRWQCB, 1997).

Trash is not only an aesthetics problem but poses an aquatic life hazard through consumption or entanglement (CRWQCB, 1997).

Chlorine is a chemical used for disinfection purposes at POTWs and is also used to kill off algae and slime growths in pipes at generating stations and elsewhere. Chlorine can be acutely toxic to aquatic organisms at excessive concentrations (CRWQCB, 1997).

Oxygen demand refers to a situation rather than a specific pollutant. Consumption of oxygen occurs with degradation of organic material such as dead leaves and algae. When this occurs in a water body with little circulation, an excessive demand is put on the available oxygen and fish kills can result. Although not likely to be a problem throughout the Bay, localized problems can occur near large discharge sites and in smaller enclosed receiving waters (CRWQCB, 1997).

Oil & grease is the physical manifestation of PAHs contamination. Usually mufti-colored sheens of oil will appear on the water surface. In most cases, the ultimate fate of the PAHs is of more concern than the sheen, however, if thick enough, oil may coat aquatic life and cause direct injury (CRWQCB, 1997).

The ***2004 State of the Bay Report*** re-evaluated environmental indicators. A diverse panel of environmental professionals chose 27 environmental indicators used in the report. The Bay's health was evaluated in three areas: pollutant loads, health risks to Bay users, and health of the Bay's living resources and habitats. The environmental indicators chosen for each area include:

Pollutant loads

- Mass loads of TSS and trace metals from wastewater treatment facilities
- Mass loads of TSS and trace metals from storm water runoff
- Watershed imperviousness
- Atmospheric input of trace metals
- Mass loading of trash from storm water runoff; trash inputs to the Bay were estimated at 1.4 million tons per year in 2004 (SMBRC, 2004)

Health risks

- Exceedances of bacterial indicator health risk thresholds at Santa Monica Bay beaches during dry and wet seasons
- Annual Average Beach Report Card grades
- Beach closures from sewage spills along the Bay coast
- Muscle tissue concentration of DDT and PCBs in white croaker, kelp bass and other sportfish

Habitats and living resources

- Acreage of protected and specially designated areas in the Bay and the Bay's watersheds
- Concentration of DDTs and trace metals in Bay bottom sediments
- Muscle tissue concentration of DDTs in Dover sole and hornyhead turbot
- Muscle tissue concentration of heavy metals in hornyhead turbot
- Benthic Response Index
- Fish Response Index
- Incidence of fish diseases
- Recreational catch per unit effort for indicator fish species
- Commercial catch per unit effort for indicator fish species
- Size of kelp canopy on Palos Verdes Shelf and along the Malibu Coast
- Available kelp-growing substrates
- Condition (size and density) of target rocky intertidal species
- Condition of grunion runs
- Percentage and acres of open space in the Bay watershed
- Acres of habitats acquired, and/or restored
- Linear miles of riparian habitats restored through non-native removal, fish passage restoration, etc.
- Breeding success of least tern at Venice Beach
- Condition of El Segundo blue butterflies (population and habitat) (SMBRC, 2004)

The SMBRC identified the following priority areas on which to focus resources:

- Achieve zero beach closure due to sewage spills.
- Achieve dry-weather bacteria TMDL limit along Bay beaches.
- Significantly reduce health risks associated with consuming Bay seafood.
- Reduce trash loading to the Bay by 50% by 2006.
- Restore Ballona Wetlands and Malibu Lagoon (SMBRC, 2004)

The ***2008 Update of the Bay Restoration Plan*** noted that significant progress had been made in improving water quality in the WMA. Major milestones accomplished included the upgrade to full secondary treatment by the City of Los Angeles' Hyperion treatment plant, and the County Sanitation Districts of Los Angeles County's Joint Water Pollution Control Plant (JWPCP), the two largest wastewater treatment facilities in the region; the development and implementation of Total Maximum Daily Loads (TMDLs) for waterbodies impaired by poor water quality; and adoption and implementation of the standard urban storm water mitigation plan under the municipal storm water permit (SMBRC, 2009).

The update report stated that despite this progress, significant amounts of pollutants such as trash, pathogens, and heavy metals continue to reach receiving waters. New challenges include addressing the loading and impacts of nutrients and emerging contaminants. Concerted efforts by regulatory and regulated communities are needed to overcome obstacles to further progress and address these new challenges (SMBRC, 2009).

The ***2010 State of the Bay Report*** observed that the pollutants of greatest concern, due to their adverse or potentially adverse impacts on the Bay's beneficial uses, are pathogens, trash, metals, DDT, PCBs, and nutrients. Known impacts of these pollutants include health hazards for humans due to pathogens in the surf zone, aesthetic impacts of trash along the Bay's beaches and streams, and chemical contamination of local fish. The report described the reduction of pollutant loads from wastewater treatment facilities with the greater relative contribution of pollutants through the storm drain system with, in particular, trash, pathogens, metals, and nutrients washing off the urban landscape, into storm drains, and out to the Bay. In addition, historical deposits of toxic pollutants in Bay sediments, such as DDT and PCBs, continue to be released into the environment through biological processes and resuspension, thus contaminating local marine life. Atmospheric deposition, boating activities, and septic systems are also known to contribute to contaminants to the Bay (SMBRC, 2010).

The development and adoption of TMDLs by the Regional Board which serve to assign load reductions needed to prevent impairment of beneficial uses, and their implementation largely through new control measures incorporated into existing National Discharge Elimination System (NPDES) permits was acknowledged. With regards to bacteria for example, the effort began with multiple low-flow diversions to the sanitary sewer at those drains with the most indicator bacteria exceedances. In some cases, year-round diversions have been necessary or installation of disinfection systems (SMBRC, 2010).

Today, impacts from invasive species is a growing concern in this WMA and, in fact, throughout the State. The invasive plant, giant reed, and the invasive animals, crayfish and New Zealand mudsnails, in particular are displacing native biota and degrading habitat (SMBRC, 2010).

California's 2010 Water Quality Assessment – Updating List of Impaired Waters

The State is required to assess the quality of its waters regularly and the results become part of a Water Quality Assessment document produced by the State Water Resources Control Board. Part of that assessment includes updating the State's list of impaired waters (Clean Water Act Section 303(d) list). It should be pointed out that all existing beneficial uses in each waterbody may not have been evaluated due to lack of data.

Surface Waters

The 2010 list of impaired waters indicates impairments of 30 square miles (out of 226 total square miles) of the Santa Monica Bay nearshore and offshore zones due to impacts on aquatic life, fish consumption, and shellfish harvesting. Various beaches are assessed as not supporting body contact recreation. Water quality in some streams within the Malibu subwatershed is impaired by excessive nutrients, bacteria, salts, and in some instances, metals. While natural sources contribute to the problem, nonpoint pollution from human activities is strongly implicated. The quality of the waterways draining more urbanized areas, such as Ballona Creek, is impaired due to a much longer list of pollutants including many metals and organic substances such as DDT and PCBs. Enclosed coastal waterbodies such as Malibu Lagoon are not fully supporting aquatic life, contact recreation, fish consumption, or shellfish harvesting beneficial uses, while many of the watershed's lakes are not supporting contact recreation, aquatic life, or fish consumption beneficial uses. The full report should be consulted for more detailed information (SWRCB website #1).

Table 1. List of Impaired Waters (Clean Water Act Section 303(d)) Approved by USEPA for 2010

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Santa Monica Bay Beaches				
Abalone Cove Beach	DDT (sediment)	TMDL required	1/1/2019	
Abalone Cove Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Abalone Cove Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Amarillo Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Amarillo Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Big Rock Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Big Rock Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Big Rock Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Bluff Cove Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Bluff Cove Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Bluff Cove Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	**Pollutant**	**TMDL Status**	**Expected TMDL Completion Date**	**Completed TMDL**
Carbon Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Carbon Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Carbon Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Castlerock Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Castlerock Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Castlerock Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Dan Blocker Memorial (Coral) Beach (includes the area of the beach at Latigo Beach and Solstice Canyon)	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Dockweiler Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Escondido Beach	DDT (fish consumption advisory)	TMDL required	1/1/2021	
Escondido Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Escondido Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Flat Rock Point Beach Area	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Flat Rock Point Beach Area	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Flat Rock Point Beach Area	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Hermosa Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Inspiration Point Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Inspiration Point Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Inspiration Point Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
La Costa Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
La Costa Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
La Costa Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Las Flores Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Las Flores Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Las Flores Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Las Tunas Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Las Tunas Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Las Tunas Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Leo Carillo Beach (South of County Line)	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Long Point Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Long Point Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	**Pollutant**	**TMDL Status**	**Expected TMDL Completion Date**	**Completed TMDL**
Long Point Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Lunada Bay Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Malaga Cove Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Malaga Cove Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Malaga Cove Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Malibu Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Malibu Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Malibu Lagoon Beach (Surfrider)	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Malibu Lagoon Beach (Surfrider)	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Malibu Lagoon Beach (Surfrider)	PCBs (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Manhattan Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Nicholas Canyon Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Nicholas Canyon Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Nicholas Canyon Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Palo Verde Shoreline Park Beach	Pathogens	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Palo Verde Shoreline Park Beach	Pesticides	TMDL required	1/1/2019	
Paradise Cove Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Paradise Cove Beach	Fecal Coliform	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Paradise Cove Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Point Dume Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Point Dume Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Point Dume Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Point Fermin Park Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Point Fermin Park Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Point Fermin Park Beach	Total Coliform	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Point Vicente Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Portuguese Bend Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Portuguese Bend Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Portuguese Bend Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Puerco Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Puerco Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Puerco Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Redondo Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Redondo Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Redondo Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Resort Point Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Robert H. Meyer Memorial Beach	Beach Closures	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Robert H. Meyer Memorial Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Robert H. Meyer Memorial Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Royal Palms Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Royal Palms Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Royal Palms Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Santa Monica Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Sea Level Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Sea Level Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Sea Level Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Topanga Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Topanga Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Topanga Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Torrance Beach	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Trancas Beach (Broad Beach)	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Trancas Beach (Broad Beach)	Fecal Coliform	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Trancas Beach (Broad Beach)	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Venice Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Whites Point Beach	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Whites Point Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Whites Point Beach	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Will Rogers Beach	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Zuma Beach (Westward Beach)	DDT (fish consumption advisory)	TMDL required	1/1/2019	
Zuma Beach (Westward Beach)	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Zuma Beach (Westward Beach)	PCBs (fish consumption advisory)	TMDL required	1/1/2019	
Ballona Creek Subwatershed				
Ballona Creek	Cadmium (sediment) (a USEPA-approved TMDL has made a finding of non-impairment for this pollutant)	TMDL completed		Ballona Creek Metals TMDL, 2008
Ballona Creek	Coliform Bacteria	TMDL completed		Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
Ballona Creek	Copper, Dissolved	TMDL completed		Ballona Creek Metals TMDL, 2008
Ballona Creek	Cyanide	TMDL required	1/1/2019	
Ballona Creek	Lead	TMDL completed		Ballona Creek Metals TMDL, 2008
Ballona Creek	Selenium	TMDL completed		Ballona Creek Metals TMDL, 2008
Ballona Creek	Toxicity	TMDL completed		Ballona Creek Metals TMDL, 2008
Ballona Creek	Trash	TMDL completed		Ballona Creek and Wetlands Trash TMDL; 2002, 2005
Ballona Creek	Viruses (enteric)	TMDL completed		Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
Ballona Creek	Zinc	TMDL completed		Ballona Creek Metals TMDL, 2008

Water Quality Limited Segment	**Pollutant**	**TMDL Status**	**Expected TMDL Completion Date**	**Completed TMDL**
Ballona Creek Estuary	Cadmium	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	Chlordane (tissue & sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	Coliform Bacteria	TMDL completed		Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
Ballona Creek Estuary	Copper	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	DDT (tissue & sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	Lead (sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	PAHs (Polycyclic Aromatic Hydrocarbons) (sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	PCBs (tissue & sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	Sediment Toxicity	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Estuary	Shellfish Harvesting Advisory	TMDL required	1/1/2006	
Ballona Creek Estuary	Silver	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Ballona Creek Estuary	Zinc (sediment)	TMDL completed		Ballona Creek Estuary Toxic Pollutants TMDL, 2006
Ballona Creek Wetlands	Exotic Vegetation	TMDL required	1/1/2019	
Ballona Creek Wetlands	Habitat alterations	TMDL required	1/1/2019	
Ballona Creek Wetlands	Hydromodification	TMDL required	1/1/2019	
Ballona Creek Wetlands	Reduced Tidal Flushing	TMDL required	1/1/2019	
Ballona Creek Wetlands	Trash	TMDL completed		Ballona Creek and Wetlands Trash TMDL; 2002, 2005
Marina del Rey Harbor - Back Basins	Chlordane (tissue & sediment)	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	Copper (sediment)	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	DDT (tissue) (a USEPA-approved TMDL has made a finding of non-impairment for this pollutant)	TMDL required	1/1/2005	
Marina del Rey Harbor - Back Basins	Dieldrin (tissue) (a USEPA-approved TMDL has made a finding of non-impairment for this pollutant)	TMDL required	1/1/2005	
Marina del Rey Harbor - Back Basins	Fish Consumption Advisory	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	Indicator Bacteria	TMDL completed		Marina del Rey Harbor Mothers' Beach and Back Basins Bacteria TMDL, 2004

Water Quality Limited Segment	**Pollutant**	**TMDL Status**	**Expected TMDL Completion Date**	**Completed TMDL**
Marina del Rey Harbor - Back Basins	Lead (sediment)	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	PCBs (tissue & sediment) (shellfish harvesting advisory)	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	Sediment Toxicity	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor - Back Basins	Zinc (sediment)	TMDL completed		Marina del Rey Harbor Toxics TMDL, 2006
Marina del Rey Harbor Beach	Indicator Bacteria	TMDL completed		Marina del Rey Harbor Mothers' Beach and Back Basins Bacteria TMDL, 2004
Malibu Creek Subwatershed				
Lake Lindero	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Lindero	Chloride	TMDL required	1/1/2019	
Lake Lindero	Eutrophic	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Lindero	Odor	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Lindero	Selenium	TMDL required	1/1/2019	
Lake Lindero	Specific Conductivity	TMDL required	1/1/2019	
Lake Lindero	Trash	TMDL	1/1/2019	

		required		
Water Quality Limited Segment	**Pollutant**	**TMDL Status**	**Expected TMDL Completion Date**	**Completed TMDL**
Lake Sherwood	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Sherwood	Ammonia	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Sherwood	Eutrophic	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lake Sherwood	Mercury (tissue)	TMDL required	1/1/2019	
Lake Sherwood	Organic Enrichment/Low Dissolved Oxygen	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Las Virgenes Creek	Benthic-Macroinvertebrate Bioassessments	TMDL required	1/1/2021	
Las Virgenes Creek	Coliform Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Las Virgenes Creek	Invasive Species	TMDL required	1/1/2021	
Las Virgenes Creek	Nutrients (Algae)	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Las Virgenes Creek	Organic Enrichment/Low Dissolved Oxygen	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Las Virgenes Creek	Scum/Foam-unnatural	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Las Virgenes Creek	Sedimentation/Siltation	TMDL required	1/1/2019	
Las Virgenes Creek	Selenium	TMDL required	1/1/2019	
Las Virgenes Creek	Trash	TMDL required	1/1/2019	
Lindero Creek Reach 1	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lindero Creek Reach 1	Benthic-Macroinvertebrate Bioassessments	TMDL required	1/1/2021	
Lindero Creek Reach 1	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Lindero Creek Reach 1	Invasive Species	TMDL required	1/1/2021	
Lindero Creek Reach 1	Scum/Foam-unnatural	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lindero Creek Reach 1	Selenium	TMDL required	1/1/2019	
Lindero Creek Reach 1	Trash	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Lindero Creek Reach 2 (Above Lake)	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lindero Creek Reach 2 (Above Lake)	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Lindero Creek Reach 2 (Above Lake)	Scum/Foam-unnatural	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Lindero Creek Reach 2 (Above Lake)	Selenium	TMDL required	1/1/2019	
Lindero Creek Reach 2 (Above Lake)	Trash	TMDL required	1/1/2019	
Malibou Lake	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibou Lake	Eutrophic	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibou Lake	Organic Enrichment/Low Dissolved Oxygen	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibu Creek	Benthic-Macroinvertebrate Bioassessments	TMDL required	1/1/2021	
Malibu Creek	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Malibu Creek	Fish Barriers (Fish Passage)	TMDL required	1/1/2019	

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Malibu Creek	Invasive Species	TMDL required	1/1/2021	
Malibu Creek	Nutrients (Algae)	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibu Creek	Scum/Foam-unnatural	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibu Creek	Sedimentation/Siltation	TMDL required	1/1/2019	
Malibu Creek	Selenium	TMDL required	1/1/2019	
Malibu Creek	Sulfates	TMDL required	1/1/2019	
Malibu Creek	Trash	TMDL completed		Malibu Creek Watershed Trash TMDL, 2009
Malibu Lagoon	Benthic Community Effects	TMDL required	1/1/2011	
Malibu Lagoon	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Malibu Lagoon	Eutrophic	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Malibu Lagoon	pH	TMDL required	1/1/2006	
Malibu Lagoon	Swimming Restrictions	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Malibu Lagoon	Viruses (enteric)	TMDL completed		Malibu Creek Bacteria TMDL, 2006

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Sedimentation/Siltation	TMDL required	1/1/2019	
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Selenium	TMDL required	1/1/2019	
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Trash	TMDL required	1/1/2019	
Medea Creek Reach 2 (Abv Confl. with Lindero)	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Medea Creek Reach 2 (Abv Confl. with Lindero)	Benthic-Macroinvertebrate Bioassessments	TMDL required	1/1/2021	
Medea Creek Reach 2 (Abv Confl. with Lindero)	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Medea Creek Reach 2 (Abv Confl. with Lindero)	Invasive Species	TMDL required	1/1/2021	
Medea Creek Reach 2 (Abv Confl. with Lindero)	Sedimentation/Siltation	TMDL required	1/1/2019	
Medea Creek Reach 2 (Abv Confl. with Lindero)	Selenium	TMDL required	1/1/2019	
Medea Creek Reach 2 (Abv Confl. with Lindero)	Trash	TMDL required	1/1/2019	
Palo Comado Creek	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006
Stokes Creek	Coliform Bacteria	TMDL completed		Malibu Creek Bacteria TMDL, 2006

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Triunfo Canyon Creek Reach 1	Lead	TMDL required	1/1/2019	
Triunfo Canyon Creek Reach 1	Mercury	TMDL required	1/1/2019	
Triunfo Canyon Creek Reach 1	Sedimentation/Siltation	TMDL required	1/1/2019	
Triunfo Canyon Creek Reach 2	Benthic-Macroinvertebrate Bioassessments	TMDL required	1/1/2021	
Triunfo Canyon Creek Reach 2	Lead	TMDL required	1/1/2019	
Triunfo Canyon Creek Reach 2	Mercury	TMDL required	1/1/2019	
Triunfo Canyon Creek Reach 2	Sedimentation/Siltation	TMDL required	1/1/2019	
Westlake Lake	Algae	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Westlake Lake	Ammonia	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Westlake Lake	Eutrophic	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)
Westlake Lake	Lead	TMDL required	1/1/2019	
Westlake Lake	Organic Enrichment/Low Dissolved Oxygen	TMDL completed		Malibu Creek Watershed Nutrients TMDL, 2003 (established by USEPA)

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Other Areas				
Santa Monica Canyon	Indicator Bacteria	TMDL completed		Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
Santa Monica Canyon	Lead	TMDL required	1/1/2019	
Santa Monica Bay Offshore/Nearshore	DDT (tissue & sediment)	TMDL required	1/1/2019	
Santa Monica Bay Offshore/Nearshore	Debris	TMDL completed		Santa Monica Bay Nearshore and Offshore Debris TMDL, 2010
Santa Monica Bay Offshore/Nearshore	Fish Consumption Advisory (due to DDT and PCBs)	TMDL required	1/1/2019	
Santa Monica Bay Offshore/Nearshore	PCBs (tissue & sediment)	TMDL required	1/1/2019	
Santa Monica Bay Offshore/Nearshore	Sediment Toxicity	TMDL required	1/1/2019	
Sepulveda Canyon	Ammonia	TMDL required	1/1/2019	
Sepulveda Canyon	Copper	TMDL completed		Ballona Creek Metals TMDL, 2008
Sepulveda Canyon	Indicator Bacteria	TMDL completed		Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
Sepulveda Canyon	Lead	TMDL completed		Ballona Creek Metals TMDL, 2008
Sepulveda Canyon	Selenium	TMDL completed		Ballona Creek Metals TMDL, 2008
Sepulveda Canyon	Zinc	TMDL completed		Ballona Creek Metals TMDL, 2008

Water Quality Limited Segment	Pollutant	TMDL Status	Expected TMDL Completion Date	Completed TMDL
Solstice Canyon Creek	Invasive Species	TMDL required	1/1/2021	
Topanga Canyon Creek	Lead	TMDL required	1/1/2019	

Groundwaters

Groundwater accounts for only a limited portion of the Santa Monica Bay WMA's supply of fresh water; however, the general quality of groundwater in the watershed has degraded from background levels. Much of degradation reflects land uses (CRWQCB, 1997).

In this watershed area, fertilizers and pesticides, typically used on agricultural lands, contribute to degrade groundwater. In areas that are unsewered, such as Malibu, nitrogen and pathogenic bacteria from overloaded or improperly sited septic tanks can seep into ground water and result in health risks to those who rely on groundwater for domestic water supplies. In areas with aboveground and underground storage tanks, toxics have leaked or are leaking, which can result in volatile organic compounds or petroleum compounds pollution in groundwater. An example of this is the methyl tertiary butyl ether (MTBE) contamination in the city of Santa Monica which has affected a number of wells in the Santa Monica Basin. Compared to surface water pollution, investigation and remediation of polluted groundwater are often more difficult, costly, and time-consuming (CRWQCB, 1997).

Seawater intrusion created by overpumping also has been a problem in the West Coast groundwater basin. However, it is under control in most areas through an artificial recharge system consisting of spreading grounds and injection wells that form a fresh water barrier along the coast. Other replenishment programs are underway using storm runoff, imported water, and recycled water to accomplish reversal of intrusion (CRWQCB, 1997).

The USGS sampled the Los Angeles Region’s coastal priority groundwater basins as part of State Board’s Groundwater Ambient Monitoring and Assessment (GAMA) program in 2006. Groundwater basins within the Santa Monica Bay WMA included in this sampling were the Santa Monica, Hollywood, West Coast, and Central Basins. The study was designed to provide a spatially unbiased assessment of raw groundwater quality within the targeted basins, as well as a statistically consistent basis for comparing water quality throughout California (USGS, 2009).

The study did not attempt to evaluate the quality of drinking water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, and/or blended with other waters to maintain acceptable drinking water quality. VOCs were detected in almost three-quarters of the grid wells, and pesticides and pesticide degradates were detected in 42 percent of the grid (randomized) wells. Potential wastewater indicators were detected in 44 percent of the grid wells. All of the detections of these organic compounds in samples from grid wells were below health-based thresholds, with the exception of tetrachloromethane (carbon tetrachloride), a VOC, which was detected above the maximum contaminant level set by the California Department of Public Health (CDPH) (MCL-CA). In targeted wells, there were two detections of trichloroethene (TCE) and one detection of perchloroethene (PCE) above the maximum contaminant level set by USEPA (MCL-US) (USGS, 2009).

Nutrient and trace element concentrations in the grid wells were below health-based thresholds. There were two detections of boron above the California notification level set by the CDPH (NL-CA) in the targeted wells. Activities of radioactive constituents in water samples collected in grid wells were below health-based thresholds, with the exception of two detections of radon-222 that were above the proposed MCL-US; however, none of the samples had an activity above the proposed alternative MCL-US. Total coliforms were detected at one of the targeted wells. Most of the samples from grid wells had concentrations of major elements and total dissolved solids below the non-enforceable thresholds set for aesthetic concerns. Four grid wells had total dissolved solids concentrations above the secondary maximum contaminant level set by the CDPH (SMCL-CA). There were two detections of manganese, and four detections of iron in grid wells above their respective SMCL-CAs, and a single detection of arsenic above the MCL-US. Two targeted wells had concentrations of chloride and sulfate above the recommended SMCL-CA (USGS, 2009).

The WMA's Designated Beneficial Uses

The Regional Board designates beneficial uses of all waterbodies in the Water Quality Control Plan for the Ventura and Los Angeles Coastal Watersheds (usually referred to as Basin Plan). These beneficial uses are the cornerstone of the State and Regional Board's efforts to protect water quality, as water quality objectives are set at levels that will protect the most sensitive beneficial use of a waterbody. Together, beneficial uses and water quality objectives form water quality standards (CRWQCB, 1994).

Twenty beneficial uses for surface waters and four beneficial uses for ground waters in the Santa Monica Bay WMA are designated in the Regional Board's Basin Plan. These beneficial uses are listed by waterbody and hydrologic unit in the table below for surface waters and by basin name and number for ground waters in a separate table. Certain site-specific water quality objectives, namely TDS, sulfate, chloride, boron, and--for surface waters--nitrogen, reflect background levels of constituents in the mid-1970s, in accordance with the State Board's Antidegradation Policy. Water quality objectives for these and for other constituents and parameters can be found in the Basin Plan (CRWQCB, 1994). It should be pointed out that more detailed analyses of beneficial uses occur as needed; these issues are often identified during the Basin Plan Triennial Review process.

Table 2. Beneficial uses of surface waters within the Santa Monica Bay WMA (combined from multiple tables in the Basin Plan) (CRWQCB, 1994)

Coastal Feature or Waterbody[a]	Hydro Unit #	MUN	IND	PROC	AGR	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
Arroyo Sequit	404.44	P*				I		E	E		E	E			E		E	E	E		E
San Nicholas Canyon Creek	404.43	P*						I	I		I				E						
Los Alisos Canyon Creek	404.42	P*						I	I		I				E		E				
Lachusa Canyon Creek	404.42	P*						I	I		I				E						
Encinal Canyon Creek	404.41	P*						I	I		I				E		E				
Trancas Canyon Creek	404.37	E*						Em	E		E				E		E				
Dume Lagoon [c]	404.36						E	E	E	E			E		E		Ee	Pf	Pf		E
Dume Creek (Zuma Canyon)	404.36	E*						E	E		E	E			E		E	P	P		
Ramirez Canyon Creek	404.35	I*						I	I		I				E				P		
Escondido Canyon Creek	404.34	I*						I	I		I				E		E				
Latigo Canyon Creek	404.33	I*						I	I		I				E		E				
Solstice Canyon Creek	404.32	E*						E	E		E				E			P	P		
Puerco Canyon Creek	404.31	I*						I	I		I				E						
Corral Canyon Creek	404.31	I*						I	I		I				E						
Carbon Canyon Creek	404.16	P*						I	I		I				E						
Las Flores Canyon Creek	404.15	P*						I	I		I				E						
Piedra Gorda Canyon Creek	404.14	P*						I	I		I				E						
Pena Canyon Creek	404.13	P*						I	I		I	E			E						
Tuna Canyon Creek	404.12	P*						I	I		I				E						
Topanga Lagoon [c]	404.11						E	E	E	E			E		E		Ee	Ef	Ef		E

Coastal Feature or Waterbody[a]	Hydro Unit #	MUN	IND	PROC	AG R	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
Topanga Canyon Creek	404.11	P*						I	I		E	E			E			P	I		
Santa Ynez Canyon	405.13	P*						I	E		I				E		E				
Santa Ynez Lake (Lake Shrine)	405.13	P*						Pk	E		E				E						
Santa Monica Canyon Channel	405.13	P*						Ps	I		P				E						
Rustic Canyon Creek	405.13	P*						I	I		I				E						
Sullivan Canyon Creek	405.13	P*						I	I		I				E						
Mandeville Canyon Creek	405.13	P*						I	I		I				E						
Coastal Streams of Palos Verdes	405.11	P*				I		I	I		I				P		E				
Canyon Streams trib. to Coastal Streams of Palos Verdes	405.12	P*				I		I	I		I				E E		Et				
Stone Canyon Reservoir	405.13	E*	E	E		P		Pk	E		E				E						
Hollywood Reservoir	405.14	E*	E	E		P		Pk	E		E				E						
Franklin Canyon Reservoir	405.14	E*						Pk,u			Pu										
Upper Franklin Canyon Reservoir	405.14	E*	E	E		P		P	E		E				E						E
Malibu Lagoon c	404.21						E	E	E				E	E	E		Ee	Ef	Ef		E
Malibu Creek	404.21	P*						E	E		E	E			E		E	E	E		E
Cold Creek	404.21	P*						E	E			P			E		E		P		E
Las Virgenes Creek	404.22	P*						Em	E		E	P			E		E	P	P		E
Century Reservoir	404.21	P*						E	E		E				E						E
Malibou Lake	404.24	P*					E	E	E		E				E		E				E

Coastal Feature or Waterbody[a]	Hydro Unit #	MUN	IND	PROC	AGR	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
Medea Creek	404.23	P*				I		Im	I		I	P			E		E				E
Medea Creek	404.24	P*				I		Em	E		E				E						E
Lindero Creek	404.23	P*						I	I		I				E						
Triunfo Creek	404.24	P*						Im	I		I				E						
Triunfo Creek	404.25	P*				I		Im	I		I				E		E				
Westlake Lake	404.25	P*					E	E	E		E				E						
Potrero Valley Creek	404.25	P*				I		I	I		P				E						
Lake Eleanor Creek	404.25	P*				I		I	I		I				E						
Lake Eleanor	404.25	P*				E		E	E		E				E		E				E
Las Virgenes (Westlake) Reservoir	404.25	E	E	E	E			Pk,v	E		P				E						
Hidden Valley Creek	404.26	I*				I		I	I		I				E						
Lake Sherwood	404.26	P*				E	E	E	E		E				E						E
Ballona Creek Estuary [c,w]	405.13						E	E	E	E			E	E	E		Ee	Ef	Ef	E	
Ballona Lagoon/ Venice Canals [c]	405.13						E	E	E	E			E	E	E		Ee	Ef	Ef	E	E
Ballona Wetlands c	405.13							E	E				E		E		Ee	Ef	Ef		E
Del Rey Lagoon c	405.13						E	E	E	E			E		E		Ee	Ef	Ef		E
Ballona Creek to Estuary	405.13	P*						ELac, ad	Ead		P				P						
Ballona Creek	405.15	P*							Ead		P				E						
Nearshore Zone ^			E				E	E	E	E				E	E	Ean	Ee	Ef	Ef	Ear	
Offshore Zone			E				E	E	E	E				E	E		Ee	Ef	Ef	E	
Nicholas Canyon Beach	403.43						E	E	E	E				E	E				P	E	
Trancas Beach	403.37						E	E	E	E				E	E				P	E	
Zuma County (Westward) Beach	404.35						E	E	E	E				E	E				P	Ear	
Dume State Beach	404.36						E	E	E	E				E	E				P	E	

Coastal Feature or Waterbody^a	Hydro Unit #	MUN	IND	PROC	AGR	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET^b
Dume Lagoon c	404.36						E	E	E	E			E		E		Ee	Pf	Pf		E
Escondido Beach	404.34						E	E	E	E				E	E				P	E	
Dan Blocker Memorial (Corral) Beach	404.31						E	E	E	E	E			E	E				P	E	
Puerco Beach	404.31						E	E	E	E				E	E				P	E	
Amarillo Beach	404.21						E	E	E	E				E	E				P	E	
Malibu Beach	404.21						E	E	E	E				E	E			E	Eas	Ear	
Malibu Lagoon c	404.21						E	E	E				E	E	E		Ee	Ef	Ef		E
Carbon Beach	404.16						E	E	E	E				E	E				P	E	
La Costa Beach	404.16						E	E	E	E				E	E				P	E	
Las Flores Beach	404.15						E	E	E	E				E	E				P	E	
Las Tunas Beach	404.12						E	E	E	E				E	E				P	E	
Topanga Beach	404.11						E	E	E	E				E	E				P	E	
Topanga Lagoon c	405.11						E	E	E	E			E		E		Ee	Ef	Ef		E
Will Rogers State Beach	405.13						E	E	E	E				E	E				P	E	
Santa Monica Beach	405.13						E	E	E	E				E	E			E	Eas	E	
Venice Beach	405.13						E	E	E	E				E	E		E	E	Eas	E	
Marina Del Rey								E													
Harbor	405.13						E	E	E	E				E	E					E	
Public Beach Areas	405.13						E	E	E	E				E	E		E				
All other Areas	405.13						E	P	E	E				E	E		E			E	
Entrance Channel	405.13						E	E	E	E				E	E		E			E	
Dockweiler Beach	405.12		E				E	E	E	E				E	E				P		
Manhattan Beach	405.12						E	E	E	E				E	E				P	E	
Hermosa Beach	405.12						E	E	E	E				E	E				Eas	E	
King Harbor	405.12		E				E	E	E	E				E	E		E				
Redondo Beach	405.12		E				E	E	E	E				E	E		E	E	Eas	E	

Coastal Feature or Waterbody[a]	**Hydro Unit #**	**MUN**	**IND**	**PROC**	**AGR**	**GWR**	**NAV**	**REC1**	**REC2**	**COMM**	**WARM**	**COLD**	**EST**	**MAR**	**WILD**	**BIOL**	**RARE**	**MIGR**	**SPWN**	**SHELL**	**WET[b]**
Torrance Beach	405.12						E	E	E	E				E	E			E	Eas	E	
Port Vicente Beach	405.11						E	E	E	E				E	E				P	E	
Royal Palms Beach	405.11						E	E	E	E				E	E				P	E	
Whites Point County Beach	405.11						E	E	E	E				E	E				P	E	

a Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
b Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory section would require a detailed analysis of the area.
c Coastal waterbodies which are also listed in Coastal Features Table (2-3) or in Wetlands Table (2-4)..
e One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting/
f Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs
k Public access to reservoir and its surrounding watershed is prohibited by Los Angeles County Department of Public Works.
m Access prohibited by Los Angeles County Department in the concrete-channelized areas.
s Access prohibited by Los Angeles Count DPW.
t Rare applies only to Agua Magna Canyon & Sepulveda Canyon areas.
u This reservoir is covered and thus inaccessible.
v Public water supply reservoir. Owner prohibits public entry.
w These areas are engineered channels. All references to Tidal Prisms in Regional Board documents are functionally equivalent to estuaries.
x Owner prohibits entry.
ac Limited (L) REC-1 use based on shallow water depths and infrequent use
ad The High Flow Suspension only applies to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Action Section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where this footnote appears.
an Areas of Special Biological Significance (along coast from Latigo Point to Laguna Point) and Big Sycamore Canyon and Abalone Cove Ecological Reserves and Point Femin Marine Life Refuge.
ar Areas exhibiting large shellfish populations include Malibu, Point Dume, Point Fermin, White Point and Zuma Beach.
as Most frequently used grunion spawning beaches. Other beaches may be used as well.
E: Existing beneficial use
P: Potential beneficial use
I: Intermittent beneficial use
E,P, and I: shall be protected as required
***** Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemption at a later date (See Basin Plan pages 2-3, 4 for more details).
^: Nearshore is defined as the zone bounded by the shoreline and a line 1000 feet from the shoreline or the 30-foot depth contours, whichever is further from the shoreline. Longshore extent is from Rincon Creek to the San Gabriel River Estuary

Table 3. Beneficial uses of groundwaters within the Santa Monica Bay WMA[ac] (CRWQCB, 1994)

DWR[ad] Basin No.	BASIN	MUN	IND	PROC	AGR
4-11	**LOS ANGELES COASTAL PLAIN**				
	Central Basin	E	E	E	E
	West Coast Basin	E	E	E	E
	Hollywood Basin	E	E	E	E
	Santa Monica Basin	E	E	E	E
4-16	**HIDDEN VALLEY**	E	P		E
4-19	**THOUSAND OAKS AREA**	E	E	E	E
4-20	**RUSSELL VALLEY**				
	Russell Valley	E	P		E
	Triunfo Canyon area	P	P		E
	Lindero Canyon area	P	P		E
	Las Virgenes Canyon area	P	P		E
4-21	**CONEJO-TIERRA REJADA VOLCANIC AREA** [ak]	E			E
	SANTA MONICA MOUNTAINS-SOUTHERN SLOPES [al]				
	Camarillo area	E	P		E
	Point Dume area	E	P		E
4-22	Malibu Valley	P	P		E
	Topanga Canyon area	P	P		E

[ac] Beneficial uses for groundwaters outside of the major basins listed on this table have not been specifically listed. However, groundwaters outside of the major basins are, in many cases, significant sources of water. Furthermore, groundwaters outside of the major basins are either potential or existing sources of water for downgradient basins, and such, beneficial uses in the downgradient basins shall apply to these areas.

[ad] Basins are numbered according to DWR Bulletin No. 118-80.

[ak] Groundwater in the Conejo-Tierra Rejada Volcanic Area occurs primarily in fractured volcanic rocks in the western Santa Monica Mountain areas.

[al] With the exception of groundwater in Malibu Valley (DWR Basin No. 4-22) groundwaters along the southern slopes of the Santa Monica Mountains are not considered to comprise a major basin and accordingly have not been designated a basin number by DWR

Beneficial Use Definitions

Beneficial uses in the Regional Board's Basin Plan that are found in the WMA are defined below. The uses are listed in no preferential order.

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

> **Limited Water Contact Recreation (LREC-1):** Uses of water for recreational activities involving body contact with water, where full REC-1 use is limited by physical conditions such as very shallow water depth and restricted access and, as a result, ingestion of water is incidental and infrequent.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

A High Flow Suspension shall apply to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (ad) footnote appears in the beneficial use table. The High Flow Suspension shall apply on days with rainfall greater than or equal to ½ inch and the 24 hours following the end of the ½-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods. The High Flow Suspension only applies to engineered channels, defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or bottom with concrete.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as **Areas of Special Biological Significance (ASBS),** established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE)
Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Migration of Aquatic Organisms (MIGR)
Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadramous fish.

Spawning, Reproduction, and/or Early Development (SPWN)
Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL)
Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

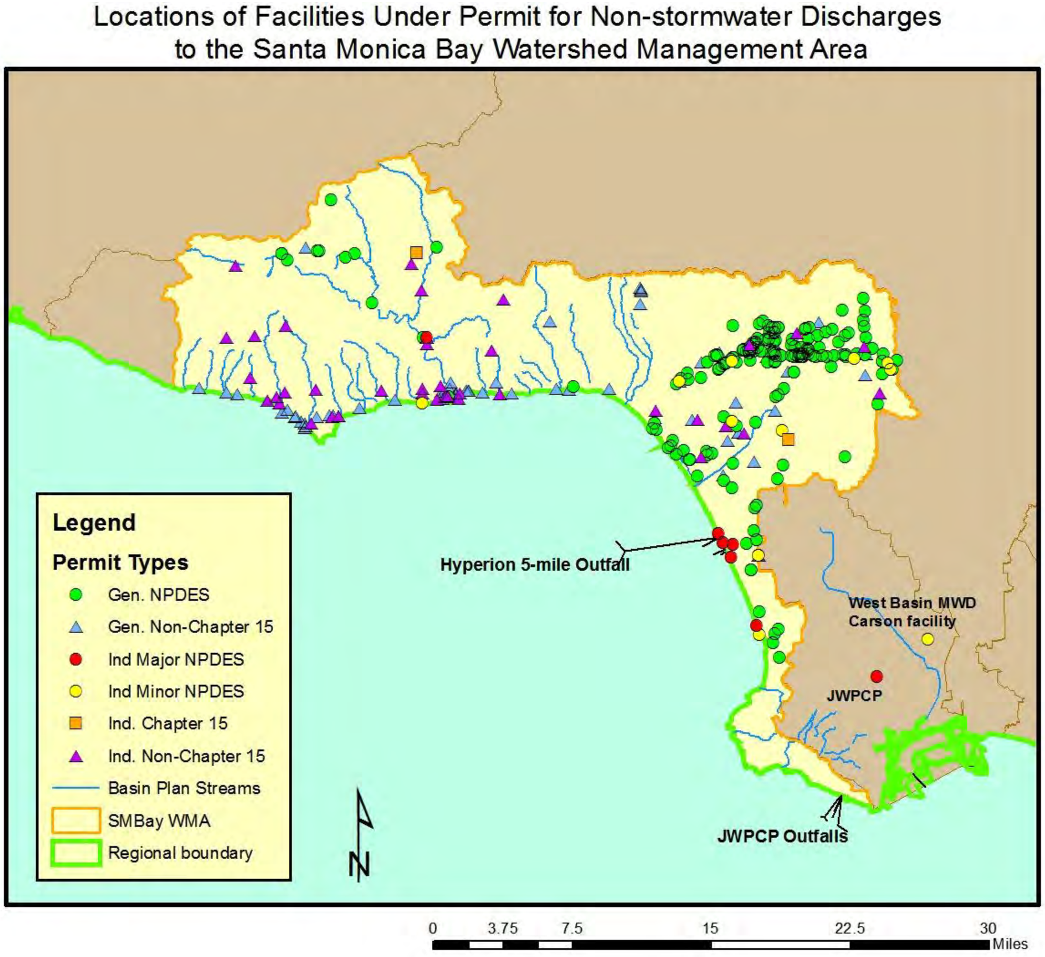
Discharges/Sources

PERMITTED DISCHARGES

There are 193 traditional NPDES discharges into the WMA including seven major NPDES permit discharges (three POTWs [two direct ocean discharges], one refinery, and three generating stations); 18 minor discharges covered under individual permits, and 175 dischargers covered under general permits. In addition, 87 dischargers are covered by an industrial storm water permit and 401 dischargers are covered by the construction storm water permit. Finally, there are 22 municipal dischargers covered under the Los Angeles County Municipal Storm Sewers System (MS4) NPDES permit; Caltrans is covered under its statewide stormwater permit. Of the major NPDES dischargers in the Santa Monica Bay WMA, the three POTWs (particularly the two direct ocean discharges) are the largest traditional point sources of pollutants to Santa Monica Bay. Pollutants from the minor discharges have been estimated to contribute less than two percent of the total pollutants being discharged to the Bay (CRWQCB, 2007).

The locations of facilities with non-stormwater discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major (CRWQCB, 2007).

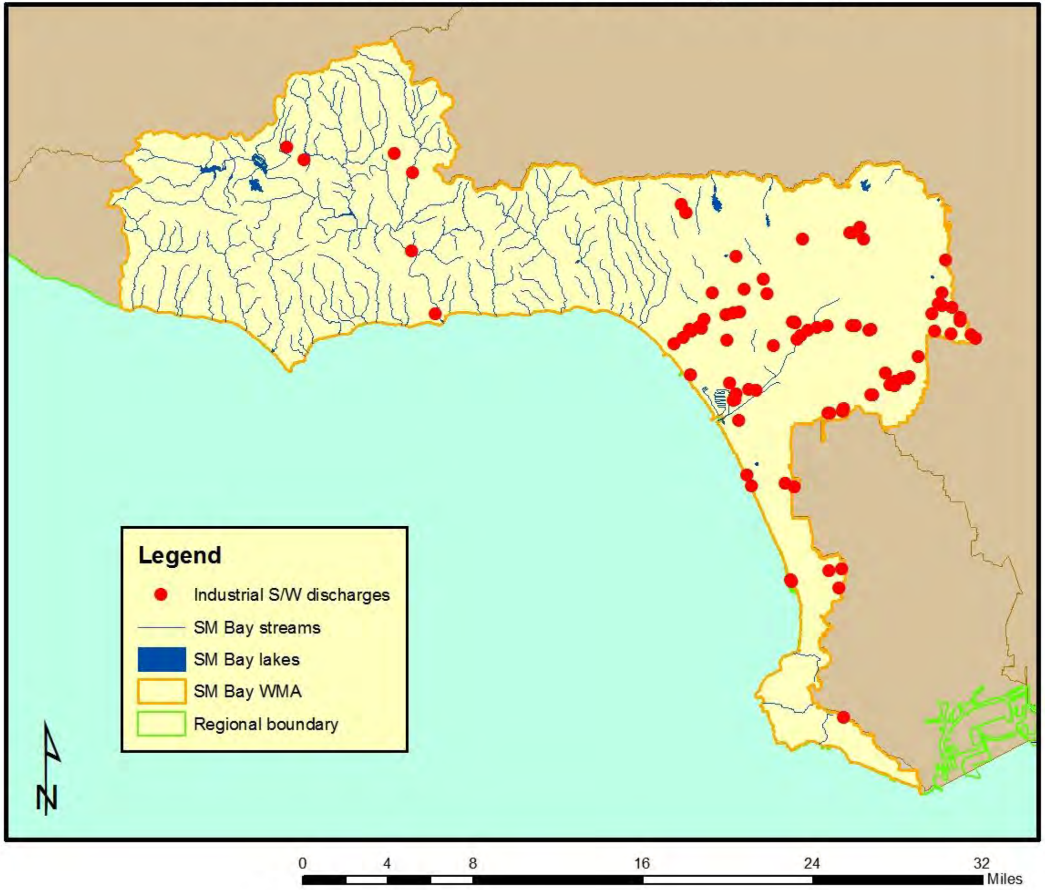
Figure 13



Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity (CRWQCB, 2007).

Figure 14

Locations of Dischargers Covered by General Industrial Stormwater Permit in the Santa Monica Bay Watershed Management Area



Discharges covered by the statewide industrial stormwater permit are shown in the figure below. A complete list of discharges in the watershed is available at http://www.waterboards.ca.gov/losangeles/water_issues/programs/regional_program/wmi/ws_santamonica.shtml . Copies of many permits may be downloaded at http://www.waterboards.ca.gov/losangeles/board_decisions/adopted_orders/by_permits_tools.shtml.

Maps showing discharges focused on individual subwatersheds, as appropriate, are shown in the separate subwatershed section of the report. Information on some of the larger discharges to the watershed follows.

Major/Significant NPDES Discharges

City of Los Angeles - Hyperion Treatment Plant

The City owns and operates the Hyperion Treatment Plant, a publicly-owned treatment works (POTW). The Hyperion Treatment Plant is a secondary treatment facility located at 12000 Vista del Mar Boulevard in Playa Del Rey. It is interesting to compare today's information on the facility with that presented in the first edition of this report in 1997. At that time, the Hyperion plant had a design capacity of 420 gallons per day (mgd) and discharged an average of 360 mgd of treated wastewater which was a combination of about 50 percent advanced primary and 50 percent secondary effluent (CRWQCB, 1997). Today, the plant has a dry weather average design treatment capacity of 450 mgd and a wet weather peak hydraulic capacity of approximately 850 mgd. In 2008, the Hyperion Treatment Plant received an average of 320 mgd of influent and discharged an average of 286 mgd of secondary treated effluent to the Pacific Ocean through the five-mile outfall. Approximately 24 mgd of secondary effluent is sent to West Basin Water Recycling Plant - El Segundo for advanced treatment. The Hyperion Treatment Plant ceased the irrigation use of in-plant chlorinated secondary treated wastewater in July 1999 and started using tertiary recycled water from West Basin MWD in August 1999 (CRWQCB website #1).

The Hyperion Treatment Plant is part of a joint outfall system commonly known as the Hyperion Treatment System that consists of the wastewater collection system, the Hyperion Treatment Plant, and three upstream wastewater treatment plants: Donald C. Tillman Water Reclamation Plant (Tillman WRP), Los Angeles-Glendale Water Reclamation Plant (LAGWRP), and Burbank Water Reclamation Plant (Burbank WRP)(owned and operated by a contract city). The Hyperion Treatment System collects, treats, and disposes of sewage from the entire City (except the Wilmington - San Pedro Area, the strip north of San Pedro, and Watts) and from a number of cities and agencies under contractual agreements (CRWQCB website #1).

Approximately 85% of the sewage and commercial/industrial wastewater comes from the City of Los Angeles. The remaining 15% comes from the Contract Cities and Agencies. There are approximately four million people in the Hyperion Treatment System Service Area (CRWQCB website #1).

Currently, the Hyperion Treatment Plant also accepts dry weather urban runoff that is diverted from storm drains into the City's collection system from April 1 to October 31. In October 2009, the City extended this diversion operation from the dry summer months to year-round in order to conform to the compliance schedule for bacteria concentration during winter dry weather, contained in the Santa Monica Bay Beach Dry-weather Bacteria TMDL adopted by the Regional Board (CRWQCB website #1).

The Hyperion Treatment System is an interconnected system and includes approximately 6,500 miles of sewer lines located within the City (including trunk sewers in contract cities and agencies) and additional sewer lines under the control of the contract cities and agencies. Sludge from the City's two upstream plants (Tillman WRP and LAGWRP) is returned to the wastewater collection system and flows to the Hyperion Treatment Plant for treatment. In addition, sludge generated from the Burbank WRP is also returned to the City of Burbank sewer system for treatment at the Hyperion Treatment Plant. The influent to the Burbank WRP can be diverted/bypassed to the Hyperion Treatment Plant during periods of emergency (CRWQCB website #1).

The Hyperion Treatment Plant has provided full secondary treatment since December 1998. Preliminary and primary wastewater treatments consist of screening, grit removal, and primary sedimentation with coagulation and flocculation. In secondary treatment, the primary effluent is biologically treated in a high purity oxygen activated sludge process. After clarification, undisinfected secondary effluent is discharged into Santa Monica Bay through a five mile submerged outfall pipe (CRWQCB website #1).

The fine solids recovered from wastewater treatment processes that consist of primarily inorganic materials are hauled away to landfills. The remaining sludge is anaerobically digested onsite. The digested sludge is screened and dewatered using centrifuges. Starting on January 1, 2003, the Hyperion Treatment Plant implemented full thermophilic digestion to generate Class A "EQ" biosolids (treated sewage sludge) which are beneficially reused offsite for land application and composting projects. The digester gas is cleaned and a major part of the gas is currently exported to the Los Angeles Department of Water and Power's Scattergood Steam Generating Plant, located immediately adjacent to the Hyperion Treatment Plant. The exported digester gas is used as fuel in the generation of electricity. In return, the generating plant provides steam for digester heating for the Hyperion Treatment Plant. During interruptions in the export of steam from the DWP Scattergood Steam Generation Plant, digester gas can be used as fuel for in-plant boilers that provide steam to heat the anaerobic digesters. Any remaining non-exported digester gas may be flared, if necessary, and is regulated under a flare operation permit from the South Coast Air Quality Management District (AQMD) (CRWQCB website #1).

The Hyperion Treatment Plant has developed an industrial wastewater pretreatment program which was approved by USEPA and the Regional Board. The facility also collects and treats in-plant storm water runoff except that, during intense storms, undisinfected storm water overflows may be discharged through Outfall 001. This storm water discharge is regulated under the State Board's storm water general permit for industrial activities (CRWQCB website #1).

The Hyperion Treatment Plant has three ocean outfalls. However, only two outfall discharge points (i.e., 001 and 002) are utilized to discharge treated wastes to the Pacific Ocean. The three ocean outfalls are described as follows:

Discharge Serial No. 001 - This is commonly referred to as the "one-mile outfall". It is a 12-foot diameter outfall terminating approximately 5,364 feet west-southwest of the treatment plant at a depth of approximately 50 feet below the ocean surface. This outfall is permitted for emergency discharge of chlorinated secondary treated effluent during extremely high flows, power failures, and preventive maintenance, such as routine opening and closing the outfall gate valve(s) for exercising and lubrication. However, during intense storms or storms associated with plant power outages, direct discharge of undisinfected storm water overflow is also permitted at this outfall. The facility's NPDES permit requires the City to notify the Regional Board and USEPA in advance of any planned preventive maintenance that results in discharges through Discharge Serial No. 001 (CRWQCB website #1). There were three planned preventive maintenance diversion events in 2008. This outfall was inspected twice in 2008 via submarine and SCUBA divers (City of LA, 2009c).

Discharge Serial No. 002 - This is commonly referred to as the "five-mile outfall". It is a 12-foot diameter outfall terminating approximately 26,525 feet west-southwest of the treatment plant at a depth of approximately 187 feet below the ocean surface. This outfall is located north of Discharge Serial No. 001 and ends in a "Y" shaped diffuser consisting of two 3,840-foot legs. This is the only outfall permitted for the routine discharge of undisinfected secondary treated effluent. This outfall was inspected twice in 2008 via submarine and SCUBA divers (City of LA, 2009c).

Discharge Serial No. 003 – This is a 20-inch diameter outfall terminating approximately 35,572 feet west of the treatment plant, at the head of a submarine canyon at a depth of approximately 300 feet below the ocean surface. This outfall had been used to discharge sludge. Under a 1987 amended Consent Decree, this outfall was deactivated in November 1987 when sludge discharge to the ocean was terminated. The outfall has been modified to prevent any possible discharge of sewage or sludge into the Pacific Ocean. The outfall has not been maintained since it was taken out of service. Any discharge from this outfall is prohibited (CRWQCB website #1).

The City has collected and assessed extensive chemical and physical data from Santa Monica Bay at 36 sites during varying conditions, including El Niño, La Niña and winter storm conditions in order to evaluate movement of the discharge plume. The data show that movement of the plume is dictated by the depth of the thermocline or stratification and the direction and strength of highly variable Santa Monica Bay currents. Under typical conditions, the plume is detected within 6,562 feet of the outfall terminus, although it has been detected as far as 26,247 feet away from the outfall. Also, the plume has almost always been detected below the thermocline at a depth ranging from 33 – 180 feet. Infrequently, during winter storm conditions, the plume has been detected at the surface in the vicinity of the outfall. On rare occasions, it has been impossible to detect the plume (CRWQCB website #1).

As the waters of Santa Monica Bay approach the shore, the thermocline intersects the rising sea bottom. This point is typically 3,281 feet (1,000 m) or more offshore and is the theoretical limit of the approach of the plume to the shoreline. The plume has never been detected less than 8,202 feet (2.5 km) from shore, at the 148 feet (45 m) depth contour (CRWQCB website #1).

The City has conducted shoreline and nearshore/inshore water quality monitoring in Santa Monica Bay since the late 1940s. The monitoring results indicated that effluent from Hyperion's five-mile outfall does not reach the shoreline and that elevated bacterial counts are associated with runoff from storm drains and discharges from piers. The direct impacts of the discharge from Hyperion's one-mile outfall on shoreline water quality have not been studied due to the lack of routine discharge. However, it is expected to be very minimal in that effluent discharged from the one-mile outfall is disinfected, and the volume of the discharge is usually much less than five million gallons occurring at most quarterly. This discharge is intended for conducting a functional test of equipment (CRWQCB website #1).

County Sanitation Districts of Los Angeles County - Joint Water Pollution Control Plant

The County Sanitation Districts of Los Angeles County (Districts) owns and operates the Joint Water Pollution Control Plant (JWPCP), a POTW. The JWPCP is a secondary treatment facility located at 24501 South Figueroa Street in Carson. The plant has a dry weather average design treatment capacity of 400 mgd and a peak design capacity of 540 mgd (CRWQCB website #1). During 2008, the effluent discharge flow from JWPCP averaged 295.6 mgd (CSDLAC, 2009). As a comparison, information on the facility presented in the first edition of this report included a description that the JWPCP was an advanced primary treatment facility with a dry weather average flow design capacity of 400 mgd, a permitted capacity of 385 mgd and a peak design capacity of 540 mgd. Secondary treatment was provided for only 200 mgd of wastewater (CRWQCB, 1997).

JWPCP is part of a Joint Outfall System with six upstream water reclamation plants - La Cañada, Whittier Narrows, San Jose Creek, Pomona, Los Coyotes and Long Beach. It treats municipal and industrial wastewater. The flow from the six upstream plants can be bypassed, to a limited extent, to JWPCP. The sludge generated from the upstream plants are returned to the joint outfall trunk sewers and conveyed to JWPCP for further treatment. There are approximately five million people in the Joint Outfall System service area and JWPCP receives discharges from more than 1,200 significant industrial users (CRWQCB website #1).

In addition to the JWPCP effluent, the waste brine generated by the West Basin Municipal Water District's Carson Regional Water Recycling Plant is discharged to the ocean through the JWPCP's outfalls via a waste brine line connected to the JWPCP effluent tunnel. This discharge of waste brine is regulated under separate waste discharge requirements and NPDES permit (CRWQCB website #1).

The JWPCP has provided full secondary treatment since 2003. Treatment consists of screening, grit removal, primary sedimentation, pure oxygen activated sludge reactors, secondary clarification, and chlorination. Effluent from the primary sedimentation tanks is biologically treated in pure oxygen activated sludge reactors. The secondary treated effluent is then clarified, chlorinated and pumped into the outfall manifold (CRWQCB website #1).

The fine solids recovered from wastewater treatment processes which are primarily inorganic materials are hauled away to a landfill. The remaining solid fractions are anaerobically digested onsite. The digested solids are screened, and dewatered using centrifuges. The dewatered cake contains approximately 25% solids (Class B biosolids). JWPCP generates approximately 11,000 wet tons of Class B biosolids per week. More than half of the biosolids are managed by composting operations in Riverside and Kern County. One quarter of the biosolids are sent to southwestern Arizona for air drying and direct land application. The remaining biosolids are lime stabilized for Class A land application in Kern County, incinerated in a cement kiln in San Bernardino County, and co-disposed with municipal solid waste in Los Angeles County (CRWQCB website #1).

Digester gas (containing approximately 65% methane), produced from anaerobic digestion of sludge, is used onsite to fuel a combined cycle power plant (gas turbines followed by boilers and a steam turbine) which generates 22 MW of electricity for plant equipment and steam for digester heating. The power plant allows JWPCP to be essentially self-sufficient with respect to its energy requirements and even produces surplus electricity for export to Southern California Edison Co. sufficient to power approximately 1,500 homes (CRWQCB website #1).

After chlorination, the secondary treated effluent travels about 6 miles through tunnels to the outfall manifold and then is discharged to the Pacific Ocean, at Whites Point off the Palos Verdes Peninsula. JWPCP has fifteen discharge points (Discharge Serial Nos. 001 through 015). Four outfalls (Discharge Serial Nos. 001 through 004) are located at Whites Point, off the Palos Verdes Peninsula. Discharge Serial Nos. 001 and 002 are routinely used for discharge of treated wastewater. Discharge Serial No. 003 is used only during times of heavy rains to provide hydraulic relief for flow in the outfall system. Discharge Serial No. 004 serves as a standby outfall to provide additional hydraulic relief during the very heaviest flows. Two discharge points (Serial Nos. 006 and 013) have been eliminated following facility modifications. The remaining nine discharge points, with seven of them being bypass points (Discharge Serial Nos. 007-012, and 014) located prior to the headworks, provide for overflow, emergency bypass, and/or hydraulic relief of the JWPCP. The NPDES permit does not authorize any discharge from these nine discharge points (Discharge Serial Nos. 005, 007-012, 014, and 015). The four permitted ocean discharge points are described in more detail below:

Discharge Serial No. 001 - This outfall routinely discharges approximately 65% of the effluent from the JWPCP. It discharges south of the shoreline off Whites Point, San Pedro. The outfall is 7,440 ft long to the beginning of a single L-shaped diffuser leg which is 4,440 ft long. Depth at the beginning of the diffuser is 167 ft and at the end of the diffuser is 190 ft.

Discharge Serial No. 002 - This outfall routinely discharges approximately 35% of the effluent from the JWPCP. It discharges southwest of the shoreline off Whites Point, San Pedro. The outfall is 7982 ft long to the beginning of a y-shaped diffuser with two legs. Each leg is 1208 ft long. Depth at the beginning of the diffusers is 196 ft and at the end of the diffusers is 210 ft.

Discharge Serial No. 003 - This outfall is used only during times of heavy rains to provide hydraulic relief for flow in the outfall system. When used, it discharges off the Whites Point shoreline between Discharge Points 001 and 002 and about 160 ft below the ocean surface. The outfall is about 6500 ft long and connects to one of three legs of a y-shaped diffuser upstream of the y-intersection. Each leg is approximately 200 ft long. This discharge point was not used in 2008.

Discharge Serial No. 004 - This outfall is used as a standby to provide additional hydraulic relief during the heaviest flow. When used, it discharges off the Whites Point shoreline between Discharge Serial Nos. 002 and 003 and about 110 ft below the ocean surface. The outfall is about 5000 ft long and connects to a single, very short diffuser. This discharge point was not used in 2008 (CRWQCB website #1).

Las Virgenes Municipal Water District - Tapia Water Reclamation Facility

The Tapia Water Reclamation Facility (Tapia) is jointly owned by the Las Virgenes Municipal Water District (LVMWD) and Triunfo Sanitation Districts (Triunfo). Tapia is located at 731 Malibu Canyon Road, in an unincorporated area of Los Angeles County. Tapia treats municipal wastewater from domestic, commercial, and industrial sources to obtain California Title 22 recycled water. The design flow for the facility is 16.1 MGD. In 2008, on average, Tapia treated 8.95 MGD and discharged 4.03 MGD to Malibu Creek (with no discharge in June and July) and less than 0.1 MGD to the Los Angeles River. Tapia recycled the remainder of the tertiary-treated wastewater. Currently, Tapia serves approximately 80,000 residents in western Los Angeles and eastern Ventura Counties (Agoura Hills, Calabasas, Hidden Hills, Thousand Oaks, and Westlake Village) with a service area of over 109 square miles (CRWQCB website #1).

In 1965, LVMWD and Triunfo in a joint venture, built the Tapia facility which discharged 750,000 gpd of secondary treated effluent by spray irrigation. In 1968, the plant's design capacity was expanded to 2 mgd. From 1969 to 1980, year-round discharge to the Creek was prohibited by the Regional Board because of human health and nutrient concerns, and maximum use of recycled water for spray irrigation of fields was required. Discharge was allowed to occur only during, and immediately following, periods of rain when spray fields or percolation areas could not be used; and, between mid-November and mid-April when reclamation and use of all spray fields had been maximized. In 1982, the plant's design capacity was expanded to 8 mgd and the Rancho Las Virgenes Farm was established for injection of biosolids. In 1984, a year-round discharge to the Creek was permitted after the tertiary filters were installed. In 1989, the plant was expanded to 10 mgd. In 1989, the Regional Board adopted an order that permitted a phased increase in the discharge rate up to 16.1 mgd. The construction of facilities for Tapia's treatment capacity expansion, from 10 mgd to 16.1 mgd, was completed in 1994 (CRWQCB website #1).

Tapia treats both the liquid and solid fractions of the municipal wastewater. Treatment starts with coarse screening, grit removal, and primary sedimentation. The flow stream then separates into two routes, one for solids and the other for liquid. The liquid treatment route consists of secondary treatment, tertiary treatment, chlorination, and dechlorination. Prior to 1993, the principal solids treatment route was aerobic digestion at Tapia and land application at the Rancho Las Virgenes Farm. After startup of the Rancho Las Virgenes Composting Facility (Rancho) in 1993, the solids were anaerobically digested, dewatered using centrifuges and then composted (CRWQCB website #1).

The facility conducts coarse screening, grit removal, primary sedimentation, secondary treatment, tertiary treatment, chlorination, and dechlorination. For secondary treatment, Tapia employs an activated sludge process with nitrification and denitrification, followed by secondary clarification. Tertiary 'treatment includes coagulant addition, flocculation and physical filtration through a mono-media coal filter. Sodium hypochlorite solution is added for effluent disinfection, and sodium bisulfate is added for dechlorination (CRWQCB website #1).

Under standard operations, the waste activated sludge (WAS) is sent to Rancho Las Virgenes Composting Facility (Rancho Facility). Generally the digested sludge is centrifuged to remove most of the liquid. The liquid generated by centrifugation (centrate) is sent to a centrate treatment facility where it is treated to reduce ammonia and nitrogen levels before being returned to Tapia via the sanitary sewer. The majority of the WAS is treated at Rancho Facility and recycled as compost. The composting and farm facilities eliminate the need for hauling and disposal of biosolids to landfills. WAS can be aerobically digested and screened at Tapia and pumped to Rancho Las Virgenes Farm, a 91-acre site located at 3240 Las Virgenes Road, for subsurface biosolids injection (the last injection was performed in 2003). The fields are planted with a variety of pasture grasses to agronomically remove nutrients from the injection operation (CRWQCB website #1).

Approximately 60 percent of the treated wastewater is used on an annual basis for landscaping irrigation. Recycled water is also used at Tapia WRF, Pepperdine University, Rancho Las Virgenes Composting Facility and Rancho Las Virgenes Farm. The use of recycled water is regulated under separate water recycling requirements (CRWQCB website #1).

The following are the discharge points to Malibu Creek:

Discharge Serial No. 001 – This is the primary discharge point to Malibu Creek located adjacent to the treatment plant. The waste discharged to Malibu Creek is limited to winter months from November 16 through April 14 of each calendar year to minimize the contribution of Tapia's discharge to the excess freshwater flow into Malibu Lagoon (which leads to elevated Lagoon level and frequent breaching of the sandbar once, or if, the sandbar has formed), thus impacting both wildlife and human health beneficial uses (CRWQCB website #1). The average discharge to Malibu Creek in 2008 during months that a discharge occurred was 5.76 mgd (LVMWD, 2009).

The discharge prohibition is in place except under certain conditions:
i. Treatment plant upset or other operational emergencies;
ii. Storm events as determined by the Executive Officer; or

iii. The existence of minimal streamflow conditions that require flow augmentation in Malibu Creek to sustain endangered species as determined by the Executive Officer (CRWQCB website #1).

For a rainfall event of less than 0.4 inches in 24 hours at the Facility Rain Gauge, the Discharger may discharge to Malibu Creek during the prohibition period during storm events with prior approval of the Executive Officer provided that *all* of the following conditions have been met:

1. The Malibu Lagoon Sand Bar is open; and
2. The spray fields at Rancho Las Virgenes Farm are saturated; and
3. There is no demand for recycled water; and
4. The capacity to send 'wastewater to the Los Angeles River has been exhausted; and
5. All other disposal options are exhausted.

The Discharger may discharge to Malibu Creek during the prohibition period during storm events without prior approval of the Executive Officer provided that *all* of the following conditions have been met:

1. The rainfall event produces 0.4 inches or greater of precipitation in 24 hours at the Facility Rain Gauge; and
2. The Malibu Lagoon Sand Bar is open; and
3. The spray fields at Rancho Las Virgenes Farm are saturated; and
4. There is no demand for recycled water; and
5. The capacity to send wastewater to the Los Angeles River has .been. exhausted; and
6. All other disposal options are exhausted.

Discharge Serial No. 002 – This discharge point is used to release surplus effluent from LVMWD's Reservoir #2 which stores water for distribution to the recycled water system. Reservoir #2 has a capacity of 17 million gallons, which is less than a two-day supply during the high demand in summer. Overflow from this reservoir is discharged to Las Virgenes Creek, a tributary to Malibu Creek, near the LVMWD headquarters building located at 4232 Las Virgenes Road in Calabasas. Stormwater runoff enters the reservoir and causes overflow. Such discharges are unintentional and infrequent.

Discharge Serial No. 003 – This discharge point is located 0.2 miles downstream of Cold Creek and is no longer used routinely. No recycled water has been discharged at this location except during the storms of 1998. This discharge location was established along with the percolation ponds to offer a bypass option in times of extremely high flow conditions to regulate flow and protect the pond structures (CRWQCB website #1).

West Basin Municipal Water District

West Basin Water Recycling Plant, El Segundo

The West Basin Municipal Water District (West Basin MWD) operates the West Basin Water Recycling Plant (El Segundo Plant) in El Segundo. West Basin MWD is contractually entitled to receive up to 70 mgd of secondary effluent from the Hyperion Treatment Plant for advanced treatment. The El Segundo Plant provides tertiary treatment and/or advanced treatments such as microfiltration and reverse osmosis (RO) to the Hyperion secondary effluent to produce Title 22 and high purity recycled water. Title 22 recycled water is used for beneficial irrigation, industrial applications including cooling water and boiler feed water, and other purposes. The RO treated recycled water is primarily injected into the West Coast Basin Barrier Project to control seawater intrusion. The El Segundo Plant receives an average of 24 mgd of secondary effluent from the Hyperion Treatment Plant (CRWQCB website #1).

The waste brine from the El Segundo Plant is discharged to the ocean through Hyperion's five-mile outfall via a waste brine line from the recycling facility; the waste brine is regulated under these separate waste discharge requirements and NPDES permit (CRWQCB website #1).

Carson Regional Water Recycling Plant, Carson

The West Basin MWD owns and operates the Carson Regional Water Recycling Plant (Carson Plant) located at 21029 South Wilmington Avenue in Carson. The Carson Plant provides advanced treatment to Title 22 recycled water produced by the El Segundo Plant that is also owned and operated by the West Basin MWD. The Carson Plant may discharge up to 0.9 MGD of reverse osmosis brine waste from the treatment process to the Pacific Ocean (offshore of Palos Verdes), via the JWPCP outfalls. 3 During 2008, the Carson Plant discharged an average of 0.53 mgd of brine through the JWPCP outfalls. ? Brine waste is not treated prior to discharge (CRWQCB website #1).

Chevron Products Company – El Segundo Refinery

Chevron has operated the El Segundo Refinery since 1911. The facility is located at 324 West El Segundo Blvd in El Segundo. It manufactures the following products from crude oil: reformulated gasoline, jet fuel, diesel fuel, fuel oils, liquefied petroleum gases, fuel blending components, coke, ammonia, and molten sulfur. Manufacturing processes used at the refinery include atmospheric and vacuum distillation, catalytic cracking, alkylation, isomerization, coking, catalytic reforming, hydrogenation, sulfur recovery, chemical treating, and product blending. Chevron plans to process a long-term average throughput estimated at 265,000 bpod (CRWQCB website #1).

The El Segundo Refinery's wastewater treatment facility discharges an average flow of 7.0 mgd of treated wastewater, with up to 8.8 mgd during dry weather and up to 27 mgd during wet weather, to Santa Monica Bay. The wastewater is comprised of refinery wastewater (6.45 mgd), petroleum hydrocarbon contaminated shallow well groundwater (up to 2.34 mgd), other intermittence sources (4 mgd), and rainfall runoff, which may be contaminated (14 mgd) (CRWQCB website #1).

The discharge occurs through an outfall located approximately 2,200 feet south of Grand Avenue that extends approximately 3,500 feet offshore with its terminus at a depth of 42 feet. In 1994, Chevron constructed a 3,200-foot outfall line extension consisting of a 60-inch nominal diameter, high density polyethylene pipe that was fitted to the existing 300 foot outfall line. A diffuser was attached at the end of the extension. The extended outfall provides a minimum dilution ratio of 80 parts of seawater to one part of effluent . The previous outfall was about 300 feet offshore and had a minimum dilution ratio of 38 parts of seawater to one part of effluent (CRWQCB website #1).

The El Segundo Refinery's wastewater treatment facility consists of two separate drain and treatment systems: the "unsegregated" and the "segregated" system. The unsegregated system is normally used for non-process wastewater including cooling tower blowdown, steam condensate, a portion of the refinery's recovery well groundwater, and other wastewater streams containing free oil removed with primary treatment only. This system is also used to collect and treat storm water. The unsegregated system includes a gravity separator and an induced air flotation unit. The segregated system is normally used to treat petroleum process wastewater containing emulsified oils and a portion of the refinery's recovery well groundwater. It is comprised of gravity separators, a dissolved air flotation unit, and activated sludge units for secondary (biological) treatment (CRWQCB website #1).

The El Segundo Refinery currently uses recycled water from the West Basin MWD for both irrigation and the cooling towers. The refinery's daily consumption of recycled water for irrigation purposes is approximately 200,000 gallons per day (gpd). Additionally, the cooling towers use approximately 3 mgd of nitrified recycled water: The low and high pressure boiler feeds consume approximately 1.23 mgd and 2.57 mgd of recycled water, respectively (CRWQCB website #1).

El Segundo Power, LLC (El Segundo Power Generating Station)

El Segundo Power, LLC, has operated the El Segundo Generating Station (El Segundo Station) since April 4, 1998. The El Segundo Station was formerly operated by Southern California Edison (from the 1950's to April 1998). The El Segundo Station is steam electric generating facility located at 301 Vista del Mar in El Segundo and has a design capacity of 1,020 megawatts. However, by 2000, the El Segundo Generating Station was consistently running less than its full capacity of 1,020 megawatts. The El Segundo Station is permitted to discharge up to 607 mgd of wastes consisting of once-through cooling water from four steam electric generating units (Units 1 through 4), treated chemical metal cleaning wastes, non-chemical metal cleaning wastes, low volume wastes, stormwater runoff, and treated sanitary wastes into the Pacific Ocean through two outfalls (CRWQCB website #1).

To cool generating units 1 and 2, ocean water is supplied at a rate of about 144,000 gallons per minute (gpm) through a concrete conduit (10-feet inside diameter) which extends approximately 2,600 feet offshore to a depth of -30 feet Mean Lower Low Water (MLLW). The intake structure is constructed with a velocity cap that is designed to divert fish away from the intake structure. It also has a screening structure that removes trash, algae, and marine organisms that enter the intake structure with the seawater. Marine fouling of the cooling water conduits (intake and discharge) is controlled by temporarily recirculating (thus increasing the temperature) and reversing the flow of the once-through cooling water alternately in each offshore conduit (i.e., the discharge point becomes the intake point, and the intake point becomes the discharge point). This procedure, referred to as heat treatment, is typically conducted every six weeks and lasts for about six hours per conduit. During the heat treatment, the high temperature last for one hour. The water temperature is increased 23°F when the units are operated at full capacity. The heated water is discharged through Outfall No. 001, a 10-feet diameter conduit that terminates approximately 1,900 feet offshore at a water depth of -26 feet MLLW. During the heat treatment, the temperature of the water discharged through the intake conduit must be raised to 125°F for two hours to kill the fouling organisms (CRWQCB website #1). No heat treatments were conducted on discharge point 001 during 2008. On January 1, 2003, Units 1 and 2 ceased commercial operation; the cooling water system continued to remain in operation. The average discharge flow from Outfall No. 001 was 29.2 mgd in 2008. Chlorination to control biological growths ceased at the end of February 2008 (El Segundo Power, 2009).

The cooling water system for Units 3 and 4 is separate from Units 1 and 2 but is a similar cooling system. The intake conduit (11-feet inside diameter) also extends 2,600 feet to a depth of -30 feet MLLW; it supplies ocean water at a rate of about 295,000 gpm. The water temperature is increased 22°F when the units are operated at full capacity. The heated water is discharged to the ocean through Outfall No. 002

which extend about 2,100 feet offshore at a depth of about -20 feet MLLW. To control biological growths, the condenser tubes are treated by intermittently injecting chlorine, for a maximum of two hours per generating unit per day, into the cooling water stream (CRWQCB website #1). The average discharge flow from Outfall No. 002 was 130.8 mgd in 2008 (El Segundo Power, 2009).

AES Redondo Beach, LLC (Redondo Generating Station)

AES Redondo Beach, LLC (Redondo Generating Station) discharges wastes from its Redondo Generating Station; the permit was originally issued to Southern California Edison, the previous owner of the facility. AES Redondo Beach, LLC, acquired the Redondo Generating Station in 1998. The Redondo Generating Station is a steam electric generating facility located at 1100 Harbor Drive in Redondo Beach. The facility has eight generating units. However, Units 1, 2, 3, and 4 have not been operated for at least four years and because the Discharger has no plans to place them into service in the future, these units are being dismantled. The remaining units (5, 6, 7, and 8) have a design capacity of 1,310 megawatts and are permitted to discharge up to 898 mgd of wastes consisting of once-through cooling water, treated chemical metal cleaning wastes, groundwater seepage, and low volume wastes into Santa Monica Bay (CRWQCB website #1).

The wastes are discharged through two outfalls; Discharge Serial No. 001 consists of two conduits, each extending approximately 1,600 feet offshore, which terminate at a depth of 25 feet MLLW. Wastes discharged through this outfall consist of up to 215 mgd of once-through cooling water from steam electric generating units 5 and 6, five mgd of groundwater seepage from basement areas of the generating station, and four mgd of low-volume wastes (CRWQCB website #1). The average discharge flow from outfall 001 was 41.375 mgd in 2008 (AES Redondo Beach, 2009). Discharge Serial No. 002 consists of one conduit, which extends approximately 300 feet off the beach at King Harbor, Redondo Beach, and terminates at a depth of 20 feet MLLW. Wastes discharged through this outfall consist primarily of once-through cooling water from Units 7 and 8 (up to 674 mgd), with small amounts of condensate overboard overflow, fuel oil tank farm rainfall run-off, and yard drains (CRWQCB website #1). The average discharge flow from outfall 002 was 37.175 mgd in 2008 (AES Redondo Beach, 2009).

Marine fouling of the cooling water conduits (intake and discharge) is controlled by temporarily recirculating (thus increasing the temperature) and reversing the flow of the once-through cooling water alternately in each offshore conduits. This procedure, referred to as heat treatment, is typically conducted every six weeks and lasts for about two hours per conduit. During the heat treatment, the temperature of the water discharged through the intake conduit must be raised to 125°F for two hours to kill the fouling organisms. To control biological growths, the condenser tubes are treated by intermittently injecting chlorine (in the form of sodium hypochlorite), for a maximum of two hours per generating unit per day, into the cooling water stream (CRWQCB website #1).

City of Los Angeles, Department of Water and Power - Scattergood Generating Station

The Scattergood Generating Station is located about 1,500 feet south of the Hyperion Treatment Plant at 12700 Vista del Mar in Los Angeles. The plant is comprised of three steam electric generating units with a total capacity of 820 megawatts and is permitted to discharge up to 496 mgd of wastes containing once-through cooling water, pretreated metal cleaning wastes, low-volume in-plant wastes, cooling tower blowdown, and stormwater runoff into Santa Monica Bay near Dockweiler State Beach in El Segundo (CRWQCB website #1). The average discharge during 2008 was 314.75 mgd (City of LA, 2009a).

Cooling water is drawn from Santa Monica Bay through a single 12 feet diameter conduit, which extends about 1,600 feet offshore. The conduit is equipped with a velocity cap to deter marine life from entering the system. After passage through the generating units' once-through cooling system, wastewater is then discharged to the same size conduit that runs parallel to the intake pipe (CRWQCB website #1).

Marine fouling of the cooling water conduits (intake and discharge) is controlled by temporarily recirculating (thus increasing the temperature) and reversing the flow of the once-through cooling water alternately in each offshore conduit. This procedure, referred to as heat treatment, is typically conducted every six weeks and lasts between two and six hours for the three generating units. To control biological growths, the condenser tubes are treated by intermittently injecting chlorine (in the form of sodium hypochlorite) or a combination of chlorine and sodium bromide, for a maximum of two hours per generating unit per day, into the cooling water stream (CRWQCB website #1).

Storm Water/Urban Runoff

Urban and storm water runoff are carried to waterbodies through the Region's massive storm drain system. In some areas of the watershed, the drainage system consists of natural streams, riparian corridors and wetlands, and therefore are waterbodies with considerable ecological value as previously described. The rest is part of the 5,000 mile concrete-lined storm drain network within Los Angeles County that was built to move flood waters quickly to the ocean. The storm drain system is completely separate from the sewer system except where storm drain diversions have been installed (CRWQCB, 1997).

Storm water and urban runoff are discharged to Santa Monica Bay through more than 200 outlets; some are as large as a 370 feet-wide concrete channel connected to other channels many miles inland, while others are so small that they are hard to detect and only drain one or two, blocks near the coast. About a dozen of these outlets have flows during dry-weather, discharging 10 to 25 gallons of water/second. On a rainy day, however, 10 billion gallons can flow through the system. Each year an average of 30 billion gallons of storm water and urban runoff are discharged into Santa Monica Bay (CRWQCB, 1997). Storm drains in the Los Angeles County portion of the WMA are shown in the map below.

Figure 15

Urban and storm water runoff contains greatly varying types of material. Land use strongly influences the types and concentrations of materials found in runoff. Runoff quantity and velocity increases when roads, buildings or pavement (impervious surfaces) cover land that once absorbed and filtered rainfall (CRWQCB, 1997).

The quality, and to some extent, the quantity of storm water runoff is controlled primarily through the use of structural and non-structural best management practices (BMPs). This approach is embodied in the MS4 NPDES permit, which was reissued in December 2001 and subsequently amended in 2006, 2007, 2009, and 2011, to the District (as principal permittee), 85 cities, and County of Los Angeles (as co-permittees) by the Regional Board. Activities such as increased street sweeping decrease the amounts of suspended solids in the receiving waters as well as pollutants which normally adhere to the solids. Public education programs strive to inform people of the impacts of activities such as pouring antifreeze or used motor oil down storm drains or overfertilizing lawns, and can offer alternatives to negative behaviors (CRWQCB, 1997).

General storm water discharge permits for industrial facilities and construction sites were issued by the State Board beginning in the summer of 1992 (CRWQCB, 1997). Currently, approximately 87 general industrial and 401 construction activity permits exist within the WMA (CRWQCB, 2007).

A study entitled, "Sources, Patterns and Mechanisms of Storm Water Pollutant Loading From Watersheds and Land Uses of the Greater Los Angeles Area" was conducted by SCCWRP in 2007. Storm water runoff and the associated contaminants from urban areas is one of the leading sources of water quality degradation in surface waters. Runoff from pervious and impervious areas carries accumulated contaminants (i.e., atmospheric dust, trace metals, street dirt, hydrocarbons, fertilizers and pesticides) directly into receiving waters. Because of the environmental effects of these contaminants, effective storm water monitoring and management requires identification and characterization of the sources, patterns, and mechanisms that influence pollutant concentrations and loads. Little is known about the mechanisms and processes that influence spatial and temporal factors that affect the magnitude and patterns of constituent loading from specific land uses. Specifically, storm water managers need to understand how sources vary by land use type, how patterns of loading vary over the course of a single storm, how loading varies over the course of a storm season, and how applicable national or regional estimates of land use-based loading are to southern California. Ballona Creek, Santa Monica Canyon, and Arroyo Sequit were three sites in the Santa Monica Bay WMA sampled both during dry and wet weather (Stein, et al., 2007).

The study concluded:

- Storm water runoff from watershed and land use-based sources is a significant contributor of pollutant loading and often exceeds water quality standards.
- No single land use type was responsible for contributing the highest loading for all constituents measured.
- All constituents were strongly correlated with total suspended solids.
- Storms sampled from less developed watersheds (i.e., Santa Monica Canyon and Arroyo Sequit) produced constituent event mean concentrations and fluxes that were one to two orders of magnitude lower than comparably-sized storms in urbanized watersheds.
- Storm water runoff of trace metals from the urban watersheds in this study produced a similar range of annual loads as those from traditional point sources such as large publicly-owned treatment plants. However, when combined with dry weather estimates of pollutant loading, the total urban and stormwater runoff from contribution from all watersheds in the greater Los Angeles area far exceeds that of the traditional point sources.
- For all storms sampled, the highest constituent concentrations occurred during the early phases of storm water runoff with peak concentrations usually preceding peak flow.
- Highest constituent loading was observed early in the storm season with intra-annual variability driven more by antecedent dry period than amount of rainfall. This seasonal pattern suggests that focusing management actions on early season storms may provide relatively greater efficiency than distributing lower intensity management actions throughout the season (Stein, et al., 2007).

Highway Stormwater Runoff

Land-use analyses indicate that approximately 0.5 square miles (sq mi) in Malibu Creek/other Rural watersheds and 6.2 sq mi in Ballona Creek/Urban Watersheds are made up of roadways, highways and freeways (CRWQCB, 2007).

Transportation and related activity on roadways, freeways and highways generate a number of pollutants of concern which arise from several sources. For example, hydrocarbons are present in fuels, motor-oil and other lubricating oils; suspended solids are generated during construction; pesticides wash-off from landscape overuse; nitrogen and phosphorous are present as additives in lubricants and in fertilizers; and heavy metals occur in fuel, lubricants, brakepads, vehicle tires, and as by-products of vehicle wear-and-tear (CRWQCB, 2007).

Pursuant to Clean Water Act Section 402(p), storm water permits are required for discharges from a municipal separate storm sewer system (MS4) serving a population of 100,000 or more. USEPA defines an MS4 as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) owned or operated by a State (SWRCB website #2).

The California Department of Transportation (Caltrans) is responsible for the design, construction, management, and maintenance of the State highway system, including freeways, bridges, tunnels, Caltrans' facilities, and related properties. Caltrans' discharges consist of storm water and non-storm water discharges from State owned right-of-ways (SWRCB website #2)

Before July 1999, storm water discharges from Caltrans' storm water systems were regulated by individual NPDES permits issued by the Regional Water Boards. On July 15, 1999, the State Water Board issued a statewide permit (Order No. 99-06-DWQ) which regulated all storm water discharges from Department owned MS4s, maintenance facilities and construction activities. The existing permit (Order No. 99-06-DWQ) will be replaced upon adoption of a new permit (SWRCB website #2).

Caltrans' Storm Water Management Plan (SWMP) describes the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters. Additional information, including technical reports characterizing various aspects of runoff from highways and BMP effectiveness, can be found at the following websites (SWRCB website #2).
http://www.waterboards.ca.gov/water_issues/programs/stormwater/gen_caltrans.shtml

http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/index.htm#SWMP

Each Caltrans district has a workplan which outlines the planned stormwater activities for the upcoming fiscal year. The Los Angeles Regional Board is contained entirely with Caltrans District 7; its workplan includes information about the district's water bodies, best management practices (BMPs) by each division, monitoring programs, corridor studies and TMDLs. It describes how the District will specifically implement the requirements of the Statewide Stormwater Management Plan (SWMP) during fiscal year 2009-2010.

Current goals of District 7 include improving compliance-monitoring practices, enhancing BMP implementation, and extending public outreach. Following are some of the goals for the respective Stormwater Departments:

- To achieve these goals, the District Stormwater Coordinator and Design Stormwater Coordinator have committed to update the Treatment BMP spreadsheet for Treatment BMP locations which fulfills the requirement from Headquarters to maintain a database of all treatment BMPs implemented in each District, and as a result, the entire department.

- The Design Stormwater Unit facilitates the incorporation of water pollution and erosion control recommendations into the planning, design, and construction of all projects in District 7.
- The TMDL Unit participates in implementation plans of adopted TMDLs with waste load allocations assigned to the District.
- The Corridor Studies Unit will oversee the studies for the treatment or reduction of the Department's stormwater discharges, in each identified watershed, by at least 20% below 1994 levels.
- The Construction Stormwater Unit properly implements the SWMP and the DWP within the Division of Construction.
- The Maintenance Unit implements a stormwater program with its allocations that utilizes best management practices for stormwater projection during all of its roadway maintenance activities. The District is committed to applying vegetation control products to minimize usage and/or eliminate pollutant runoff. The District is committed to inspect, repair or clean storm drain systems.
- The Encroachment Permit Stormwater Unit ensures that all permits issued to agencies and other public entities encroaching into the Department's Right-of-Way comply with the NPDES Permit that is consistent with what is required of Maintenance, Construction, and Design.
- The Right-of-Way Stormwater Unit complies with the NPDES permit as required through the SWMP.

The District has also committed to implement BMPs appropriate to the projects, additional education for the staff and the public in partnership with other stakeholders bring the urgency of eliminating stormwater runoff pollution (Caltrans, 2010).

ADDITIONAL SOURCES

Atmospheric Deposition

Deposition of airborne pollutants is recognized as a potentially significant source of contamination to waterbodies in the watershed. The Santa Monica Bay Watershed is situated within the South Coast Air Basin, which experiences the nation's worst air quality. Contaminants that are found to originate from atmospheric deposition include, but are not limited to, chlorinated organic compounds, metals, PAHs, and oxides of nitrogen. The most plausible sources of these pollutants (except chlorinated organic compounds) are deposition of vehicle fuel exhaust and wear of auto parts (CRWQCB, 1997).

It is estimated that most airborne pollutants are carried eventually to waterbodies by storm water runoff, both wet deposition as intercepted by rain drops, and dry deposition as scoured by surface flows. Atmospheric deposition directly to the Bay can be significant when wind direction changes and push air from inland to the sea. Other notable sources of direct deposition include air traffic and wildfire (CRWQCB, 1997).

A study that measured and modeled atmospheric deposition on Santa Monica Bay and the Santa Monica Bay WMA was conducted by SCCWRP and reported on in 2001. This study was designed to answer the following questions:

- What is the total annual load of toxic contaminants and nutrients to Santa Monica Bay/Watershed via atmospheric deposition?
- What proportion of the annual load of toxic contaminants and nutrients from atmospheric deposition is contributed during specific meteorological events or conditions?
- How do atmospheric concentrations of toxic contaminants and nutrients and associated loads vary spatially within the Santa Monica Bay watershed and receiving water and among other regions of Los Angeles (Stolzenbach, et al., 2001)?

The major findings and conclusions of this study were:

- The annual rate of atmospheric transport and deposition of trace metals to Santa Monica Bay, defined as the sum of direct and indirect (on the watershed) deposition, is significant relative to other inputs of metals to the Bay.
- The annual total of atmospheric deposition of metals on Santa Monica Bay and its watershed is primarily the result of chronic daily dry deposition throughout the year, which far exceeds the estimated annual dry deposition of metals resulting from Santa Ana conditions and the annual wet deposition of metals.
- Most of the mass of metals deposited by dry deposition on Santa Monica Bay and its watershed originates as relatively large (bigger than 10 microns) aerosols from area sources (off-road vehicles and small businesses) in the Santa Monica Bay watershed.
- The relative amounts of chromium and zinc contributed by atmospheric and non-atmospheric sources are approximately equal; on the other hand, almost all of the lead inputs to Santa Monica Bay are through atmospheric sources. Non-atmospheric inputs contribute the majority of copper and nickel to the Bay.

The major implications for environmental management are:

- At least for metals, direct atmospheric deposition, primarily chronic daily dry deposition, must be considered as a significant nonpoint source in establishing TMDLs for Santa Monica Bay and waterbodies in the Bay's watershed.
- For some metals, the majority of the metal mass in the urban runoff during the wet season may be material originally associated with aerosols that are transported some distance from their original point of emission into the atmosphere before being deposited in the watershed.
- Reductions of nonpoint source inputs may require a coupling between air quality and water quality regulatory actions and policies. For metals, the most important sources of emission to the atmosphere are non-permitted area sources, which may be relatively difficult to regulate.
- For some sources, the deposition may be primarily composed of large aerosols and may occur very locally, perhaps within 100-500 meters of the source. This pattern of deposition will be difficult to monitor on a regional scale and will require a larger number of localized measurements (Stolzenbach, et al., 2001).

Contaminated Sediments

Contaminated sediment problem areas in the Bay include DDT- and PCB-contaminated sediments around the JWPCP outfall on the Palos Verdes Shelf and Slope, and around the Hyperion Plant outfall in the Santa Monica submarine canyon (CRWQCB, 1997).

Over the last 20 years, there has been a substantial increase in our knowledge about the characteristics of sediments and sediment contamination on the Palos Verdes Shelf. Most of the information comes from the natural resource damage assessment conducted by trustees of a National Oceanic and Atmospheric Administration (NOAA) lawsuit and studies conducted by the SMBRP (CRWQCB, 1997).

Based on the NOAA assessments and other existing information, the U.S. EPA in July 1996 began a Superfund investigation of the contaminated sediments on the Palos Verdes Shelf. Under this investigation, EPA recently completed a site characterization investigation and feasibility analysis and selected a preferred alternative for cleanup of the site (CRWQCB, 1997). More information on these studies are found elsewhere in this document.

Currently, disposal of dredged material is not a significant source of pollutant loading in Santa Monica Bay. The Ballona Creek Entrance Channel is one area of concern for sediment buildup and where periodic maintenance dredging is carried out. Dredged material from these sites is disposed of directly on the beach if it is deemed "clean" and is otherwise compatible (coarse-grained) or is placed in the nearshore zone so that waves can redistribute the sand onto the beach. No permanent solution has been reached for disposal of contaminated sediment. Ocean disposal within Santa Monica Bay is unlikely since there is no permitted ocean dumpsite located in the Bay at this time (CRWQCB, 1997).

Sediment resuspension has been and will continue to be the major loading source for historically deposited toxic chemicals, most notably, DDT and PCBs on the Palos Verdes Shelf. Because of the large size of the contaminated area, capping will only reduce, but not eliminate the input from this source (CRWQCB, 1997).

Water Supply

Water supply could become a source of pollutant loading if the concentration of certain pollutants in either imported water or pumped ground water exceeds the "background" level of existing surface waters. It could be a concern when water supply is considered the only or major source of the pollutant (CRWQCB, 1997).

Natural Sources

In 2007 SCCWRP released a report entitled “Assessment of Water Quality Concentrations and Loads from Natural Landscapes.” The overall goal of this study was to evaluate the water quality contributions and properties of stream reaches in natural catchments throughout southern California. Specific questions addressed by this study were:

- What are the ranges of concentrations, loads, and fluxes of various metals, nutrients, solids, algae, and bacteria associated with storm and non-stormwater runoff from natural areas?
- How do the ranges of constituent concentrations and loads associated with natural areas compare with those associated with urban (developed) areas and existing water quality standards?
- How do the environmental characteristics of catchments influence constituent concentrations and loads from natural landscapes?

These questions were addressed by measuring surface water quality at 22 natural open-space sites spread across southern California’s coastal watersheds including two sites within the Santa Monica Bay WMA; Arroyo Sequit in the North Coast Area and Cold Creek within the Malibu Creek Watershed.

The results of this study yielded the following conclusions:

- Concentrations and loads in natural areas are typically between one to two orders of magnitude lower than in developed watersheds.
- The wet-weather TSS concentration from natural catchments was similar to that from developed catchments.
- Differences between natural and developed areas are greater in dry weather than in wet weather
- Dry weather loading can be a substantial portion of total annual load in natural areas.
- Peak concentration and load occur later in the storm in natural areas than in developed areas.
- Natural catchments do not appear to exhibit a stormwater first flush phenomenon.
- Concentrations of metals from natural areas were below the California Toxic Rule criteria.
- The ratio of particulate to dissolved metals varies over the course of the storm.
- Wet-weather bacteria concentrations for *E. coli*, *enterococcus*, and total coliform exceeded freshwater standards in 40 to 50% of the samples.
- Concentrations of several nutrients were higher than the proposed USEPA nutrient guidelines.
- Catchment geology was the most influential factor on variability in water quality from natural areas.
- Catchments underlain by sedimentary rock generally produce higher constituent concentrations than those underlain by igneous rock.
- Other environmental factors such as catchment size, flow-related factors, rainfall, slope, and canopy cover as well as land cover did not significantly affect the variability of water quality in natural areas (Stein and Yoon, 2007).

Other Sources

Besides trash and debris generated in the watershed and carried to the ocean via storm flows, beach littering and boating wastes are two other important sources of marine debris. Although the high number of beachgoers and recreational boats utilizing the Bay suggests that the scale of the problem could be large, there is little information regarding the contribution of marine debris from these sources compared with stormwater/urban runoff (CRWQCB, 1997).

In, addition to marine debris, boating activities (and in particular boat maintenance) have been known to be the major source of TBT found in marinas and harbors. Boating activities are also potential sources of pathogens, oil and debris, and the heavy metals copper and zinc (the former from anti-fouling paint and the latter from zinc anodes) (CRWQCB, 1997).

If. not contained, a major oil or hazardous materials spill can cause considerable ecological damage and contribute to the total pollutant loading of polycyclic aromatic hydrocarbons in the watershed. However, large scale spills are generally rare in Santa Monica Bay; most reports of oil spills/sheens over the past three years involve amounts of a few gallons. The majority of larger spills into the Santa Monica Bay WMA involve sewage (CRWQCB, 1997). Spills reported to the California Emergency Management Agency can be viewed as reports at the website http://www.oes.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=1; the spill list can be narrowed down through a search (CEMA website).

Watershed Stakeholder Groups

There are a large number of watershed stakeholder groups with interests in the Santa Monica Bay, both the ocean and the watersheds draining to it. While many meet and conduct activities that focus on their own areas of interest, they will often participate in some of the larger scale groups as well which are highlighted below.

Santa Monica Bay Restoration Commission (formerly, Santa Monica Bay Restoration Project) The Santa Monica Bay Restoration Project (SMBRP) was formed in 1989 under the National Estuary Program in response to the crucial problems of the Bay. The SMBRP was charged with the responsibility of assessing the Bay's problems, developing solutions and putting them into action. Under the five year development process outlined in the Clean Water Act, a comprehensive characterization of the Bay's environmental condition and a plan of action was structured with the involvement of a diverse group of stakeholders organized into SMBRP's Management Conference (Management Committee, Technical Advisory Committee and Public Advisory Committee). The organization and membership of the Bay Watershed Council expanded from the pre-BRP SMBRP Management Conference and became representative of the key stakeholders for the watershed (CRWQCB, 1997). The Bay Commission is now composed of a Watershed Council, Governing Board, Executive Committee, and Technical Advisory Committee (CRWQCB, 2007) More information may be found at http://www.santamonicabay.org .

The scientific characterization of the Bay was described in the SMBRP's "State of the Bay, 1993" report and other technical investigations. This report, along with the Project's recommendations for action, comprised the Bay Restoration Plan (BRP), which was approved by the Governor Wilson and the EPA Administrator Carol Browner in March 1995. With over 200 actions, the Plan addressed the need for pollution prevention, public health protection, habitat restoration and comprehensive resource management (CRWQCB, 1997).

Guided by a watershed perspective, the Bay Restoration Plan recommended many watershed/ subwatershed-based pollutant management strategies and actions and thus became the first watershed management plan developed in the Los Angeles Region (CRWQCB, 1997).

Malibu Creek Watershed Council (with subcommittees) A number of stakeholders began meeting in the late 1980's/early 1990's in the Malibu area. Through their efforts, a list of priority issues that need to be resolved was formulated. This lead to the development of a Natural Resources Plan for the watershed which was prepared by the U.S. Natural Resources Conservation Service. Separate task forces and subcommittees have formed over the years to address specific issues. The Watershed Council consists of members from State and local agencies and organizations, environmental groups, business and dischargers, special districts and the general public. Their mission is to oversee and implement actions that will protect, enhance and restore habitats of the watershed, as well as improve water quality. Current active committees/task forces under the Council include those focusing on habitat/species, monitoring/ water quality, education, and Rindge Dam. The Council's Malibu Lagoon Task Force served as an advisory group to a recently completed lagoon restoration plan. A copy of the final lagoon restoration plan funded by the Coastal Conservancy may be found at http://www.healthebay.org/currentissues/mlhep/default.asp. The Monitoring Subcommittee also met regularly to serve as a Technical Advisory Committee to a Proposition 13-funded watershed-wide monitoring program which has been completed. It is currently working to establish a central repository for monitoring metadata for the watershed. A Malibu Creek Ecosystem Restoration Feasibility Study is underway. The U.S. Army Corps of Engineers and California Department of Parks and Recreation are the major partners in this effort which will evaluate, among other options, the feasibility of restoring the ecosystem through removal of Rindge Dam. The technical advisory group for the effort meets approximately monthly while a larger stakeholder focus group meets as needed. Watershed Council meetings occur every other month while subcommittees may meet intermittently or regularly. More information may be found at http://www.malibuwatershed.org/ (CRWQCB, 2007).

Ballona Creek Watershed Task Force The task force was formed in 2000 as a stakeholder group addressing water quality and habitat issues in the watershed and developing a Ballona Creek Watershed Management Plan which can be found at http://www.ladpw.org/wmd/watershed/bc. The group continues to meet in pursuit of Plan implementation (CRWQCB, 2007).

Topanga Watershed Committee The committee was formed in 1998 as a followup to previous a community group working on developing alternatives to traditional flood control measures. Their focus has expanded to include general watershed management and protection activities as well as volunteer monitoring. Work has also been completed to define the extent of restoration feasible to Topanga Lagoon. A 205(j) grant-funded project conducted baseline water quality monitoring for two years during both dry- and wet-weather. A watershed management plan was finalized in 2002. Watershed residents continue work on implementation of actions identified in the Management Plan. The group meets on an as-needed basis. More information about this group may be found at their website http://www.topangacreekwatershedcommittee.org (CRWQCB, 2007).

Water Quality and Beneficial Use Issues By Subwatershed Areas

This section provides summaries of water quality issues for nine subwatershed areas in the Santa Monica Bay watershed. These nine subwatershed areas are grouped from 28 catchment basins based on their distinctive geographical (topographical and land use) characteristics. Descriptions on each of the nine regions are confined to the land and coastal water areas (areas defined as "waters of the state") and span 414 square miles. Collectively they are known as the ***Santa Monica Bay Watershed Management Area***. Issues related to ocean water outside the "waters of the state" are addressed in a separate "Ocean" section (CRWQCB, 1997).

Each summary of the subwatersheds (including the "Ocean" section) includes a general description of the region, listed of identified beneficial uses, evidence of beneficial use impairments, list of pollutants of concern, information on sources and loading, and water quality improvement strategies. Descriptions and discussion emphasize issues that are specific to and/or a priority in a subwatershed area (CRWQCB, 1997). As appropriate or useful, maps shown in earlier sections of the report are shown again, now zoomed to the subwatershed under discussion.

North Coast

The North Coast region represents one of nine different subwatershed groups that drain to Santa Monica Bay. This subwatershed drains an area of approximately 55 square miles and borders the eastern portion of Ventura County to the west, the Malibu Creek subwatershed to the north and east, and the Pacific Ocean to the south. Several minor streams and creeks discharge directly to the Bay, but there are no major traditional point sources discharges in this subwatershed; permits for discharges to land are generally for on-site septic systems. The area is largely undeveloped, has similar land use activities and pollutant load characteristics, and the immediate receiving waterbody is generally considered pristine (CRWQCB, 1997).

Flows

A number of creeks and streams in the North Coast subwatershed flow directly into Santa Monica Bay. The largest of these creeks are Arroyo Sequit and Trancas. Together, the flows in this region total approximately 5,500 acre-feet per year (CRWQCB, 1997).

Land Uses

Although this region is rural, there is still evidence of development in the North Coast subwatershed. Most of the development is located close to the coastline, near Point Dume and just north of Malibu Creek and Lagoon. Additionally, a few areas in the upper subwatershed area have been developed, but the percentage is relatively small. Land use activities can be broken down into the following: 92% open space, 7% residential, and less than 1% for commercial/industrial and public (CRWQCB, 1997).

Wetlands

The North Coast region is home to some of the County's last remaining wetlands. They can be found in the drainage areas of Arroyo Sequit Canyon, Trancas Lagoon and Lower Zuma Creek and Lagoon; each varies in both type and function. The Arroyo Sequit Canyon, and Zuma Creek and Lagoon areas are considered riparian freshwater wetlands while Trancas Lagoon represents a more typical saltwater coastal wetland. The drainage areas of these creeks and lagoons lie within the Santa Monica Mountains National Recreation Area, as do several others in this subwatershed. Local wetlands serve several purposes, including providing essential habitats for a diversity of species such as birds, fish, amphibians, reptiles, invertebrates, and mammals. They also act as natural filters which are able to absorb, retain and remove pollutants from the water, recharge groundwater, and they provide flood protection, recreational use, and aesthetic value. The lagoons provide feeding and resting areas for shore birds and migratory waterfowl (CRWQCB, 1997).

<u>Arroyo Sequit Canyon</u> Arroyo Sequit is located approximately 28 miles west of the City of Santa Monica and is one of the best preserved small coastal drainages in the Santa Monica Bay watershed. The drainage area of this canyon is approximately 7,203 acres. The riparian wetlands located there begin at the confluence of the East and West Forks of Arroyo Sequit and extend 3.2 miles to the Pacific Ocean, where a small coastal lagoon has formed. The habitat is primarily sycamore alluvial woodland. Stream flow supports a wide variety of native aquatic animals, including resident and migratory populations of rainbow and steelhead trout. However, the lower floodplain has been encroached upon by the camping facility for Leo Carillo State Beach. Barriers to fish passage and the presence of various invasive species are also concerns. Restoration of the riparian and lagoon habitats is important for native plant and wildlife species (CRWQCB, 1997).

<u>Zuma Creek and Lagoon</u> The Zuma Creek and Lagoon drainage area, of approximately 5,722 acres, is mostly undeveloped national parkland and open space. Lower portions of the creek are channelized in places, and there is a residential area adjacent to the stream just north of the Pacific Coast Highway bridge. The riparian corridor is supported by a small perennial stream, providing the primary source of water for the generally closed lagoon. Freshwater wetland vegetation can also be found there, although it is severely stressed during periodic drought conditions. This area also supports a dune habitat. In dry years, there is typically little water present, but with increased runoff from development and during "wet" years, a larger two-acre lagoon has formed. However, this lagoon has most likely fluctuated in size over time. The area is currently degraded due to past dumping practices and the presence of non-native vegetation. Barriers to fish passage are also of concern and a top priority of the SMBRC (CRWQCB, 1997).

<u>Trancas Creek and Lagoon</u> Trancas Lagoon is a small coastal lagoon approximately nine acres in size located several miles west of Point Dume in Los Angeles County and is fed by numerous small tributaries. However, some runoff enters the lagoon from hillsides and from adjacent land uses, such as residential, commercial, and local roadways (CRWQCB, 1997).

Trancas Creek drains a watershed of 6,233 acres. The mouth of the creek is often closed by sand bars which form due to wave action and littoral transport of sand. The berm closes the system to tidal action and causes the creek flow to back up within the lagoon. In the past, the lagoon was mechanically breached periodically in order to allow outflow and to prevent local flooding. A cement and boulder lined debris basin has been built 0.8 miles up Trancas Canyon and ends at a broad basin just east of PCH near Trancas Beach. The mouth of Trancas Creek has been highly constricted by fill. A shopping center and nursery operation border one side of the lagoon and an old, vacant horse riding area borders the other side (CRWQCB, 1997).

<u>Solstice Canyon Creek</u> Solstice Canyon is home to some of Santa Monica Bay watershed's unique wetlands. Specifically, the Solstice Canyon wetlands are palustrine, i.e., non-tidal wetlands dominated by vegetation. Streams feeding these wetlands are intermittent, flowing only part of the year and the stream corridors are typically steep, narrow and highly erosive. This confines riparian vegetation

to the immediate stream channel area (CRWQCB, 1997). The invasive New Zealand mudsnail is of great concern in this area.

Beneficial Uses

The North Coast subwatershed is host to many beneficial uses as can be seen in the table below (CRWQCB, 1994).

Table 4. Beneficial uses of the waters within the North Coast subwatershed

Coastal Feature or Waterbody	Hydro Unit #	MUN	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Arroyo Sequit	404.44	P	I		E	E		E	E			E	E	E	E		E
San Nicholas Canyon Creek	404.43	P			I	I		I				E					
Los Alisos Canyon Creek	404.42	P			I	I		I				E	E				
Lachusa Canyon Creek	404.42	P			I	I		I				E					
Encinal Canyon Creek	404.41	P			I	I		I				E	E				
Trancas Canyon Creek	404.37	E			E	E		E				E	E				
Dume Lagoon	404.36			E	E	E	E			E		E	E	Pf	P		E
Dume Creek (Zuma Canyon)	404.36	E			E	E		E	E			E	E	P	P		
Ramirez Canyon Creek	404.35	I			I	I		I				E			P		
Escondido Canyon Creek	404.34	I			I	I		I				E	E				
Latigo Canyon Creek	404.33	I			I	I		I				E	E				
Solstice Canyon Creek	404.32	E			E	E		E				E		P	P		
Puerco Canyon Creek	404.31	I			I	I		I				E					
Corral Canyon Creek	404.31	I*			I	I		I				E					
Nicholas Canyon Beach	403.43			E	E	E	E				E	E			P	E	
Trancas Beach	403.37			E	E	E	E				E	E			P	E	
Zuma County (Westward) Beach	404.35			E	E	E	E				E	E			P	E	
Dume State Beach	404.36			E	E	E	E				E	E			P	E	
Dume Lagoon	404.36			E	E	E	E			E		E	E	P	P		E
Escondido Beach	404.34			E	E	E	E				E	E			P	E	
Dan Blocker Memorial (Corral) Beach	404.31			E	E	E	E	E			E	E			P	E	
Puerco Beach	404.31			E	E	E	E				E	E			P	E	
Amarillo Beach	404.21			E	E	E	E				E	E			P	E	

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Significant Regions

Sections offshore of the North Coast subwatershed (from the Ventura County line to Latigo Point) have been designated as an Area of Special Biological Significance (ASBS) by the State Water Resources Control Board (SWRCB); portions of the land area have been designated as Significant Ecological Areas (SEA) by Los Angeles County. These areas require protection of species or biological communities to the extent that alteration of natural water quality is undesirable, and that the preservation of natural water quality be maintained to the extent practicable. Zuma Canyon, Arroyo Sequit and Point Dume are three such designated areas in this region (CRWQCB, 1997).

The North Coast is also home to state and federally listed endangered species such as *Pentachaeta lyonii* (an endangered plant), *Vireo Belli/* pusillus (an endangered bird), and steelhead trout (an endangered anadramous fish) (CRWQCB, 1997).

The area falls within the Santa Monica Mountains biogeographic population group described in the Draft Steelhead Recovery Plan; the value of and threats to the Core 1 population of fish within Arroyo Sequit, specifically, are highlighted while Solstice Creek is considered to be currently occupied by a Core 2 population. The Core 1 populations are those populations identified as a high priority for recovery actions based on a variety of factors, including: the intrinsic potential of the population in an unimpaired condition; the role of the population in meeting the spatial and/or redundancy viability criteria; the conditions of the population, the severity of the threats facing the populations; the potential ecological or genetic diversity the watershed and population could provide to the species; and the capacity of the watershed and population to respond to the critical recovery actions needed to abate those threats. Core 1 populations form the nucleus of the recovery strategy. Core 2 populations must eventually meet the biological recovery criteria; however, these populations are considered to be of secondary importance in terms of recommended priority of recovery efforts (NOAA, 2009).

Local Parks and Beaches

Zuma Beach is one of the most heavily used beaches in Los Angeles County. Hundreds of thousands of residents and tourists use the area for sunbathing and surfing activities each year. Additionally, educational meetings and field trips are held there for local students and the general public. In 2000, the SMBRC, together with the National Park Service, Los Angeles County Department of Beaches and Harbors, with additional funding from USEPA, completed the restoration and enhancement of lower Zuma Creek and Lagoon. Zuma Wetlands is a small, 6-acre, freshwater marsh and creek situated just north of Point Dume. The wetlands have historically served as a wildlife corridor and nesting site for a variety of birds and small mammals. By the early 1990s, periodic dumping of surplus construction and road building material had heavily impacted the wetlands and surrounding uplands. The existing wetlands had been greatly reduced and, in many areas, native species had been completely replaced by exotic ornamental trees, annual grasses, fennel, mustards, and thistles. High visitation at Zuma Beach also impacted the site (SMBRC website). Barriers to fish passage are also of concern and a top priority of the SMBRC.

Despite the long-term habitat degradation, studies indicated that the site had high potential for successful restoration. In the fall of 1993, federal, state, and nonprofit conservation agencies began planning efforts for a restoration of the remnant freshwater marsh, riparian woodland, saltgrass terrace, and locally rare foredunes at the site. A final restoration plan was completed in April 1997 and in 1998 restoration began. Over the next two years, excavation of construction fill, recontouring of upland habitats, removal of exotic plant species, in-planting of more than 5000 native plants, and the re-creation of an additional two acres of freshwater wetland/dune/riparian habitat was accomplished. The resulting restored wetland has an unusually diverse and highly valuable habitat for wildlife. As an example, more than 110 bird species were recorded over a one-year monitoring period. The project continues to be monitored for exotic species control and habitat protection (SMBRC website).

Leo Carillo State Beach is another popular beach in the North Coast subwatershed. This beach offers many of the same opportunities **as** Zuma Beach, in addition to providing camping grounds, hiking and biking opportunities and many other outdoor activities (CRWQCB, 1997).

Evidence of Impairment

While the beaches are listed as impaired for indicator bacteria and fish consumption, to date there is no documented evidence of impairment from pollutants of concern in the North Coast subwatershed streams, although potential pollution problems exist for areas not in public stewardship (CRWQCB, 1997).

However, this region is threatened by invasion of non-native plant and animal species, sedimentation and erratic stream flows, trash and debris, septic systems and is frequently used by transients which limit diversity and density of plants and wildlife, and pose public safety concerns (CRWQCB, 1997).

Habitat Degradation

Invasive New Zealand mudsnails were first discovered in Solstice Creek in 2007 and in Ramirez and Trancas Creeks in 2009. The individual snails are very small, only 3 – 5 mm long. Each snail can reproduce enormous amounts of offspring through a cloning process called parthenogenesis which can result in very high snail densities on the bottoms of streams which displace native aquatic invertebrates utilized by fish and amphibians for food; they can easily be transferred to other streams through contact with animals or recreational/monitoring equipment. They do not appear to have any natural native predators (SMBRF, 2009).

Pollutants of Concern

There are no associated pollutants of concern for the inland waters of the North Coast subwatershed due to limited human activity in this area. However, as mentioned above, the threat of trash and debris, oil spills and possibly even excessive sedimentation are potential issues for the region. Beaches along Santa Monica Bay, including the ones of this subwatershed, are listed as impaired for indicator bacteria and fish consumption (CRWQCB, 1997).

Sources and Loadings

There are links between potential sources of pollution with pollutants (as identified above) that may threaten the waterbodies and habitats of this region (CRWQCB, 1997).

Trash and Debris

Trash and debris found in the creeks and lagoons most likely comes from improper disposal of waste by beach-goers, visitors, transients and residents. This trash and debris adversely impacts the sensitive habitats of the area as well as creating an aesthetic nuisance (CRWQCB, 1997).

Oil Spills

The threat of spills to the Bay resulting from oil tankers exists given the continual oil transporting activities that occur along California's coastline. Ocean currents have the potential to transport oil from spills directly to the shoreline, thereby significantly degrading this sub-watershed's special coastal habitats (CRWQCB, 1997).

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been properly implemented, improper land grading activities, horse and animal farms located too close to waterbodies, and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and streams, which ultimately flow to the lagoons and ocean. Furthermore, fire residual may be washed down by storm runoff, thereby contributing excessive sediments and nutrients to the watershed's receiving waters (CRWQCB, 1997).

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the North Coast subwatershed could be achieved by focusing efforts on the following:

- Protect and restore remaining wetlands in the North Coast subwatershed.
- Implement measures to control excessive sedimentation.
- Implement measures to reduce the amount of trash and debris.
- Prevent the introduction of and reduce/eliminate non-native invasive species where feasible.
- Examine the use of septic systems in this subwatershed, particularly near the coastline (CRWQCB, 1997)
- Conduct source identification
- Implement TMDLs

Wetlands Protection and Restoration

Although federal and state regulations seek to protect wetlands from being filled in unnecessarily and assure mitigation of unavoidable impacts, there needs to be more coordination at the local level to ensure protection of the unique wetlands found in this region. Because the wetlands in this subwatershed are affected by the land use activities and water quality impacts that occur upstream, as well as invasion of non-native species, any restoration activities taking place should consider these issues. The SMBRC's Bay Restoration Plan identifies specific actions that can be taken to protect and restore Trancas Lagoon, Arroyo Sequit Canyon and other priority wetlands found throughout the Santa Monica Bay watershed. Development of a comprehensive plan should address identified pollutants and sources found in the North Coast subwatershed and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration (CRWQCB, 1997). Additionally, the State's Wetlands Policy and the Southern California Wetlands Recovery Project (WRP) (described elsewhere in the document) are working to ensure wetlands protection and restoration occurs.

Zuma Canyon Creek and Lagoon In 2000, restoration and enhancement of lower Zuma Creek and Lagoon was completed. The project continues to be monitored for exotic species control and habitat protection (SMBRC website).

A Zuma Canyon restoration and steelhead enhancement feasibility study is on the WRP workplan as a Tier 2 project. The project is estimated to cost $400,000 and would restore 3.5 acres of agricultural area near the entrance of Zuma Canyon on steep slopes that has been planted in avocados. About four acres of agricultural land adjacent to the creek in the coastal plain has already been restored with SMBRC funds. In addition, the National Park Service will expand on the initial baseline habitat assessment by Caltrout, and determine habitat quality and feasibility of steelhead restoration in Zuma Creek, including a habitat assessment, fish passage evaluation, and development of a conceptual restoration plan. A funding source has not yet been identified for the remaining 3.5 acres (SCWRP website #2).

Trancas Canyon Creek and Lagoon The WRP has identified a parcel adjacent to the lagoon for acquisition (Birosik, personal notes).

Solstice Canyon Creek Solstice Creek has been identified as a primary candidate for recovery of the southern steelhead trout, a federal endangered species. Design plans were completed for a project on the WRP workplan to restore steelhead access to approximately 1.5 miles of Solstice Creek. Seven barriers in the National Recreation Area were removed in 2006 and a box culvert within the City of Malibu at the Corral Canyon Road crossing was replaced with a clear span bridge over Solstice Creek. The final fish passage barrier is at Pacific Coast Highway. This project will be a CalTrans Environmental Enhancement and Mitigation program project that would modify the culvert at PCH downstream of the proposed project area. Additionally, acquisition of various parcels near the creek are of importance to preserve habitat linkages (SCWRP website #2).

Arroyo Sequit The middle to upper Arroyo Sequit between State Parks and National Park has an identified gap that could be filled through acquisition from a willing seller (Birosik, personal notes).

Control of Excessive Sedimentation

Sediments are transported by creeks and streams to lagoons and ultimately the ocean. It is a necessary and natural function that replenishes beaches along the coastline. However, excessive sedimentation can be harmful to downstream habitats (as discussed previously) and efforts must be made to control unnatural sediment loads from reaching the local creeks and streams. These efforts should include promoting proper implementation of runoff controls at construction sites, planting native species that will prevent erosion of hillsides and stabilize topsoils, educate appropriate audiences about the impacts of improper land grading activities, and educate owners of horse/animal farms about how the location of their livestock can contribute to sedimentation of adjacent creeks and streams (CRWQCB, 1997).

Reduction of Trash and Debris

Although problems resulting from trash and debris are intermittent and do not pose a constant threat to this watershed, appropriate action should be taken where recurrent problems arise. This may include installing additional trash receptacles, educating the local public and visitors, posting informational signs, installing "trash nets" and establishing volunteer programs where people can serve as both watchdogs and support for cleanup activities (CRWQCB, 1997).

Removal of Non-native Invasive Species

Non-native species limit diversity of local, native plants and animals. Location and types of non-native species throughout the North Coast subwatershed should be identified and mapped. Once this information has been prepared, an assessment should be performed in priority habitats on the feasibility of eliminating non-native species and restoring the area with native, indigenous species (CRWQCB, 1997).

In 2002, the California Department of Fish and Game began developing a plan to coordinate state programs, create a statewide decision-making structure and provide a shared baseline of data and agreed-upon actions so that state agencies may work together more efficiently. In January 2008, with input from multiple state agencies, the public, and other stakeholders, the California Aquatic Invasive Species Management Plan (CAISMP) was approved by the Governor. The CAISMP seeks to identify the steps necessary to minimize the harmful impacts of aquatic invasive species (AIS) in California. More than 160 management actions are organized under the following eight objectives: Coordination & Collaboration, Prevention, Early Detection & Monitoring, Rapid Response & Eradication, Long-term Control & Management, Education & Outreach, Research, and Laws & Regulation. The implementation of the highest priority actions was initiated in 2008 with the formation of the California Aquatic Invasive Species Team (CAAIST). The CAAIST's mission is to coordinate the activities of state agencies charged with implementation of the CAISMP. CAAIST is composed of representatives from over 25 California state agencies, including the Santa Monica Bay Restoration Commission. If the priority actions of the CAISMP can be successfully implemented, California resource managers and policy makers will have taken a huge step forward in the effort to prevent new invasions and minimize impacts from established AIS (SMBRF, 2009).

Examination of Septic Systems

Septic systems are located throughout the North Coast subwatershed. Although there is no direct evidence that septic systems have impaired the beneficial uses or degraded water quality of this subwatershed, they have the potential to leak bacteria and nutrients which can then migrate to sensitive habitats and the surf zone. Special attention should be given to them due to these concerns and other associated problems found in adjacent subwatersheds. Special focus could be given to monitoring water quality in the creeks and lagoons for presence of human pathogens and along the surf zone where potentially problematic septic systems have been identified (CRWQCB, 1997).

Conduct Source Identification

Source Identification Pilot Study The beaches adjacent to the mouths of Ramirez and Escondido Canyons exhibited high levels of fecal indicator bacteria from 2004 through 2006, prompting a study to identify the sources of fecal indicator bacteria and to develop a source tracking protocol that can be used at other beaches in southern California. SCCWRP has been conducting a source identification pilot study in Ramirez Canyon and Escondido Canyon, funded largely by the County Supervisors (SCCWRP website #2).

During the first phase of the study, bacterial surveys of the entire watershed were conducted to identify problem locations that might be contributing to high concentrations at the beach. Fecal bacteria indicators (Enterococcus and total and fecal coliforms), human Bacteroides, optical brighteners, and flow rates were sampled adjacent to key land use areas and at critical tributary confluences. The beach was sampled at the creek mouth and at sites up and down coast. The surveys were conducted weekly from March through May in 2007-2009 (SCCWRP website #2).

The two key findings from this first phase were that: 1) the high bacterial counts observed at the beach during the summers of 2004-2006 were no longer prevalent, and 2) the few beach exceedances we observed did not appear to result from the watershed, which generally had low bacterial concentrations (SCCWRP website #2).

In 2010, the studies will refocus on investigating alternative sources near the mouth of the creek and offshore. These include: 1) birds on the beach and pier, 2) activities at Paradise Cove Beach Café (i.e., washing down restaurant equipment, inadequate disinfection of wastewater), 3) regrowth of enterococci in the concrete channel right near the creek mouth, and 4) contaminated groundwater (SCCWRP website #2).

Implement TMDLs

The TMDLs in effect which impact the North Coast are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. Trancas and Zuma Beaches among others in this subwatershed are listed as impaired for indicator bacteria. On the other hand, the North Coast also contains the reference subwatershed for the Santa Monica Bay beach bacteria TMDLs, Arroyo Sequit and its associated beach, Leo Carrillo. For the purpose of implementing the bacteria TMDLs, the area has been divided up into "jurisdictional groups" (JG) – most of the North Coast falls into JG1. The Nicholas Canyon area however falls into JG4. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The number of exceedance days for Nicholas Canyon is fifteen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The District, City of Los Angeles, and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned. (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the bacteria TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris TMDL

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

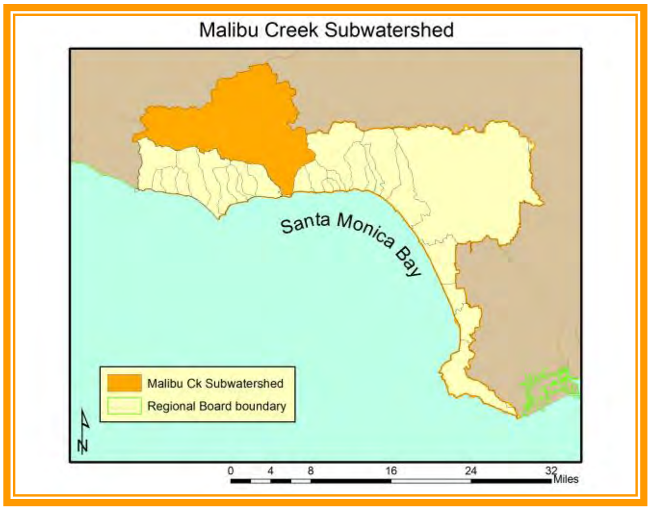
Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). Low flow diversions/treatment facilities found within the North Coast subwatershed are show in the table below.

Table 5. Low flow diversions/treatment facilities within the North Coast subwatershed

Diversion/Facility	Year Operational	Agency
Paradise Cove	2010	Malibu
Marie Canyon	2007	District

Malibu Creek



The Malibu Creek subwatershed is one of the largest draining to Santa Monica Bay. With its discharge point to the Bay at the mouth of Malibu Creek and Lagoon, it drains an area of about 109 square miles. Approximately two-thirds of this subwatershed lies in Los Angeles County and the remaining third in Ventura County. Much of the land is part of the Santa Monica Mountains National Recreation area and is under the purview of the National Parks Service. The region borders the eastern portion of Ventura County to the west and north, the North Coast subwatershed to the south, and portions of the Topanga Canyon subwatershed and Los Angeles River watershed to the east. Major tributaries contributing flows to Malibu Creek and Lagoon include Cold Creek, Lindero Creek, Las Virgenes Creek, Medea Creek, and Triunfo Creek. Additionally, five lakes and two reservoirs are located upstream from Malibu Creek; they are Malibou Lake, Lake Sherwood, Westlake Lake, Lake Lindero, Lake Eleanor, and the Las Virgenes and Century Reservoirs. Located at the end of and receiving flows from Malibu Creek is the 40-acre Malibu Lagoon. The Lagoon includes coastal salt marshes and wetlands, and is home to several diverse plant, marine and animal species (CRWQCB, 1997). The subwatershed is underlain by portions of four groundwater basins (Russell Valley, Conejo-Tierra Rejada, Hidden Valley, and Thousand Oaks) and by the entire Malibu Valley groundwater basin; the latter has not been used as a drinking water supply since 1965 and shows evidence of seawater intrusion (MWD, 2007; DWR, 2004).

Flows

At the mouth of Malibu Creek, the estimated dry-weather base flow is approximately 4-11 cfs although peak flows of more than 24,000 cfs have been recorded at the Los Angeles County gauging station in Malibu Creek during the rainy season, which is significantly more that minimum dry-weather flows (CRWQCB, 1997). The broad difference in values between minimum dry-weather and maximum wet-weather flows reflect the dominant influence of storm water runoff, which is typical of stream flow patterns in Southern California. In fact, in the Malibu Creek subwatershed over 70% of the total annual runoff occurs during the winter months, which results in approximately 13,565 acre-feet of water discharged to the Bay each year (Stenstrom and Strecker, 1993).

Land Uses

Although still relatively rural, this region's population has risen to 90,000, resulting in significant changes in types of land use activities. Consequently, artificial flows in the Malibu Creek subwatershed have increased. Today, the region's land uses are 88% open space, 3% commercial/light industry, 9% residential and less than 1% public. However, approximately 22% this subwatershed region is either part of the Santa Monica Mountains National Recreation Area or state park land and development opportunities are limited (CRWQCB, 1997).

Wetlands

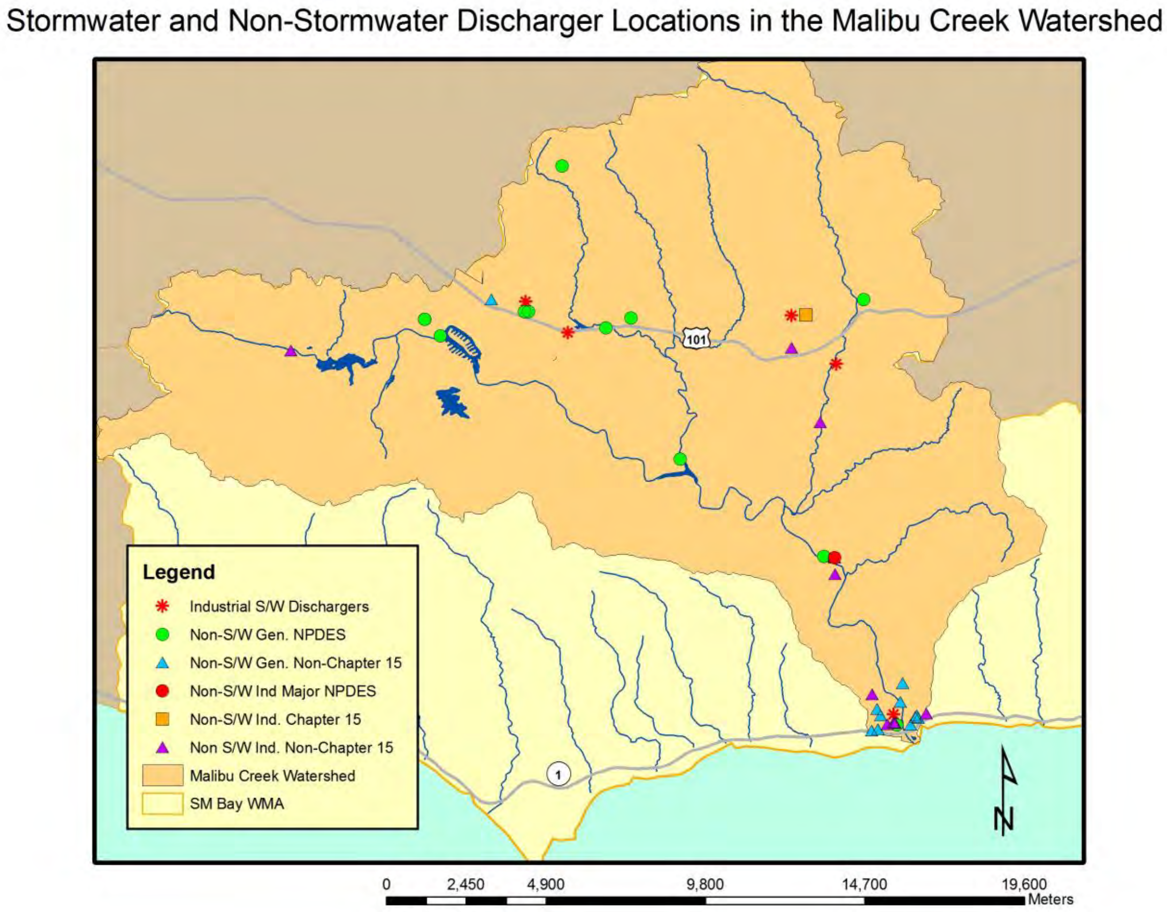
The Malibu Creek subwatershed is also home to some of Southern California's last remaining wetlands. Malibu Lagoon, located at the mouth of Malibu Creek, occupies approximately 40 acres and is characterized as a coastal saltwater wetland habitat. Prior to commercial and residential development of the adjacent and upstream areas, the total acreage of wetlands was approximately 272 acres. Although the area has been severely impacted by urbanization, it supports a variety of species including steelhead trout and tidewater goby (CRWQCB, 1997).

Permitted Discharges

The Malibu Creek subwatershed includes one permitted wastewater treatment facility, the Tapia Water Reclamation Facility, located on Malibu Canyon Road near Tapia Park serves a population of approximately 80,000 from five cities, the western portion of Los Angeles County, and a small portion of Ventura County. Tapia is a tertiary wastewater treatment plant with a design capacity of 16.1 mgd. Pollutant loadings such of TSS, BOD, and metals found in Tapia's wastewater discharges are low. The waste discharged to Malibu Creek is limited to winter months from November 16 through April 14 of each calendar year (except under certain conditions) to minimize the contribution of Tapia's discharge to the excess freshwater flow into Malibu Lagoon (which leads to elevated Lagoon level and frequent breaching of the sandbar once, or if, the sandbar has formed), thus impacting both wildlife and human health beneficial uses (CRWQCB, 1997). The average discharge to Malibu Creek in 2008 during months that a discharge occurred was 5.76 mgd (LVMWD, 2009). Tapia's recycled water is used for such activities as landscape irrigation; the biosolids generated are recycled at a state-of-the-art composting facility located nearby, then sold or given away (CRWQCB website #1). .

The Malibu Creek subwatershed also includes a number of additional permitted facilities, some of which are covered by the general industrial stormwater permit as can be seen in the figure below (CRWQCB, 2007). In addition, municipal dischargers in the watershed are covered by the Los Angeles County and Ventura County MS4 permits.

Figure 16



Beneficial Uses

The Los Angeles Regional Water Quality Control Board has designated several beneficial uses for the Malibu Creek subwatershed, including unique habitats that support a variety of marine life and wildlife, waters that are used for municipal and domestic supply and commercial and sport fishing opportunities, recreational areas that provide outdoor opportunities for tourists and residents, parks that provide educational opportunities, and groundwater recharge projects. The table below summarizes the beneficial uses designated for all waterbodies in this subwatershed (CRWQCB, 1994).

Table 6. Beneficial uses of the waters within the Malibu Creek subwatershed

Coastal Feature or Waterbody	Hydro Unit #	MUN	IND	PROC	AGR	GWR	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Malibu Lagoon	404.21						E	E	E				E	E	E	E	E	E		E
Malibu Creek	404.21	P						E	E		E	E			E	E	E	E		E
Cold Creek	404.21	P						E	E			P			E	E		P		E
Las Virgenes Creek	404.22	P						E	E		E	P			E	E	P	P		E
Century Reservoir	404.21	P						E	E		E				E					E
Malibou Lake	404.24	P					E	E	E		E				E	E				E
Medea Creek	404.23	P				I		I	I		I	P			E	E				E
Medea Creek	404.24	P				I		E	E		E				E					E
Lindero Creek	404.23	P						I	I		I				E					
Triunfo Creek	404.24	P						I	I		I				E					
Triunfo Creek	404.25	P				I		I	I		I				E	E				
Westlake Lake	404.25	P					E	E	E		E				E					
Potrero Valley Creek	404.25					I		I	I		P				E					
Lake Eleanor Creek	404.25	P				I		I	I		I				E					
Lake Eleanor	404.25	P				E		E	E		E				E	E				E
Las Virgenes (Westlake) Reservoir	404.25	E	E	E	E			P	E		P				E					
Hidden Valley Creek	404.26	I				I		I	I		I				E					
Lake Sherwood	404.26	P				E	E	E	E		E				E					E
Malibu Beach	404.21						E	E	E	E				E	E		E	E	E	

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Significant Regions

Certain sections offshore of the Malibu Creek subwatershed have been designated as Areas of Special Biological Significance by the State Water Resources Control Board (SWRCB); other land-based portions have been designated as Significant Ecological Areas (SEA) by Los Angeles County. These areas require protection of species or biological communities to the extent that 1) alteration of natural water quality is undesirable and that 2) the preservation of natural water quality be maintained to the extent practicable. The Malibu coastline, Malibu Canyon and Lagoon, Las Virgenes, Malibu Creek State Park and Cold Creek are all such designated areas (CRWQCB, 1997).

The area falls within the Santa Monica Mountains biogeographic population group described in the Draft Steelhead Recovery Plan; the value of and threats to the Core 1 population of fish within Malibu Creek are highlighted. The Core 1 populations are those populations identified as a high priority for recovery actions based on a variety of factors, including: the intrinsic potential of the population in an unimpaired condition; the role of the population in meeting the spatial and/or redundancy viability criteria; the conditions of the population, the severity of the threats facing the populations; the potential ecological or genetic diversity the watershed and population could provide to the species; and the capacity of the watershed and population to respond to the critical recovery actions needed to abate those threats. Core 1 populations form the nucleus of the recovery strategy (NOAA, 2009).

Malibu Lagoon Located at the mouth of Malibu Creek, the lagoon is a brackish waterbody, influenced by intermittent breaching events and inflows from Malibu Creek. The Lagoon serves several purposes such as providing essential habitats for a diversity of species -- birds, fish, reptiles, invertebrates and mammals -- and is an important feeding/nesting area for birds migrating along the Pacific flyway. The Tidewater Goby was reintroduced here, and subsequently declared an endangered species. The lagoon also acts as natural filter which is able to absorb, retain and remove pollutants from the water. It provides recreational use, educational opportunities, aesthetic value, flood protection and is a source of groundwater recharge. In fact, Malibu Lagoon represents one of the most significant coastal lagoons in the entire Santa Monica Bay watershed; Malibu Creek, which feeds the Lagoon, continues to be a significant steelhead trout watercourse and spawning area (CRWQCB, 1997). Malibu Lagoon is currently undergoing the initial phases of a large restoration.

Local Parks and Beaches There are several parks located in this sub-watershed, most notably Malibu Creek State Park and Malibu Creek State Beach. These grounds provide hiking, picnicking, horseback riding, bicycling and educational opportunities as well as swimming, surfing and sunbathing activities. Thousands of visitors flock to this subwatershed's parks and beaches each year and take advantage of the opportunities they provide (CRWQCB, 1997).

Evidence of Impairment

This region's environmental quality is impaired by three major causes: alterations of natural flow regime, pollutant inputs, and degradation of sensitive habitat (CRWQCB, 1997).

Alterations of Natural Flow

Due to the population increase in the Malibu Creek subwatershed, there has been a continued increase of pollutants to Santa Monica Bay from this region. At the terminus of Malibu Creek, Malibu Lagoon receives the natural and artificial runoff from the entire 109-sq. mi. watershed, which reaches as far north as Simi Hills and as far west as Thousand Oaks. While the

population utilizes imported water which can lead to increased flows to the creek from irrigation overflows, flow increases can also be attributed to increased hardscaping, and to reduced surface water diversions and withdrawals from wells since local water is no longer being utilized for domestic use (Mundy, comm. ltr.).

Rindge Dam, which was constructed in the 1924-25, has long since filled up with sediment deposits. The 100ft dam now poses problems for fish migration and spawning, where available upstream habitats are crucial to their existence. Most notably impacted by this structure are steelhead trout; the dam impacts their ability to spawn further upstream. Nevertheless, how best to deal with impacts from Rindge Dam are currently underway via a U.S. Army Corps of Engineers ecosystem restoration feasibility study (CRWQCB, 1997).

Contamination

As the volume of runoff in the Malibu Creek subwatershed increases, additional pollutant loads have impaired the region's recreational and biological resources. Advisories are posted discouraging the collection of mussels from the lagoon due to bacteria contamination. Sensitive habitats and native species also found at the Lagoon may be threatened by increased flows from the creek which disrupts the salinity regime and natural flow conditions. Critical habitats are smothered by high TSS loading. Suspended sediments also provide a transport medium for heavy metals, pesticides and other pollutants. Potential problems resulting from increased temperatures also exists in this subwatershed, due to sparse vegetative cover along segments of the creeks. Bacterial counts from water samples taken in the subwatershed creeks and Malibu Lagoon suggest the presence of harmful pathogens in downstream receiving waterbodies (CRWQCB, 1997). While algae is abundant throughout creeks and streams in the Santa Monica Mountains, Busse, et al. (2003) found while studying algae and nutrients in Malibu Creek that human development affects stream algal communities. Both algal biomass and nutrient concentrations were much lower at undisturbed and rural sites than at developed sites.

Furthermore, multiple sources such as storm drain runoff, street runoff, and development activities contribute sediments, trash and debris, and other contaminants to the waterbodies and wetlands located in the Malibu Creek subwatershed. Another source of pollution in this region, especially recently, has been what remains after fires burn in the area. Unfortunately, fire season comes directly before the rainy season so there is little or no opportunity for hillsides to restabilize naturally. The rain, consequently, washes fire residue directly to the local streams and ultimately to Malibu Creek and Lagoon. The result is an increased TSS, nitrogen compounds, and trash and debris (CRWQCB, 1997).

Densely populated suburban commercial and residential developments have encroached upon the Malibu Creek subwatershed and further contribute to the pollution problems it faces. The presence of livestock and intense grazing activities also degrade water quality by denuding vegetation cover, increasing the erodability of soils and hence the sediment load carried by the streamflow. Septic systems, which are located primarily in the lower watershed and coastal stretches, have the potential to leach pathogens and nutrients to local area waterbodies (CRWQCB, 1997).

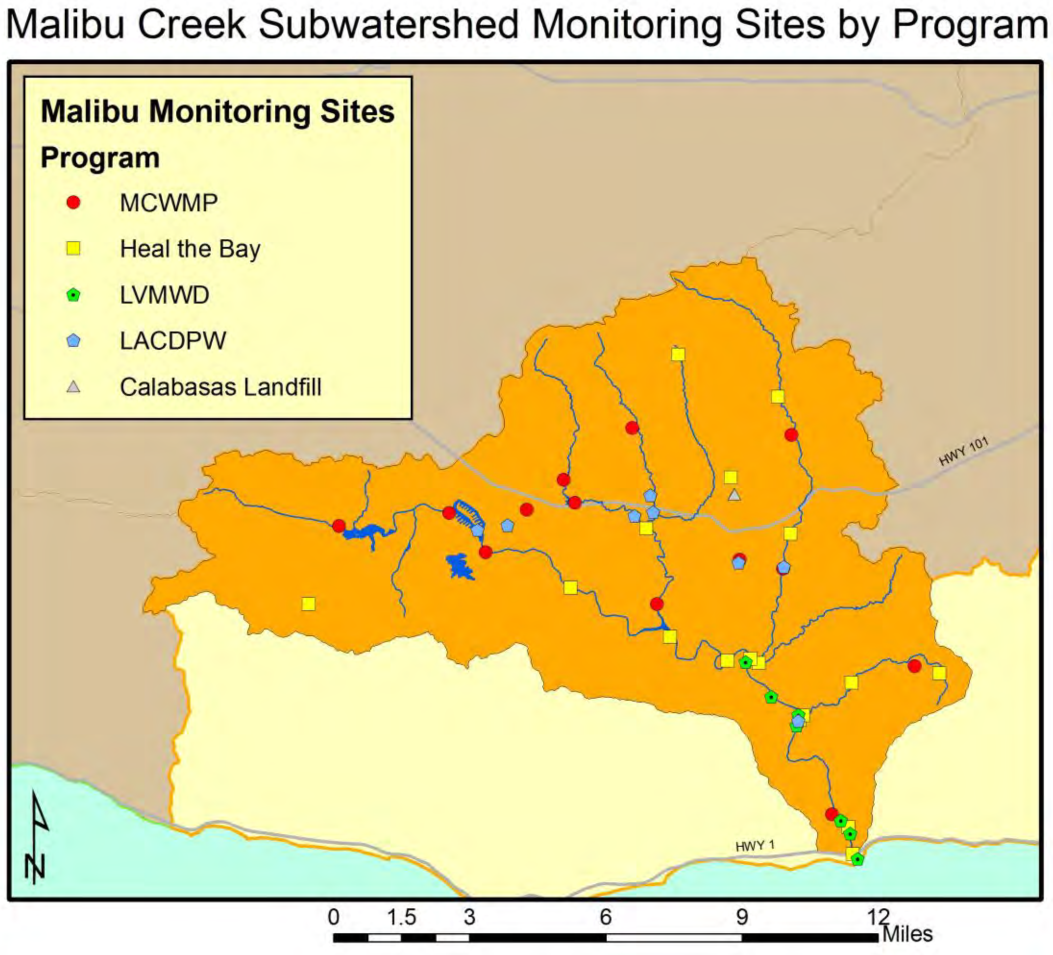
Epidemiology studies are used to identify if swimmers are at risk of developing illnesses based on water contact recreation. Historically, these studies have been conducted infrequently, predominantly at freshwater beaches with known sources of human fecal contamination. The largest benefit from these studies is the identification of relationships between the frequency of illness and levels of fecal indicator bacteria such as total coliforms, fecal coliforms or E. coli, and enterococcus. Such knowledge helps shoreline managers to make appropriate decisions about beach closures and other management measures based on measures of fecal indicator bacteria (SCCWRP website #1). A SMBRP epidemiological study conducted during the summer of 1995 strongly suggested an increased risk of a relatively broad range of symptoms caused by swimming in ocean water near storm drains with positive associations between adverse health effects and a) distance from the drain, and b) bacterial indicators and presence of enteric viruses (SMBRC, 1996).

Epidemiology studies being conducted by SCCWRP address at least two outstanding issues. The first involves potential differences in health risk due to contamination from point source versus nonpoint source discharges. Point sources typically consist of a single predominant source of largely human-derived fecal contamination, while nonpoint sources typically consist of numerous smaller sources, sometimes entirely nonhuman and partially non-fecal in origin. The second involves the application of new water quality indicators. Recent advances in technology have improved indicator measurement methods producing new methods that are more human specific and quite rapid. Before shoreline managers use any of these new methods or indicators for making decisions regarding risk to swimmers, they need to be tested in an epidemiological study to assess their correlation with actual illness rates (SCCWRP website #1).

SCCWRP is currently conducting epidemiological studies to assess the risk of swimming-related illnesses following exposure to nonpoint source contaminated waters at three beaches: Doheny Beach in Dana Point, Avalon Bay Beach on Santa Catalina Island and Surfrider Beach in Malibu. These studies will examine several new techniques for measuring traditional fecal indicator bacteria, new species of bacteria, and viruses to determine whether they yield a better relationship to human health outcomes than the indicators presently used in California (SCCWRP website #1).

Monitoring in the watershed by various agencies over the years has been fairly extensive but also somewhat uncoordinated. The map below shows the major monitoring programs underway; except for the Malibu Creek Watershed Monitoring Program (MCWMP) which was a grant–funded program developed to locate watershed “hot spots” and monitoring by Heal the Bay, the majority of monitoring occurs for rather specific program purposes which may not answer questions concerning watershed health. However, even those programs with common goals may not collect samples on the same day or under similar weather conditions, analyze samples using compatible methods and parameters, and report results in a similar manner.

Figure 17



The MCWMP collected samples twice a month during dry and wet weather at thirteen sites in the watershed between February 2005 and February 2006. Water quality parameters were chosen based on general categories of 303(d)-listed pollutants, including bacteria indicators and those related to sediment and nutrient impairments. After analyzing first year baseline data, “hot spots” were identified for further testing in order to identify the sources of biological and ecological degradation in the watershed. These hot spots were determined by the reoccurrence of high levels of pollutants, especially bacteria and nutrients. Additional monitoring was then conducted in the second (and last) year of the program. The report produced at the end of the two-year period summarized available data for all of the sites shown on the above map; some of the conclusions provided include:

- Bacteria concentrations are generally greatest downstream of urbanized land use areas in most waterbodies.
- Nutrient concentrations are greatest downstream of agricultural areas in the Hidden Valley Creek subwatershed. Organic nitrogen was the predominant form of nitrogen in the Malibu Creek streams, except for Malibu Creek downstream of Tapia WRF during the winter months, when effluent is discharged to the creek.
- Upstream land use alone was not a strong predictor of water quality concentrations.
- Ammonia concentrations were below acute and chronic toxicity targets in most samples.
- The Index of Biotic Integrity (IBI) scores, which grade the health of the invertebrates living on the bottom of streams, were poor or very poor throughout watershed, except in Lower Malibu Creek, where conditions were categorized as fair. Similar results were found by the LA County municipal stormwater permit bioassessment monitoring. Poor IBI scores were influenced by degradation of stream habitat and anthropogenic inputs.
- Calabasas Landfill may be a significant source of total suspended solids in Cheseboro and Liberty Canyon Creeks.
- Most "hot spots" monitoring found exceedances for metals not currently on the 303d list, including aluminum, iron, molybdenum, manganese, and strontium. Mercury and lead generally were below water quality targets (except at the landfill) although on the 303(d) list for Triunfo Creek.
- Selenium concentrations exceeded targets in most subwatersheds. Selenium is positively correlated with nitrate, suggesting that nitrate in groundwater may be mobilizing Se from marine sedimentary bedrock.
- Summer season total phosphorus frequently exceeded the 0.1 mg/l target at most sites (City of Calabasas, 2008). A study conducted by the LVMWD utilizing multiple datasets indicates that summer baseflow and storm runoff from the rock of the Monterey Formation, which dominates the northern headwaters of the watershed, may be naturally high in phosphorus (LVMWD, 2011).

The 2008-2009 Los Angeles County Municipal Stormwater Permit mass emissions monitoring station on Malibu Creek is located at Piuma Road, above the area of tidal influence. Approximately, 105 square miles of land drains to this site; 79% is vacant, close to 6% of the area is used as single family high density residential, about 1% is multi-family residential, and 12.5% is designated as other uses (LACDPW website).

Mass loading While there are considerable loading differences between results for wet- and dry-weather sampling events as well as between the various wet-weather events, the variability is much less here than in an urban watershed such as Ballona Creek. For example, during 2009-2009, copper varied from a low of 0.15 lbs during one dry-weather sampling event to a high of 70.83 lbs during a wet-weather event. Within the dry-weather sampling events, copper loads ranged up to 1.25 lbs. Other metals followed a similar pattern with zinc loading ranging from a low of 0.63 lbs during dry-weather to a high of 258.23 lbs during a wet-weather sampling event (LACDPW website).

Toxicity testing Two dry-weather toxicity sampling events during 2008-2009 resulted in no acute or chronic toxicity to a freshwater organism (*Ceriodaphnia*); a toxic effect was seen during one of the two chronic sea urchin fertilization tests. There was a toxic effect with both species during one the two wet-weather sampling events; there was an effect on the sea urchin only during the other sampling event (LACDPW website).

Chemical/bacteriological testing During the three dry-weather sampling events, fecal coliform bacteria attained the applicable water quality objective (400 mpn/100 ml); however, during two of three sampling events, sulfate did not meet the watershed-specific water quality objective of 500 mg/l (LACDPW website).

During the four wet-weather sampling events, fecal coliform was at excessive concentrations three of four times. Sulfate did not attain the watershed-specific water quality objective in two out of five wet weather events sampled in Malibu Creek. Total dissolved solids (TDS) did not attain the watershed-specific water quality objective (2000 mg/L) once out of five wet weather events sampled (LACDPW website).

The Malibu Creek Watershed falls within the Santa Monica Mountains National Recreational Area for which the National Park Service has developed the Mediterranean Coast Network Vital Signs Monitoring Plan. The network also includes Cabrillo National Monument and Channel Islands National Park. The monitoring plan includes assessing a wide variety of ecosystem elements and process, including water quality (NPS, 2005).

Habitat Degradation

In addition to increased water supplies, major modifications of natural land features such as channelization of tributaries, destruction of riparian zones and wetlands, changes in soil infiltration characteristics and the construction of dams cause additional adverse impacts. The invasion of non-native plant species further upsets the natural condition of wetlands and other riparian zones, which in turn impairs their biological functions. Only 5% of the 133 plant species identified at Malibu Lagoon are native estuarine species, and only 30% are native to California (CRWQCB, 1997).

Non-native aquatic species are found in the creeks, streams and lakes of the Malibu Creek sub-watershed and include species such as large-mouth bass, black bullhead, and green sunfish, as well as, a number of non-native invertebrates including Oriental shrimp, crayfish, and the latest threat, New Zealand mudsnail. These non-native aquatic species may adversely affect indigenous species of the area. Crayfish is one such non-native species likely responsible for the severe decline in salamanders and frogs (CRWQCB, 1997).

New Zealand mudsnails were discovered a number of locations in the watershed in 2006 although they likely existed there since at least 2005. The individual snails are very small, only 3 – 5 mm long. Each snail can reproduce enormous amounts of offspring through a cloning process called parthenogenesis which can result in very high snail densities on the bottoms of streams which displaces native aquatic invertebrates utilized by fish and amphibians for food; they can easily be transferred to other streams through contact with animals or monitoring/recreational equipment. They do not appear to have any natural native predators (SMBRF, 2009).

Malibu Lagoon Malibu Lagoon, which for the past 11 years has been managed by State Parks and Recreation Department, now faces new problems. Previously, under an Interim Water Management Plan, State Parks breached the Lagoon's sand berm barrier when water levels rose above 3.7 feet. However, concern for the impacts on endangered species and habitats, the possible adverse health effects to surfers and swimmers, and abrupt changes in salinity of the Lagoon have changed the breaching protocol. Additionally, the California Coastal Commission requires a Coastal Development Permit before breaching activities continue (CRWQCB, 1997). Lagoon enhancements were recommended in the 1999 Malibu

Lagoon enhancement plan prepared by UCLA for the State Coastal Conservancy and a restoration plan has since been developed (SCWRP website #2).

Pollutants of Concern

The pollutants of concern identified for this subwatershed include nutrients (nitrogen and phosphorus compounds), sediments, pathogens, TSS, trash and debris, and oil spills . This region has the second highest loading of TSS in the Santa Monica Bay watershed, which may be in part due to natural causes (CRWQCB, 1997).

Although the Bay Restoration Plan has identified heavy metals as pollutants of concern within the entire Santa Monica Bay, they have not been specifically identified as pollutants of concern in the Malibu Creek sub-watershed. However, heavy metals should continue to be monitored in runoff, especially since models suggest inputs to the Bay from this subwatershed. Likely sources contributing to heavy metals loadings include runoff contaminated from transportation-related activities, as well as, air deposition. More monitoring is warranted before the overall impacts of heavy metals can be confirmed (CRWQCB, 1997).

Sources and Loadings

In the Malibu Creek subwatershed, many point and nonpoint sources of pollution have been identified and can be linked to pollutants of concern (CRWQCB, 1997).

Permitted Discharges

The Tapia Water Reclamation Facility, this subwatershed's major discharger, contributes pollutants including nutrients to Malibu Creek and Lagoon and monitors both effluent and receiving water; no discharge is allowed from April 15 to November 15 except under certain specific circumstances. The concentrations of the majority of pollutants discharged are within the effluent limitations set forth within the NPDES permit; however, there have been exceedances of a few parameters in the effluent: average monthly limitations for total dissolved solids, total suspended solids, total phosphorus, and dichlorobromomethane were exceeded one to two times over a five-year period prior to the last permit renewal. Monitoring is also required by both the Ventura County and Los Angeles County MS4 permits. There are currently no monitoring sites in the Ventura County portion of this subwatershed; a mass emissions site is monitored in Malibu Creek at a Los Angeles County location. There were exceedances of water quality objectives for fecal coliform and sulfate during two of the four wet-weather sampling events in 2009-2010. During dry weather, sulfate exceeded the water quality objective during two of four monitoring events while total dissolved solids did not meet water quality objectives during one of the four sampling events.

Nutrients

Nutrients, which are a major source of pollution to the receiving waterbodies, are found throughout the watershed and have several suspect and known sources. The Tapia Water Reclamation Facility, area storm drains, horse and animal farms, land grading activities, septic systems, agricultural activities and transportation-related activities have all been identified as contributors to the nutrient loads found in the local creeks, streams and the Lagoon (CRWQCB, 1997). Additionally, Stein and Yoon (2008) found watershed geology to be a major factor that influences constituent concentrations from natural catchments.

Catchments underlain by sedimentary rock had higher concentrations of metals, nutrients, and total suspended solids, as compared to areas underlain by igneous rock.

A recent evaluation of available nitrogen data, and modeling to estimate nitrogen loads to Malibu Lagoon from discharges of wastewater through onsite wastewater disposal systems (OWDSs) in the Malibu Civic Center area, was conducted by Regional Board staff. The results estimate that wastewaters transport 30 lb/day of total nitrogen into Malibu Lagoon. The model also indicates that loads are increasing. Nitrogen loads from OWDSs are significantly above the waste load allocation of 6 lb/day established in a TMDL adopted by the US EPA in 2003; staff has determined that OWDSs in the Malibu Civic Center area cumulatively release nitrogen at rates that contribute to eutrophication and impair aquatic life in Malibu Lagoon (CRWQCB website #4).

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been implemented, improper land grading activities, horse and animal farms located to close to creeks and stream and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and stream, which ultimately flow to Malibu Creek and Lagoon. Furthermore, fire residual may be washed down by storm runoff and contribute acute excessive sediments and nutrients to the watershed's receiving waters (CRWQCB, 1997).

Pathogens

Malfunctioning septic systems have long been suspected of contributing to the pathogen loads found in Malibu Creek and Lagoon (CRWQCB, 1997). Although the Tapia Water Reclamation Facility also discharges to Malibu Creek, the discharge is in compliance with the 2.2 cfu/100 ml limits for indicator coliform bacteria set by the Regional Board (CRWQCB website #1). Other potential sources of pathogens include recreational inputs and wildlife, households, and storm drain discharges. Regional Board staff recently conducted an evaluation of available indicator bacteria data in the Malibu Civic Center area to examine the hydraulic connection of discharges from OWDSs through groundwater to nearby surface waters. Staff determined that pathogens from wastewaters are likely to migrate to surface waters and that, consistent with data supporting the designations of impairments, threaten human health. The levels of enterococcus do not meet standards protective of human health. Staff also determined that risks of infectious disease from water contact recreation were elevated at beaches in the Malibu Civic Center (CRWQCB website #4).

Oil Spills

Although not currently an issue, the threat of oil spills to the Bay from tankers exists due to continual oil transporting activities along California's coastline. Ocean currents have the potential to transport oil from spills directly to the shoreline, thereby significantly degrading this sub-watershed's special coastal habitats (CRWQCB, 1997).

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the Malibu Creek subwatershed could be achieved by focusing efforts on the following:

- Protect and restore remaining wetlands in the Malibu Creek subwatershed.
- Reduce nonpoint source, and urban and stormwater runoff pollutant loading
- Enhance and protect beach and intertidal habitats for threatened and endangered species.
- Develop specific erosion and sediment-control strategies; consider the impacts of hillside developments.
- Implement TMDLs.
- Reduce/eliminate non-native invasive species where feasible.
- Fully implement the provisions of the Basin Plan amendment passed in November 2009 to prohibit On-Site Wastewater Disposal Systems in the Malibu Civic Center Area.
- Encourage water conservation, water recycling, and other steps to reduce the Malibu Creek subwatershed's dependence on imported water and input of unseasonal freshwater into the Creek (CRWQCB, 1997)

Wetlands Protection and Restoration

Because Malibu Lagoon and other wetlands in this subwatershed are affected by the land use activities and water quality impacts that occur upstream, any restoration activities taking place should consider these issues. Development of a comprehensive plan should address pollutants of concern for this region and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration. The SMBRC's Bay Restoration Plan and the WRP's Regional Strategy identify specific actions to protect and restore Malibu Lagoon, as well as other priority wetlands found throughout the Santa Monica Bay watershed (CRWQCB, 1997; SCWRP website #1).

Malibu Lagoon A Tier 1 project on the WRP workplan is restoration of Malibu Lagoon. A restoration and enhancement plan was developed on 2005; Phase 1 of the Restoration and Enhancement Plan included relocation and redesign of the existing public parking and staging areas to maximize habitat restoration area in Phase 2 and to improve water quality in the Lagoon through implementation of BMPs. Phase 2 will involve restoration of the lagoon, including recontouring western lagoon channels, enhancing circulation in the lagoon, creating bird nesting habitat and providing improved educational and recreational opportunities for the public. Ultimately, the goal is restoration and enhancement of the ecological structure and function of Malibu Lagoon by increasing circulation and enhancing wetland habitat. The wetland habitat could potentially be enlarged in the future by restoring the adjacent property once it is acquired (SCWRP website #2). A copy of the lagoon restoration plan, funded by the Coastal Conservancy, may be found at http://www.healthebay.org/currentissues/mlhep/default.asp.

Malibu Creek/Cold Creek A completed WRP project is acquisition of 71.5 acres of upland and riparian habitat along Cold Creek which is a major tributary to Malibu Creek. Other completed WRP projects include the replacement of the Cross Creek Road Arizona crossing of Malibu Creek, which blocked steelhead passage, with a one-lane bridge; and removal of *Arundo donax* from approximately 5.2 miles of stream corridor along Malibu Creek (SCWRP website #2).

Current projects on the WRP workplan include the Upper Malibu Creek Feasibility Study led by the U.S. Army Corps of Engineer with the California Department of Parks and Recreation as the local sponsor. The feasibility study is evaluating options for restoration and enhancement of riparian and aquatic systems above Malibu Lagoon, including the possible removal of Rindge Dam, located about 3 miles upstream from the lagoon. The dam, which is almost completely silted in, acts as a complete barrier to steelhead migration. The study is also focusing on enhancements for endangered steelhead trout and riparian bird habitat. Another current project is the acquisition of approximately 90 acres of wetland, riparian and upland habitat that support La Sierra Lake. The acquisition includes a portion of the lake, four blue-line streams, and the seeps and ephemeral watercourses in the uplands that protect the water source for this three-acre, year-round lake. The primary vegetation communities found on the project site include riparian woodlands, dominated by coast live oak, California bay-laurel, and western sycamore. La Sierra Lake supports 35 obligate and associated wetland plant species, two aquatic mosses, and a rare vernal pool species which has only been reported one other time since 1891 in the Santa Monica Mountains. The project site is immediately downstream from a primarily undisturbed watershed that supports a series of oak, sycamore, willow, and mixed oak and bay riparian plant communities, and is adjacent to the county-designated La Sierra Canyon Significant Ecological Area (SCWRP website #2).

Reduce Nonpoint Source Pollutant Loading

Critical Coastal Area Designations California's Nonpoint Source (NPS) Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. These areas include Environmentally Sensitive Habitat Areas (ESHAs) currently designated in California's Coastal Zone Management (CZM) program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), National Estuary Program (NEP), and National Marine Sanctuaries. A long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. The short-term plan to achieve this goal is to identify, educate, and promote stakeholder involvement. The State's 2002 CCA Draft Strategic Plan identifies 101 CCAs statewide of which 13 are in the Los Angeles Region (CRWQCB, 2007).

Malibu Creek is identified as CCA #60 in the State's Draft Strategic Plan. It has been identified as such since it flows into a Marine Protected Area and is an impaired water body. The major efforts listed to implement NPS management measures include: work by the Malibu Creek Watershed Advisory Council, various efforts to manage septic systems near Surfrider Beach, projects to capture and treat runoff from Malibu Creek and storm drains in the area, the Assessment of Water Quality and Loadings From Natural Landscapes project conducted by SCCWRP, and implementation of the Santa Monica Bay Restoration Plan (CRWQCB, 2007).

Beaches and Intertidal Habitats

Malibu Creek and Lagoon, as well as several other unique habitats in this sub-watershed, are home to a few threatened and endangered species such as tidewater goby and steelhead trout. Many non-threatened/non-endangered species also rely on these habitats for their existence and may become threatened if habitat degradation continues. Long-term, protective management strategies should be implemented for their protection and may include acquisition of land, public education about the values of these species/habitats, increased enforcement activities, on-going monitoring, and interagency cooperation (CRWQCB, 1997).

Erosion Control Strategies

Development of an erosion and sediment control strategy must consider several factors, including pre-development sediment transport volumes and the impacts of development on the normal sediment transport process. Although natural erosion and sedimentation transport activities are both necessary and desirable for natural beach replenishment and healthy functioning wetlands, excessive erosion and sediment transport can adversely impact downstream sensitive habitats. Assessing appropriate and necessary transport volumes is key to developing this overall control strategy (CRWQCB, 1997).

Implement TMDLs

The Malibu Creek Watershed Monitoring Report also describes the Integrated TMDL Implementation Plan developed by those entities in the watershed affected by current and future TMDLs. The structural and nonstructural BMPs noted address multiple impairments. The targeted pollutants are: trash, sediment (TSS), nutrients (nitrogen and phosphorus), metals, and bacteria (City of Calabasas, 2008).

Beach Bacteria TMDLs Two of the TMDLs in effect which impact Malibu are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches. Surfrider and Malibu Beaches are listed as impaired for indicator bacteria. For the purpose of implementing those TMDLs, the area has been divided up into "jurisdictional groups" (JG) – Malibu Creek falls into JG9. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site, in this case, Leo Carrillo Beach upcoast (CRWQCB website #3).

The dry-weather TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions and treatment facilities have been completed and others are planned. (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

Malibu Creek Bacteria TMDL The bacteria TMDL allows 3 to 6 years for compliance with applicable bacteria water quality standards during dry-weather conditions, and 10 years for compliance during wet-weather conditions, or up to 18 years for wet weather, if an integrated water resources approach is pursued. The implementation plan provides minimum prescriptive criteria for identifying high-risk areas, where onsite-wastewater treatment systems (OWTS) are potentially contributing to bacteria exceedances in the Malibu Creek watershed. Local agencies (city and county health departments and/or building departments) are required to focus their efforts to monitor and require upgrades to OWTS located in high-risk areas. In addition to the areas falling within the high-risk areas, local agencies must also use their knowledge to identify other areas, outside of the high-risk areas, that are likely to impact surface water quality due to local conditions (e.g., fractured bedrock). Legacy Park, in the Malibu Civic Center, which will include treatment wetlands, is a major water quality improvement project aimed at reducing bacteria levels.

Malibu Creek Trash TMDL Compliance with the TMDL is based on the Numeric Target and the Waste Load (point sources) and Load Allocations (nonpoint sources) which are defined as zero trash in and on the shorelines of the listed reaches and lakes of the Malibu Creek Watershed. Consequently, compliance is based on installation of structural best management practices such as full capture or partial capture systems, or implementing a program for trash assessment and collection, or any best management practices approved by the Executive Officer of the Regional Board, to attain a progressive reduction in the amount of trash in the waterbodies of concern.

Santa Monica Bay Nearshore and Offshore Debris TMDL The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather Bacteria

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

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http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Malibu Creek Bacteria

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_23_2004-019R_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2004-019R/05_0309/Resolution%202004-19R%20and%20Attachment%20A.pdf

Malibu Creek Trash

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_63_2008-007_td.shtml

Santa Monica Bay Nearshore and Offshore Debris TMDL

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). A low flow diversion/treatment facility in the subwatershed has been in operation since 2007 in the Civic Center.

Reduction of Non-native Invasive Species

Non-native species limit diversity of indigenous plants and animals. Location and types of non-native species throughout the Malibu Creek subwatershed should be identified and mapped. Once this information has been prepared, an assessment should be performed in priority habitats on the feasibility of eliminating non-native species and restoring the area with native, indigenous species (CRWQCB, 1997).

In 2002, the California Department of Fish and Game began developing a plan to coordinate state programs, create a statewide decision-making structure and provide a shared baseline of data and agreed-upon actions so that state agencies may work together more efficiently. In January 2008, with input from multiple state agencies, the public, and other stakeholders, the California Aquatic Invasive Species Management Plan (CAISMP) was approved by the Governor. The CAISMP seeks to identify the steps necessary to minimize the harmful impacts of aquatic invasive species (AIS) in California. More than 160 management actions are organized under the following eight objectives: Coordination & Collaboration, Prevention, Early Detection & Monitoring, Rapid Response & Eradication, Long-term Control & Management, Education & Outreach, Research, and Laws & Regulation (SMBRF, 2009).

The implementation of the highest priority actions was initiated in 2008 with the formation of the California Aquatic Invasive Species Team (CAAIST). The CAAIST's mission is to coordinate the activities of state agencies charged with implementation of the CAISMP. CAAIST is composed of representatives from over 25 California state agencies, including the Santa Monica Bay Restoration Commission. If the priority actions of the CAISMP can be successfully implemented, California resource managers and policy makers will have taken a huge step forward in the effort to prevent new invasions and minimize impacts from established AIS (SMBRF, 2009).

Septic System Management Strategy

Septic systems are located throughout the lower Malibu Creek subwatershed. Water quality monitoring results suggest that septic systems might be contributing factors to the impairment of beneficial uses and degrade sensitive habitats in certain areas of this region. These systems have the potential to leak bacteria, pathogens and nutrients which can then migrate through sensitive habitats, and ultimately to the surf zone (CRWQCB, 1997).

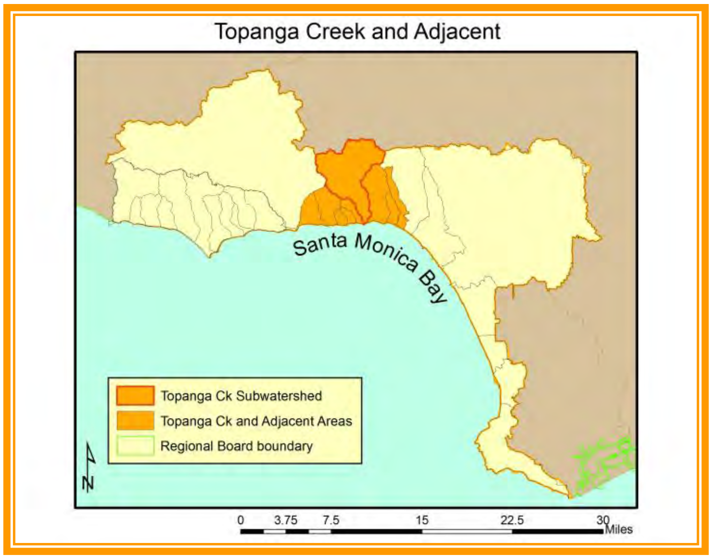
At a November 5, 2009 public hearing, the Regional Board voted to adopt Resolution No. R4-2009-007, an amendment to the Basin Plan to prohibit on-site wastewater disposal systems in the Malibu Civic Center area. The amendment prohibits all new discharges, except certain specific projects which have already progressed through the entitlement process and prohibits discharges from existing systems within six years in commercial areas and within ten years in residential areas from the date of adoption by the Regional Board. This prohibition does not preclude a publicly owned, community-based, solution that includes specific wastewater disposal sites subject to waste discharge requirements to be prescribed by the Regional Board (CRWQCB website #2).

Water Conservation

Water conservation practices, spearheaded by the Las Virgenes Municipal Water District, are already being encouraged in this subwatershed. They have a number of existing programs and pilot projects underway to reduce the importation of water into the watershed, including residential and light commercial water use efficiency surveys, rebates for a variety of outdoor and indoor equipment such as appliances and fixtures including weather-based irrigation controllers, rotating sprinkler nozzles, and high-efficiency clothes washers, among others. LVMWD offers water conservation landscape and irrigation training classes throughout the year to professional and home gardeners, supports conservation education in local schools, provides facility tours, supports local public events and recycles wastewater biosolids into compost which it gives away for free. LVMWD continually seeks to partner with local cities both in and out of its service area, and with other watershed stakeholder groups on projects that reduce water demand and/or benefit the watershed in various ways (Mundy, comm. ltr.). Nearly all the programs implemented by LVMWD are co-funded with local, state and federal funds and are administered with the cooperation of the Municipal Water District of Southern California. Bond funds available through the IRWMP process would be another way to improve water conservation. Currently, over 20% (5,000 acre-feet) of the watershed's urban water demands are being met by water conservation and wastewater recycling (CRWQCB, 1997).

Topanga Creek and Adjacent

Located approximately 4.5 miles west of the City of Santa Monica, the Topanga subwatershed includes Puerco, Corral, Carbon, Las Flores, Piedra, Pena, Tuna, Topanga, and Santa Ynez Canyons, which covers an area of 18 square miles within the Santa Monica Mountains. This subwatershed borders the Malibu Creek subwatershed to the west, the Los Angeles River watershed to the north, the Santa Monica Canyon and Ballona Creek subwatersheds to the east and the Pacific Ocean to the south. Several creeks and streams discharge directly to the Bay. There are no major point source discharges in this subwatershed (CRWQCB, 1997).



Flows

The creeks in this region flow through towns in the upper reaches and through steep, narrow gorges in the lower reaches, ultimately emptying into the ocean just south of Highway 1. In the lower reaches, the canyons broaden into floodplains with dense riparian vegetation, houses, shacks, and stream crossings. In many places, Topanga Canyon Creek has been lined with boulders and concrete, and banks have been sandbagged to protect from erosion. Abandoned partially-buried vehicles and buildings attest to recurrent flooding experienced in this region. Topanga Canyon has the largest drainage area (and corresponding average annual storm runoff volume), then Santa Ynez, Puerco and Corral Canyons, Las Flores Canyon, Carbon Canyon, and finally Piedra Gorda Canyon, Pena Canyon and Tuna Canyon have the smallest drainage area (CRWQCB, 1997).

Land Uses

Though this region is rural, there is still evidence of residential development in the Topanga subwatershed. Additionally, a few areas in the upper sub-watershed area have been developed, but the percentage is relatively small. Land use activities can be broken down into the following: 92% open space, 7% residential, and less than 1% for commercial/industrial and public (combined) (CRWQCB, 1997).

Topanga Canyon

A small lagoon exists at the mouth of the creek due to a berm created by littoral drift and wave action. The lagoon is constrained to a narrow, linear basin defined by the high bluffs to either side of the creek. Tidal action occurs, as evidenced by aquatic marine vegetation within this lower part of the creek (CRWQCB, 1997).

Beneficial Uses

The Topanga subwatershed is host to many beneficial uses, including recreational (swimming and surfing), wildlife and marine/aquatic habitat, fish spawning and migration, tidepools, intertidal and beach habitats, among others shown below (CRWQCB, 1994).

Table 7. Beneficial uses of the waters within the Topanga Creek subwatershed and adjacent areas

Coastal Feature or Waterbody	Hydro Unit #	MUN	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Carbon Canyon Creek	404.16	P		I	I		I				E					
Las Flores Canyon Creek	404.15	P		I	I		I				E					
Piedra Gorda Canyon Creek	404.14	P		I	I		I				E					
Pena Canyon Creek	404.13	P		I	I		I	E			E					
Tuna Canyon Creek	404.12	P		I	I		I				E					
Topanga Lagoon	404.11		E	E	E	E			E		E	E	E	E		E
Topanga Canyon Creek	404.11	P		I	I		E	E			E		P	I		
Santa Ynez Canyon	405.13	P		I	E		I				E	E				
Santa Ynez Lake (Lake Shrine)	405.13	P		P	E		E				E					
Carbon Beach	404.16		E	E	E	E				E	E			P	E	
La Costa Beach	404.16		E	E	E	E				E	E			P	E	
Las Flores Beach	404.15		E	E	E	E				E	E			P	E	
Las Tunas Beach	404.12		E	E	E	E				E	E			P	E	
Topanga Beach	404.11		E	E	E	E				E	E			P	E	
Will Rogers State Beach	405.13		E	E	E	E				E	E			P	E	

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Areas within the Topanga subwatershed have been designated as *Significant Ecological Areas (SEA)* by Los Angeles County. These areas require protection of species or biological communities to the extent that alteration of natural water quality is undesirable and that the preservation of natural water quality be maintained to the extent practicable. Tuna Canyon is one such designated area in this region (CRWQCB, 1997).

Topanga Canyon is home to some of the unique wetlands that can be found throughout the Santa Monica Bay watershed. Specifically, the Topanga Canyon wetlands are palustrine, i.e., non-tidal wetlands dominated by vegetation (trees, shrubs, herbs, mosses and lichens). Many of the streams feeding these wetlands are intermittent, flowing only part of the year and the stream corridors are typically steep, narrow and highly erosive. This in turn confines riparian vegetation to the immediate stream channel area (CRWQCB, 1997).

The area falls within the Santa Monica Mountains biogeographic population group described in the Draft Steelhead Recovery Plan; Topanga Creek is considered to be currently occupied by a Core 2 population. The Core 1 populations are those populations identified as a high priority for recovery actions based on a variety of factors, including: the intrinsic potential of the population in an unimpaired condition; the role of the population in meeting the spatial and/or redundancy viability criteria; the conditions of the population, the severity of the threats facing the populations; the potential ecological or genetic diversity the watershed and population could provide to the species; and the capacity of the watershed and population to respond to the critical recovery actions needed to abate those threats. Core 1 populations form the nucleus of the recovery strategy. Core 2 populations must eventually meet the biological recovery criteria; however, these populations are considered to be of secondary importance in terms of recommended priority of recovery efforts (NOAA, 2009).

Local Parks

There are several parks located in this subwatershed, most notably Topanga Creek State Park, Will Rogers State Park and Will Rogers State Beach. These grounds provide hiking, picnicking, horseback riding and bicycling opportunities as well as swimming, surfing and sunbathing activities. Semi-regular interpretive and educational meetings are also held at these locations. Thousands of visitors visit these locations each year and take advantage of the opportunities they provide (CRWQCB, 1997).

Evidence of Impairment

There is a certain amount of loss and degradation of riparian habitat, as well as, degradation of coastal wetlands such as Topanga Lagoon. While there is limited development in this area, the potential for pollution problems increases as the percentage of developed land increases (CRWQCB, 1997).

The proposed lower Topanga restoration area encompasses almost 204 acres of land including 1.2 miles of Topanga Creek and its surrounding floodplain. Development within the watershed has caused erosion, degraded water quality and habitat values. For example, concrete sacks, rocks, and debris have been used for erosion control, reducing the vegetation along the stream (this problem has recently been corrected). Stream temperatures are high, and because of the high nutrients discharged to the stream summer algal growth is significant. The area is also affected by debris, trash, uncontrolled discharges and vegetation removal (CRWQCB, 1997).

Pollutants of Concern

The pollutants of concern identified for this subwatershed include pathogens, TSS and lead (CRWQCB, 1997).

Likely sources contributing to heavy metals loadings include runoff contaminated from transportation-related activities and air deposition. More monitoring is warranted before the overall impacts of heavy metals can be confirmed (CRWQCB, 1997).

Sources and Loadings

Potential sources of pollution may be linked with the pollutants of concern (identified above) found to threaten the waterbodies of this region.

TSS and Fine-grained Sediments

Sediments and total suspended solids (which hinder light transmission into waters, smother spawning areas and hard-bottom subtidal habitats, and provide a transport medium for other pollutants such as heavy metals and pesticides) also have several known and suspect sources. Non-stabilized hillsides, development activities where best management practices have not been implemented, improper land grading activities, horse and animal farms located too close to creeks and stream and other relevant agricultural activities all contribute sediments and TSS to this watershed's creeks and stream, which ultimately flow to Santa Monica Bay. Furthermore, fire residue may be washed down by storm runoff and contribute acute excessive sediments to the watershed's receiving waters (CRWQCB, 1997).

Water Quality Improvement Strategies

In accordance with previously identified problems and in order to protect the beneficial uses of waterbodies in this region, the greatest benefits in achieving water quality improvements in the Topanga subwatershed could be achieved by focusing efforts on the following:

- Protect and restore remaining wetlands in the Topanga subwatershed.
- Reduce nonpoint source, urban runoff, and stormwater pollutant loading.
- Implement TMDLs.

Wetlands Protection and Restoration

Because the wetlands in this subwatershed are affected by the land use activities and water quality impacts that occur upstream, any restoration activities taking place should consider these issues. Development of a comprehensive plan should address pollutants of concern for this region and should be based on water quality, salinity, habitat and biodiversity objectives for wetlands restoration. Special focus should be given to the Lower Topanga Canyon wetlands area. The SMBRP's Bay Restoration Plan identified specific actions to protect and restore Lower Topanga Canyon as well as other priority wetlands throughout the Santa Monica Bay watershed (CRWQCB, 1997).

<u>Topanga Creek and Lagoon</u> Completed WRP projects include feasibility studies needed to determine the potential for restoring some of the historic extent and function of Topanga Creek and Lagoon, technical assessments for restoration of Topanga Lagoon based on a conceptual plan in the Topanga Lagoon and Watershed Restoration Feasibility Study, and acquisition of approximately 120 acres in the upper Topanga watershed including Zuniga Pond, a constructed pond, in order to protect western pond turtle habitat, a state-listed species of special concern. A Tier 1 project on the WRP workplan is implementation of the recommendations of the 2002 Topanga Creek Watershed and Lagoon Restoration Feasibility Study. This is a multi-phased program that will be implemented over several years and in partnership with multiple agencies, particularly State Parks. The primary goals of the program are to:

1. Restore habitat at identified priority locations in order to increase benefits to the endangered steelhead trout and tidewater goby, as well as other aquatic species of special concern in the watershed.

2. Improve passage opportunities for steelhead trout and extend the reach of creek providing suitable habitat for spawning and rearing.
3. Identify ways to improve sediment transport and delivery in order to enhance conditions in the creek and restore beach nourishment opportunities.
4. Improve water quality in all areas of the watershed where impairments have been identified.
5. Continue monitoring of water quality, sediment loads, streambank condition and target species populations (steelhead trout, tidewater gobies, western pond turtles, CA newts, etc.) in order to identify population trends related to restoration actions (SCWRP website #2).

Steelhead trout passage has been improved recently through removal of a berm created previously by private landowners to protect their homes in the floodplain. This land is now owned by the California Department of Parks and Recreation and removal of the berm material was accomplished through funding from multiple agencies. Vegetation in the affected area was also restored with native species plantings and invasives removal (SMBRF, 2009).

<u>Tuna Canyon</u> A completed WRP project is acquisition of approximately 417 acres of land at the lower end of Tuna Canyon to protect a perennial spring and well-developed riparian habitat (SCWRP website #2).

<u>Las Flores Creek</u> A project on the WRP workplan is the restoration of ecological function to Las Flores Canyon Creek, resulting in improved channel stability, protection of the emergent wetland downstream and increased potential habitat for steelhead trout and other native species. Las Flores Canyon drains a watershed of 2,646 acres. The project area is approximately 3.4 acres and involves 2,400 linear feet of the creek. In-stream habitat features will expand the number of current pools available to steelhead trout and create larger pools. Improved passage, resting pools and escape cover will also provide for movement of steelhead to larger upstream spawning pools. The project will install biotechnical bank stabilization to protect against sediment loading and landslides, which are deleterious to native aquatic species as well as the downstream emergent wetland. It will also remove and manage invasive exotic plant species including a small cluster of arundo. The project will preserve and expand native tree canopy to improve in-stream and riparian habitat. Finally, the site will be revegetated with native species (coastal scrub, riparian, sycamore woodland) to restore cover, vegetative structure and increase native diversity. Revegetation will result in increased physical steelhead habitat as well as improved water temperature regulation (SCWRP website #2).

<u>Corral Canyon</u> A Tier 1 project on the WRP workplan is Acquisition of two blocks of property to preserve 849 acres of wildlife and riparian habitat within the Santa Monica Mountains National Recreation Area and reaches of Corral Canyon Creek, a perennial stream that flows into Santa Monica Bay. The objectives of this project are to prevent further fragmentation of wildlife habitat in an area under severe development pressure, as well as to help protect the water quality of the Corral Canyon watershed. Both properties have entitlements that would allow for development. But they both currently remain as undeveloped open space and are part of a major core of coastal habitat and wildlife corridors in the Santa Monica Mountains. Primary vegetation communities include a mosaic of coastal sage scrub and chaparral, oak riparian woodland and upland coastal live oak woodland. Acquisition of these areas would provide an opportunity to link Malibu Creek State Park with parkland owned by the Santa Monica Mountains Conservancy within the SMMNRA. Both properties have the highest priority in the SMMNRA Land Protection Plan (SCWRP website #2).

Reduce Nonpoint Source Pollutant Loading

Critical Coastal Area Designations California's Nonpoint Source (NPS) Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. These areas include Environmentally Sensitive Habitat Areas (ESHAs) currently designated in California's Coastal Zone Management (CZM) program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), National Estuary Program (NEP), and National Marine Sanctuaries. A long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. The short-term plan to achieve this goal is to identify, educate, and promote stakeholder involvement. The State's 2002 CCA Draft Strategic Plan identifies 101 CCAs statewide of which 13 are in the Los Angeles Region (CRWQCB, 2007).

Topanga Canyon Creek is identified as CCA #61 in the State's Draft Strategic Plan since it flows into a Marine Protected Area and is an impaired water body. The major efforts listed to implement NPS management measures include: work by the Malibu Creek Watershed Advisory Council (the small Topanga watershed is adjacent to the much larger Malibu watershed), various efforts to manage septic systems, participation with the Topanga Watershed Committee, implementation of the watershed management plan, and continuance of creek monitoring (CRWQCB, 2007).

Implement TMDLs

The TMDLs in effect which impact the Topanga Creek and adjacent area are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. Topanga and Carbon Beaches, among others in this subwatershed, are listed as impaired for indicator bacteria. For the purpose of implementing the bacteria TMDLs, the area has been divided up into "jurisdictional groups" (JG) – the Topanga and adjacent area fall s into JG1 and JG2. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

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http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

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http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris TMDL

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). Low flow diversions found within the Topanga and adjacent area are show in the table below.

Table 8. Low flow diversions within the Topanga Creek subwatershed and adjacent areas

Low Flow Diversion	Year Operational	Agency
Palisades Park	2000	City of LA
Bay Club Drive	2001	City of LA
Temescal Canyon	2003	City of LA
Pulga Canyon	2004	District
Santa Ynez	2006	District
Marquez Avenue	2006	City of LA
Parker Mesa/Castlerock	2006	District

Santa Monica Canyon

Santa Monica Canyon drains runoff into Santa Monica Bay at the stretch of Will Rogers State Beach near the intersection of Chautauqua Boulevard and Pacific Coast Highway in Pacific Palisades, a community of the City of Los Angeles. The drain receives runoff from an approximately 5,600 acre drainage area, including the Pacific Palisades and the Brentwood/Palisades communities, and a nominal portion of the City of Santa Monica. It also drains runoff from popular attractions such as Will Rogers State Park, Riviera Country Club and portions of Topanga State Park (CRWQCB, 1997).

The Santa Monica Canyon storm drain has two major branches, Santa Monica Canyon and Rustic Canyon. Santa Monica Canyon is a concrete-lined, rectangular open channel, except for a stretch where it traverses underground through the Riviera Country Club. It branches off to Mandeville Canyon and Sullivan Canyon storm drains, near the intersection of Sunset Boulevard and Mandeville Canyon Road. Mandeville Canyon is approximately 1.5 miles long. Sullivan Canyon is first intercepted by the Sullivan Canyon Park Debris Basin, then extends towards Mulholland Drive. Including Sullivan Canyon, the Santa Monica Canyon has a total length of approximately eight miles. Rustic Canyon joins Santa Monica Canyon near the intersection of Entrada Way and Short Avenue. It also has a total length of approximately eight miles and is an open, natural creek for most of its length. Its upper reach extends to the Topanga State Park near Mulholland Drive (CRWQCB, 1997).

The drainage area of Santa Monica Canyon is comprised of mostly low density residential and open spaces, with minimal manufacturing and industrial activities (CRWQCB, 1997).

Santa Monica Canyon flows year round with a typical dry flow of approximately 100-300 thousand gallons/day. As occurs in the storm drain system elsewhere in the county, flow in the drain can increase to an estimated hundred million gallons per day during a significant storm event (CRWQCB, 1997).

Beneficial Uses

Beneficial uses are identified for this subwatershed in two areas: those associated with the creeks and those associated with ocean water influence by discharges from the land. The table below summarizes the beneficial uses designated for waterbodies in this subwatershed (CRWQCB, 1994).

Table 9. Beneficial uses of the waters within the Santa Monica Canyon

Coastal Feature or Watershed	Hydro Unit #	MUN	REC1	REC2	WARM	WILD
Santa Monica Canyon Channel	405.13	P	P	I	P	E
Rustic Canyon Creek	405.13	P	I	I	I	E
Sullivan Canyon Creek	405.13	P	I	I	I	E
Mandeville Canyon Creek	405.13	P	I	I	I	E

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Evidence of Impairments

The Will Rogers State Beach is one of the heavily used recreational area in Santa Monica Bay. Yet the area has also developed a reputation for severe pollution as indicated by bacterial count measurements and special studies. Over the years, high indicator bacterial counts have been found in nearshore waters surrounding the nearby drain's outlet. As a result, warning signs advising people not to swim in the adjacent area are permanently posted. However, although a SMBRP study found enteric viruses in Pico-Kenter drain (now diverted to a treatment facility), enteric viruses were not found in runoff samples collected at Santa Monica Canyon (CRWQCB, 1997).

The strongest evidence of impairment is provided by the SMBRP epidemiological study conducted in summer 1995. The beach adjacent to Santa Monica Canyon was one of the three sites surveyed. Besides finding higher health risks associated with swimming near the storm drains, the study also showed that bacterial indicator counts were higher near the Santa Monica Canyon drain than farther from it (CRWQCB, 1997).

Pollutants of Concern

The pollutants of concern identified for this subwatershed area include pathogens and total suspended solids (CRWQCB, 1997).

Sources and Loadings

The occurrence of pathogenic contamination of runoff and surfzone water as measured by bacterial indicator concentrations is highly episodic. Generally the incidence of contamination occurs only when there is storm drain flow. However, the frequency and magnitude of contamination does not seem to be related to the frequency and amount of the flow, nor the size of the drainage area. Surfzone water is more likely be contaminated when a storm drain discharges directly to the surfzone (CRWQCB, 1997).

In 1994, the City of Los Angeles conducted a study of the possible sources of bacterial contamination in the Santa Monica Canyon. In this study, samples from the Santa Monica Canyon upstream sub-drainage basin were collected at 10 locations and were analyzed for total and fecal coliform in order to isolate the pollutant sources. The test results appear to show no discernible pattern. However, the test results did indicate consistently higher bacterial contamination counts coming from the Santa Monica Canyon branch, specifically from the upper watershed (CRWQCB, 1997).

Septic tanks do not seem to be a major source of bacterial contamination. Only about 2% of the total number of homes in the drainage area have no sewer connections and, therefore, have septic tanks. The most likely bacterial contamination sources are fecal matter being released from horse stables, pets, and wild animals, and decomposed organic matter from trees. There are several horse stables built adjacent to Sullivan Canyon, Mandeville Canyon, and Rustic Canyon. Rustic Canyon is used as a trail by horseback riders. Finally, Will Rogers State Park has continuous equestrian activities and maintains some horse stables within the facility (CRWQCB, 1997).

Water Quality Improvement Strategies

There is a general consensus among stakeholders that the greatest impact and need for improvement in this subwatershed area is to reduce acute health risks associated with swimming at beaches impacted by pathogen-contaminated surfzone waters. Control of pathogen inputs into the nearshore areas should be the priority for pollutant control measures planned in this area (CRWQCB, 1997).

However, unlike in Pico-Kenter and adjacent drain area, diversion of low flow to treatment plant is not a desirable solution to the problem because the sewer facilities in this area do not have the extra capacity to receive and transport the expected amount of added low flow. Re-design and construction of the pipeline would be costly. There are two other alternative measures that are considered more suitable at this time. The first one is a public education program. The second is to promote implementation of BMPs by horse stable operators, by disseminating pamphlets, conducting employee training, and installing runoff containment devices (CRWQCB, 1997).

Reduce Nonpoint Source Pollutant Loading

Critical Coastal Area Designations California's Nonpoint Source (NPS) Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. These areas include Environmentally Sensitive Habitat Areas (ESHAs) currently designated in California's Coastal Zone Management (CZM) program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), National Estuary Program (NEP), and National Marine Sanctuaries. A long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. The short-term plan to achieve this goal is to identify, educate, and promote stakeholder involvement. The State's 2002 CCA Draft Strategic Plan identifies 101 CCAs statewide of which 13 are in the Los Angeles Region (CRWQCB, 2007).

Santa Monica Canyon is identified as CCA #62 in the State's Draft Strategic Plan; it is an impaired water body that flows into a Marine Protected Area. Santa Monica Canyon is formed by the confluence of three major watersheds. Approached from the shoreline it extends upstream for a couple of miles to include lower Rustic Canyon and lower Sullivan Canyon, both entering tangentially from the northwest and ends at the entrance to Mandeville Canyon which extends six miles farther north to the crest of the Santa Monica Mountain. The major efforts listed to implement NPS management measures include: work by the nearby Malibu Creek Watershed Advisory Council; dry weather diversions at Will Rogers State Beach; and participation with the North Santa Monica Bay Water Quality Improvement Project (CRWQCB, 2007).

Implement TMDLs

The TMDLs in effect which impact the Santa Monica Canyon are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. For the purpose of implementing the bacteria TMDLs, the area has been divided up into "jurisdictional groups" (JG) – the Santa Monica Canyon area falls into JG2. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the bacteria TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

<u>Santa Monica Bay Nearshore and Offshore Debris TMDL</u> The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from

achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris TMDL

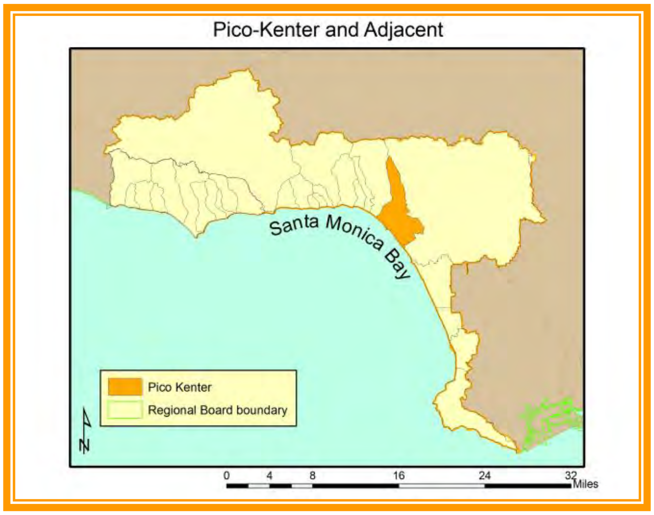
http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean. A low flow diversion was installed in 2003 by the City of Los Angeles to treat dry weather runoff from this drainage.

Pico-Kenter and Adjacent



The land use in this mostly urbanized subwatershed is 48% single family, 21% multiple family, 6% commercial, 3% public, and 19% open space. The subwatershed is named after the Pico-Kenter drain which is located where Pico Boulevard intersects the beach in the City of Santa Monica. The drain enters Santa Monica Bay in a 20-foot-wide by 8-foot high reinforced concrete box. The storm drain system drains a 4,147 acre area that includes much of Santa Monica and part of West Los Angeles and Brentwood. There are two drains: one owned by Los Angeles County and the other by CalTrans. Except for some upstream canyon areas, the drain is largely underground pipe. The storm drain flows year round with a typical dry flow of approximately 0.5 cubic feet per second (100-300 thousand gallons/day). Like storm drain channels in the rest of the watershed, flows in the drain can swell to an estimated hundred million gallons per day during a significant storm (CRWQCB, 1997).

Besides the Pico-Kenter drain, there are about a dozen relatively small catchment basins with beach or surfzone outlets between Pacific Palisades and Marina del Rey. These drains are also mostly concrete underground pipes. Combined with and including the Pico-Kenter drain, they drain a subwatershed of 9,105 acres. The other drains, in order of size of drainage area are: Rose Avenue, Wilshire Boulevard, Montana Avenue, Brooks Avenue, Thornton Avenue, Ashland Avenue, Venice Pavilion, and Santa Monica Pier (CRWQCB, 1997). Dry weather diversion/treatment facilities are in operation at these drains.

Beneficial Uses

Beneficial uses for waterbodies in this subwatershed are primarily identified for the coastal waters that receive discharges from the storm drains. Beaches in the area include the Santa Monica Beach and Venice Beach. These beaches are often heavily used, especially on weekends and in summer months. Santa Monica Beach is the busiest beach in the County, with up to 2.5 million visits each year (CRWQCB, 1994).

Table 10. Beneficial uses of the waters within the Pico-Kenter and adjacent area

Coastal Feature or Waterbody	Hydro Unit #	NAV	REC1	REC2	COM M	MAR	WILD	RARE	MIGR	SPWN	SHELL
Santa Monica Beach	405.13	E	E	E	E	E	E		E	E	E
Venice Beach	405.13	E	E	E	E	E	E	E	E	E	E

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Despite the high usage by humans, the beaches do provide habitats for many species of seabirds. A breeding site for the California least tern is located at Venice Beach (CRWQCB, 1997).

The nearshore surfzone areas are sandy bottom and are popular swimming and surfing areas. Like most offshore zones of the Bay, the sea floor consists of soft-bottom habitat that supports a diverse number of organisms, including more than 100 species of demersal fish. It is also an area with significant recreational boat traffic (CRWQCB, 1997).

Evidence of Impairments

Health Risks Associated with Swimming

The beaches and surfzone in the Santa Monica-Venice area are probably the most heavily used recreational area in Santa Monica Bay. Yet the area has also developed a reputation for severe pollution as indicated by bacterial count measurements and special studies. Over the years, high indicator bacterial counts have been found in nearshore waters surrounding several storm drain outlets. Prior to diversion of low flows to Hyperion treatment plant in 1992, total coliform and enterococcus counts in surfzone near Pico-Kenter storm drain exceeded Ocean Plan objectives as high as 18 percent of times. As a result, warning signs advising people not to swim in the adjacent area were posted permanently. Warning signs were also posted near other area drains with low flows. In a study conducted by the SMBRP in 1992, enteric viruses were found in runoff samples collected at the Pico-Kenter storm drain (CRWQCB, 1997).

The strongest evidence of impairment is provided by the SMBRP epidemiological study conducted in summer 1995 as presented earlier. Ashland Avenue storm drain was one of the three study sites surveyed during the study. Besides finding that higher health risks are associated with swimming near flowing storm drains such as Ashland, the study also showed that bacterial indicator counts were higher near the Ashland storm drain than farther from it (CRWQCB, 1997).

Elevated Contaminant Levels and Toxicity

Data collected over the years have shown that contaminants have accumulated in marine organisms in the nearshore area of the watershed. Studies conducted by the SMBRP in 1993 found that dry-weather runoff from Ashland Avenue was toxic to marine organisms. Toxicity exhibited at this site in general was higher than the toxicity exhibited in Ballona Creek and other sites investigated during the study. Toxicity identification and evaluation indicated that the sources of toxicity likely resulted from heavy metals (CRWQCB, 1997).

In a SMBRP pilot study conducted in 1991, chemical analysis of low flow runoff samples from Kenter Canyon drain showed that mean concentrations of chromium, copper, lead and zinc exceeded Ocean Plan Water Quality objectives. The levels of PAHs were about 35 times the Ocean Plan objectives. Furthermore, in a two week episode, high concentration of chlordane were detected in the runoff (CRWQCB, 1997).

The storm drains in this area also carry trash and debris to the nearshore waters. This trash and debris, either washing back onto beaches, or deposited on the sea floor, create a nuisance and health hazard to beach goers, swimmers, and boaters, and pose danger to marine life. Significant hazardous material spills infrequently occur in the drainage areas and wash down to the ocean, caused beach closures and the posting of warning signs (CRWQCB, 1997).

Pollutants of Concern

The pollutants of concern identified for this subwatershed area include pathogens, heavy metals (Pb, Cu, Zn, Cd, Ag), debris, oil and grease, PAHs, and chlordane (CRWQCB, 1997).

Sources and Loadings

Pathogens

Besides Pico-Kenter and Ashland Avenue drains, high concentrations of bacterial indicators were also found in effluent from drains at Santa Monica, Thornton Avenue, and Brooks Avenue. The occurrence of pathogenic contamination of runoff and surfzone water as measured by bacterial indicator concentrations is highly episodic. Surfzone water is more likely be contaminated when a storm drain outlet discharges directly to the surfzone (CRWQCB, 1997).

Potential sources of pathogens to storm drains include illegal sewer connection and sewer dumping, sewer leak, domestic animals, food service business, and outdoor camping (CRWQCB, 1997).

Heavy Metals, TSS, PAHs, and Oil and Grease

The Pico-Kenter storm drain has the second (to Ballona Creek) largest drainage area in the southern urban area of the watershed. Due to its large size and urban land use, the Pico-Kenter drainage contributes significantly to total loadings of several pollutants to the Bay. The SMBRP in 1993 estimated that the drain is the third largest loading source among 28 catchment basins (second in the southern urban area) for lead, copper, zinc, total suspended solids, and oil and grease. Combined, the area contributes approximately 5% of heavy metals, 4% of total suspended solid, and 6% of oil and grease (CRWQCB, 1997).

The MS4 discharge apparently is the primary source of pollutant loading in this subwatershed. There are fourteen non-stormwater permitted discharges in the area; the majority are discharges of treated groundwater and are of small volume. There are ten discharges covered by the general industrial stormwater NPDES permit and nine (a mix of residential and commercial) covered by the general construction stormwater NPDES permit. On the other hand, transportation-related activities are identified as probably the most important source for heavy metals, PAHs, and oil and grease. The loading of these (heavy metals and PAHs) are likely result of deposition of auto fuel exhaust and auto part wear (tires, brake pad, etc.). Other potential sources of heavy metals are excessive fungicide and insecticide use (CRWQCB, 1997).

Chlordane

Since the use of chlordane has been restricted since 1988, the source of chlordane in runoff is believed to be from unauthorized usage and dumping of stocked chemicals (CRWQCB, 1997).

Trash and Debris

Littering and illegal dumping are the primary sources of trash and debris found in the Pico-Kenter Area. However, the amount of trash and debris collected (through street sweeping and annual cleanup of catch basins and storm drain channels) is unknown at this time (CRWQCB, 1997).

Water Quality Improvement Strategies

There is a general consensus among stakeholders that the greatest impact and need for improvement in this area is the acute health risks associated with swimming in runoff contaminated surfzone waters. Control of pathogen inputs in the nearshore water should be the priority for pollutant control measures planned in this area. Other pollutants of concern identified for this area should continue be monitored (CRWQCB, 1997).

Several alternatives for pathogenic contamination control have been investigated in this area. The outlet of the Pico-Kenter storm drain was first extended 600 yard beyond the surfzone in 1991 Then in 1992, the Pico-Kenter storm drain became the first drain in the watershed to have its low-flow temporarily diverted to a treatment plant (CRWQCB, 1997).

Planned as a long-term solution, the City of Santa Monica and City of Los Angeles partnered to construct a facility that uses ultraviolet light to treat the effluent of Pico-Kenter and Santa Monica Pier storm drains on site at the Santa Monica Urban Runoff Recycling Facility (SMURRF). The facility became active in 2001 and began diverting and treating 500,000 gallons per day to recycled water quality. Additionally, the City of Los Angeles and the District conducted a series of studies that evaluated the feasibility and cost-effectiveness of diverting other problematic storm drains in the area to the sanitary sewer. The City of Los Angeles is diverting runoff from eleven drains during the dry season to the Hyperion treatment facility. These drainage areas include eight within the City of Los Angeles: Temescal Canyon, Palisades Park, Santa Monica Canyon, Rose Avenue Drain, Thornton Avenue Drain, Venice Pavilion Drain, Imperial Avenue Drain, and the Bay Club Drain. The District has built three low-flow diversions: Ashland Avenue Drain, Brooks Avenue Drain, and Playa del Rey. This combined effort prevents seven million gallons a day of contaminated runoff from flowing untreated into Santa Monica Bay (City of Santa Monica website, SWRCB website #3).

Implement TMDLs

The TMDLs in effect which impact the Pico-Kenter area are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. For the purpose of implementing the bacteria TMDLs, the area has been divided up into "jurisdictional groups" (JG) – the Pico-Kenter area falls into JG3. Both Santa Monica and Venice Beaches are listed as impaired for indicator bacteria. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the bacteria TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

Santa Monica Bay Nearshore and Offshore Debris TMDL The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

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Santa Monica Bay Beaches Wet Weather

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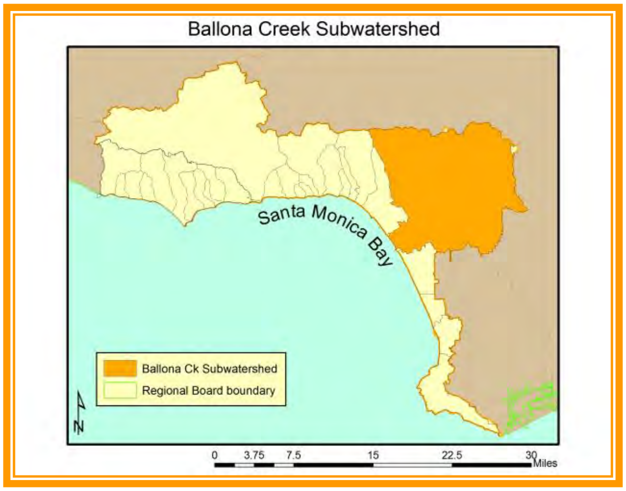
Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). Low flow diversions found within the Pico Kenter and adjacent area are show in the table below.

Table 11. Low flow diversions within the Pico-Kenter and adjacent areas

Low Flow Diversion	**Year Operational**	**Agency**
Ashland Avenue	2006	District
Electric Avenue Pump Plant	2001	District
Montana Avenue	2005	Santa Monica
Pico-Kenter	2001	Tri-agency
Rose Avenue	2005	District
Santa Monica Pier	2001	Santa Monica
Thornton Avenue	1999	City of LA
Venice Pavilion (Windward Ave Pump Station)	2003	City of LA
Wilshire Avenue	2005	Santa Monica

Ballona Creek



Ballona Creek, with its discharge point to Santa Monica Bay adjacent to the entrance of the Marina del Rey harbor, drains a watershed of about 127 square miles. It is the largest drainage tributary to Santa Monica Bay. The watershed boundary extends in the east from the crest of the Santa Monica Mountains southward and westward to the vicinity of central Los Angeles and thence to Baldwin Hills. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous other storm drains. Ballona Creek is concrete lined upstream of Centinela Boulevard. All of its tributaries are either concrete channels or covered culverts. The channel downstream of Centinela Boulevard is trapezoidal composed of grouted rip-rap side slopes and an earth bottom (CRWQCB, 1997).

Adjacent to the downstream channel of Ballona Creek are Marina del Rey small craft harbor, Ballona Lagoon and Venice Canals, Del Rey Lagoon, and Ballona Wetlands. Although they do not discharge directly into the Creek, they are grouped as waterbodies in this subwatershed because of their proximity and various forms of hydrological connections to the Ballona Creek (CRWQCB, 1997).

Flows

Ballona Creek conveys approximately 10 cfs of dry-weather base flow and up to 36,000 cfs of wet-weather flow (100-year storm event). The maximum wet-weather flow can be about 400 times the minimum dry-weather flow. This is suggestive of the dominant influence of stormwater runoff, which is typical of the stream flow pattern in Southern California (CRWQCB, 1997). The average annual runoff from Ballona Creek is 34 billion gallons per year; runoff from a 0.45 inch storm is 0.5 billion gallons based on an average rainfall of 14.95 inches per year (City of LA, 2009).

Land Uses

Ballona Creek collects runoff from several partially urbanized canyons on the south slopes of the Santa Monica Mountains as well as from intensely urbanized areas of West Los Angeles, Culver City, Beverly Hills, Hollywood, and parts of central Los Angeles. The urbanized area accounts for 80 percent of the watershed area; the partially developed foothill and mountains make up 20 percent. There are some areas of undeveloped land in the Santa Monica Mountains on the north side of the subwatershed, and a section along the east side of Ballona Creek near the Pacific Ocean. Some open space also remains in the Baldwin Hills area along with an oil field. All other areas are typically urbanized (CRWQCB, 1997).

Beneficial Uses

Beneficial uses are identified for this subwatershed in three areas: beneficial uses associated with the Ballona Creek channel, those associated with other waterbodies such as Marina del Rey, Ballona Wetlands and Lagoon, and those associated with ocean water influenced by discharges from the land. and are shown below (CRWQCB, 1994).

Table 12. Beneficial uses of the waters within the Ballona Creek subwatershed

Coastal Feature or Waterbody	Hydro Unit #	MUN	NAV	REC1	REC2	COMM	WARM	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Marina Del Rey				E											
Harbor	405.13		E	E	E	E			E	E				E	
Public Beach Areas	405.13		E	E	E	E			E	E	E				
All other Areas	405.13		E	P	E	E			E	E	E			E	
Entrance Channel	405.13		E	E	E	E			E	E	E			E	
Ballona Creek Estuary	405.13		E	E	E	E		E	E	E	E	E	E	E	
Ballona Creek to Estuary	405.13	P		EL	E		P			P					
Ballona Creek	405.15	P			E		P			E					
Ballona Lagoon/Venice Canals	405.13		E	E	E	E		E	E	E	E	E	E	E	E
Ballona Wetlands	405.13			E	E			E		E	E	E	E		E
Del Rey Lagoon	405.13		E	E	E	E		E		E	E	E	E		E

E: Existing beneficial use
P: Potential beneficial use
I: Intermittent beneficial use
EL: Limited beneficial use

Marina del Rey/Ballona Creek Complex

Marina del Rey Harbor and the estuarine portion of Ballona Creek together provide many important beneficial uses. Marina del Rey is one of the largest small craft harbors in the world accommodating more than 6,000 private pleasure boats. Besides the recreational value provided, the Marina/Creek complex is an important habitat for many invertebrates, fish, bird, and mammal species (CRWQCB, 1997).

The benthic fauna in the area is typical of areas with shallow warm waters, a fine-grained, silty bottom and, in the marina, with limited circulation. The most common benthic species in the area are roundworms that account for about 30% of the total benthic population and found primarily in the channel entrance. Polychaetes are also common in the poorly-circulated inner marina. The fish population has limited diversity due to the less favorable physical and environmental conditions in the area. Certain seabirds are seasonally common in the area. The species found here are those that occur in sheltered waters of shallow depths (e.g., grebes and scoters), or generalist species (e.g., gulls). California sea lions and harbor seals are often seen on the breakwater and jetties (CRWQCB, 1997). Sampling during 2004 yielded 77,674 total fish of all age groups (including larvae and eggs) representing 56 different species. By far, the majority of these were eggs, larvae, and juveniles, which attests to the Harbor's continued value as a nursery ground (ABC Labs, 2005).

Several federally defined threatened, endangered, and candidate species may occur in the complex and adjacent beach areas. The species that are sensitive to environmental disturbances include the California least tern, California brown pelican, and western snowy plover (CRWQCB, 1997).

Ballona Wetland Complex

The Ballona Wetlands ecosystem represents one of the few remaining regionally significant coastal wetlands available in Santa Monica Bay. Within Los Angeles County, it is estimated that coastal wetlands have been reduced by 96% compared with pre-development conditions. The nearest comparable wetlands are Malibu and Mugu Lagoons to the north and Los Cerritos Wetlands to the south. The Ballona Wetlands play not only a crucial role in sustaining regionally limited habitats and species, but also an important role in providing opportunities for the public to experience these environments (SCC, 2006).

The project site is owned by the State of California, the California Department of Fish & Game (CDFG) owns 540 acres and the State Lands Commission (STC) owns 60 acres. The California Fish and Game Commission also recently designated the Ballona Wetlands as an Ecological Reserve. This designation covers the land owned by CDFG and part of the land owned by SLC. The designation provides additional protection for the natural resources of the site and specifies compatible public uses for the area (SCC, 2006).

In previous studies the site has been divided into three areas designated as Areas A, B, and C. In addition, the Freshwater Marsh lies within the project area (SCC, 2006).

Area A includes approximately 139 acres north of the Ballona Creek, west of Lincoln Boulevard and south of Fiji Way. Site elevations range between approximately 9 and 17 ft MSL, fill was placed on Area A during the excavations of Ballona Creek and Marina Del Rey. Area A is undeveloped with the exception of a parking area along the western boundary and a drainage channel along the northern boundary. In addition, the Gas Company currently maintains four monitoring well sites in the western end of this Area (SCC, 2006).

Area B, approximately 338 acres in size, lies south of Ballona Creek and west of Lincoln Boulevard. Area B extends south to Cabora Drive, a utility access road near the base of the Playa Del Rey Bluff. To the west, Area B extends into the dunes that border homes along Vista del Mar. Site elevations range between approximately 2 and 5 ft in the lower flat portions, and up to 50 ft MSL below the Del Rey Bluff. Area B contains the largest area of remnant unfilled wetlands with abandoned agricultural lands to the northeast, and the Freshwater Marsh to the southeast. The Gas Company has easements for oil wells, one of which is active, and supporting access routes in Area B (SCC, 2006).

Area C is north of the Ballona Creek and east of Lincoln Boulevard in the City of Los Angeles. The Harbor Freeway forms the sites northeastern border. The site is approximately 66 acres in size and is traversed in an east-west direction by Culver Boulevard. Area C contains fill from the construction of the Ballona Creek Flood Control Channel, and developments such as Marina del Rey, the Pacific Electric Railroad, the raising of Culver Boulevard and the Marina Freeway. Elevations within Area C range approximately between 4.5 and 25 ft MSL. Area C is mostly undeveloped with exception of ball fields and supporting minor structures (SCC, 2006).

The *Freshwater Marsh* is located west of Lincoln Blvd, south of Jefferson Boulevard adjacent to Area B in the City of Los Angeles. The Freshwater Marsh was constructed between 2001 and 2003 and treats urban runoff and stormwater from the Playa Vista development and from Jefferson Boulevard. It is operated and managed by the Ballona Wetlands Conservancy, a non-profit organization established for that purpose. A riparian corridor east of Lincoln Boulevard and outside of the project area is currently being constructed that will connect to the south end of the Freshwater Marsh (SCC, 2006).

CDFG owns the *Ballona Creek* through the project area. The channel is trapezoidal, with bottom widths varying from 80 to 200 feet and depths varying from 19 to 23 feet from the top of the levee. The side slopes are lined with concrete, paving stones and riprap; the channel bottom is not armored (SCC, 2006).

The Del Rey Lagoon/Ballona Wetlands is a mixture of habitats dominated by coastal salt marsh. Freshwater riparian habitat also exists along the foot of the bluff. The wetlands support hundreds of species of plants, insects, and animals. Common plant species include pickleweed, salt grass, frankenia, jaumea, saltbush, etc. in the salt marsh area and tale, cattail, willows, cottonwood, threesquare, umbrella sedge, etc. in the freshwater riparian area. Animal species across all major taxonomic groups are observed in the wetlands, including many special status species such as Belding's Savannah sparrow, salt marsh shrew, Dorothy's El Segundo dune weevil, and salt marsh skipper, etc. The wetlands also provide spawning ground for fish species such as California halibut (CRWQCB, 1997).

The 16-acre Ballona Lagoon is an artificially confined tidal channel that connects the Venice canal to the Pacific Ocean (CRWQCB, 1997).

Beaches

The adjacent beaches of the area include Venice Beach located upcoast and Dockweiler State Beach located downcoast. These beaches are often heavily used, especially on weekends and in summer months. Jetties along the channels are also regularly used by pedestrians and fishers (CRWQCB, 1997).

Nearshore and Offshore Areas

The nearshore and offshore zones near the discharge point of Ballona Creek are areas heavy in traffic for recreational boat activities because its vicinity to Marina del Rey. Like in most parts of the Bay, the sea floor is consisted of soft-bottom habitat that supports a diverse number of organisms, including more than 100 species of demersal fish (CRWQCB, 1997).

Evidence of Impairments

The Ballona Creek subwatershed is part of the Santa Monica Bay region that continues to experience significant development in response to demand for housing and business with coastal amenities. Two of many consequences associated with modern human inhabitation are natural habitat replacement/ destruction, and increased pollutant loading to waterbodies within the subwatershed (CRWQCB, 1997).

Habitat Degradation

At one time, the Ballona Wetland Complex was 2,100 acres of coastal estuary and wetlands. With the development of Marina del Rey, the Venice canals, and other residential and commercial properties, the draining of wetlands for agricultural use, oil drilling, and to control insects; and the channelization of Ballona Creek; the Wetland Complex has been reduced to approximately 430 acres (CRWQCB, 1997). The 2001 graduate thesis, "Seeking Streams", produced by a team of students in the Cal Poly Pomona Department of Landscape Architecture 606 Studio Program, documented the locations of the underground remnants of the stream system which once drained from the Santa Monica Mountains to the coastal wetlands (Braa, et al., 2001).

Most parts of the 260-acre Ballona Wetlands are degraded or severely degraded. After channelization of Ballona Creek, the wetland's only connection to the ocean is culverts with flap gates. However, these flap gates allow only limited amounts of sea water into the marsh. The tidal range rarely exceeds one meter. In Area A of the wetlands next to the Marina, there is no tidal exchange through the culvert to the Marina because bank height and elevation of the surrounding lands are above the tidal amplitude (CRWQCB, 1997).

The degraded wetlands support fewer species and is less productive. Many species characteristic of pristine salt marshes in the area are lacking. Additional adverse impacts include the introduction of non-native plants and animals, debris and bacteria from urban runoff, and recreational overuse (CRWQCB, 1997).

Elevated Contaminant Levels and Toxicity

Data collected over the years have shown that contaminants are accumulated in the estuarine area of the watershed both in sediments and in marine organisms (CRWQCB, 1997).

Studies conducted by the SMBRP in 1993 and 1995 found that both dry- and wet-weather runoff were toxic to marine organisms. Almost all samples collected from the main channel and two major tributaries exhibited toxicity using the sea urchin fertilization test until the runoff/storm waters were diluted 10 times. Tests conducted on sediment samples also exhibited toxic effects. Toxicity identification and evaluation indicated that the probable sources of toxicity varies. In one case the source was consistent with the presence of organic chemicals. On another occasion the source was consistent with the presence of toxic metals (CRWQCB, 1997).

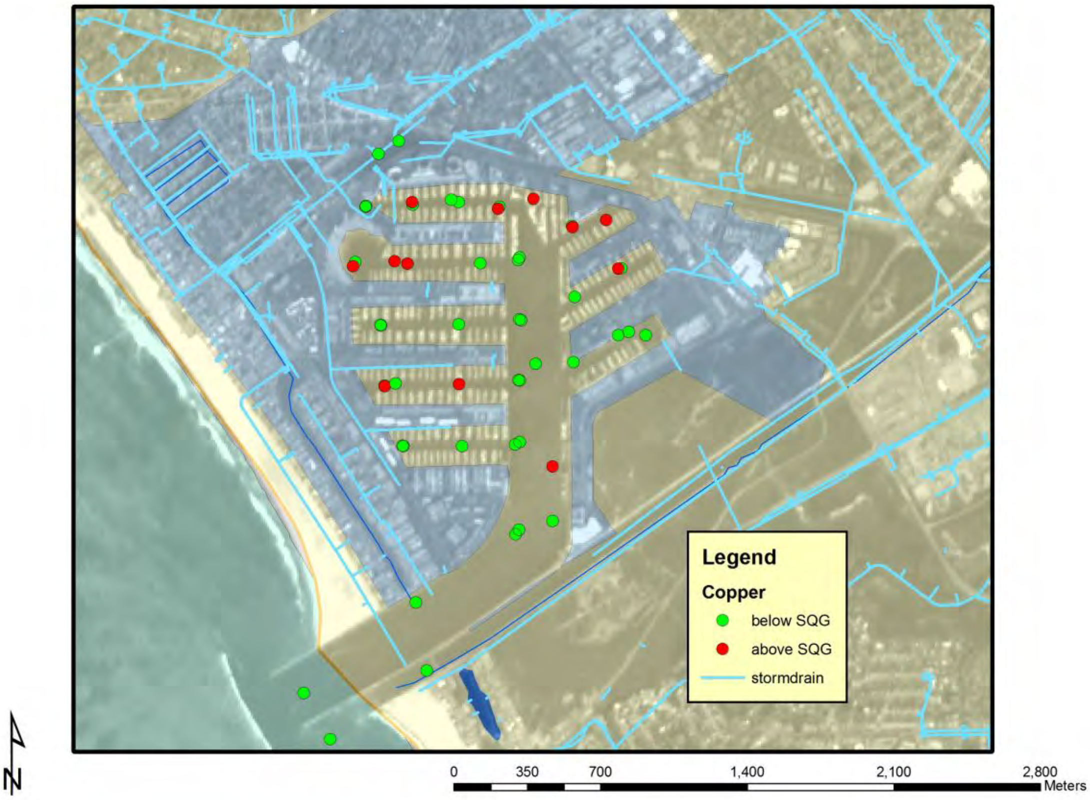
Sediment samples have been collected in the harbor and analyzed for a number of pollutants for years by ABC Labs for the Los Angeles County Department of Beaches and Harbor; and prior to that, by USC Harbors Environmental Projects. Recently, more intensive characterization sampling has been conducted by Weston Solutions. The figures below show a small subset of the available data; namely, copper in the sediment in 1997 versus in 2007 when compared to sediment quality guidelines which serve as a simple general point of reference.

Figure 18

Copper in Marina del Rey Harbor Sediments, 1997 (ABC Labs)

Figure 19

Copper in Marina del Rey Harbor Sediments, 2007 (Weston Solutions and ABC Labs)



Broadly speaking, at least with regards to copper, concentrations which may be of concern are mostly found in the back basins of the harbor.

Bacterial indicator levels measured at stations near Ballona Creek entrance frequently exceed levels prescribed in the Basin Plan. As a result, warning signs are posted permanently on each side of the Creek to advise people not to swim in the area. Over the years, beach areas were closed many times due to sewage spills and illegal dumping (CRWQCB, 1997).

Everyday, tons of trash and debris wash into the sea from Ballona Creek. When floating on the water surface, washed back onto beaches, or deposited on the sea floor, trash creates a nuisance and health hazard to beach goers, swimmers, and boaters, and pose dangers to marine life (CRWQCB, 1997).

The results of a study on watershed-based sources of contaminated sediments in San Pedro Bay-area harbors (in this case, the Ballona Creek Watershed as a source to Marina del Rey Harbor) conducted by SCCWRP and reported on in 2003, found typical modeled wet-weather annual loads to Marina del Rey from Ballona Creek range from 7 kg/year for cadmium to 381 kg/yr for lead, 1,081 kg/yr for copper, and

6,901 kg/year for zinc. Suspended solid loadings typically range from approximately 3,000 metric tons/year from Ballona Creek. General conclusions reached included that the majority of contaminants to the Harbor were deposited from Ballona Creek while industrial discharges represented a fraction of the total annual load. In some years, dry season loading may equal or exceed wet weather loading and constitute the majority of total annual load from the watershed. The magnitude of dry season flow translates to large dry season loading for several contaminants, such as copper, nickel, and zinc. Long-term trends in annual loading of metals appear consistent, while trends in annual loading of DDTs and PCBs appear to have declined. Annual loads of most metals are in the 103 – 105 kg/year range, with zinc and copper loading typically exceeding loads of other metals, most likely due to their relatively ubiquitous use and distribution. As a result, management strategies would need to account for typical annual variations of up to five orders of magnitude. Industrial and residential land uses contribute the greatest percent of annual contaminant loading (Stein, et al., 2003).

Another study conducted by SCCWRP and reported on in 1999 addressed the effect of stormwater and urban runoff discharge into Santa Monica Bay and found the following:

- Virtually every sample of Ballona Creek stormwater tested was toxic to sea urchin fertilization.
- The first storms of the year produced the most toxic stormwater in Santa Monica Bay during the study.
- The toxic portions of the stormwater plume were variable in size, extending from ¼ to 2 miles offshore of Ballona Creek.
- Surface water toxicity caused by unidentified sources was frequently encountered during dry weather in Santa Monica Bay.
- Zinc was the most important toxic constituent identified in stormwater. Copper and other unidentified constituents may also be responsible for some of the toxicity measured in Santa Monica Bay.
- The measured concentrations of zinc and copper in Ballona Creek stormwater were estimated to account for only 5 to 44 percent of the observed toxicity.
- Sediments offshore of Ballona Creek generally had higher concentrations of urban contaminants, including common stormwater constituents such as lead and zinc.
- Sediments offshore of Ballona Creek showed evidence of stormwater impacts over a large area (Bay, et al., 1999).

Pollutants of Concern

The pollutants of concern identified for this subwatershed include heavy metals (Pb, Cu, Zn, Cd, Ag), debris, pathogens, oil and grease, PAHs, and chlordane. Possible future hydrological modifications of existing infrastructure such as dredging, fill, damming, channelization, and other types of construction are also a major concern because of their potential for impairment of water quality and aquatic and marine habitats (CRWQCB, 1997).

Although not identified as pollutants of concern initially in the Bay Restoration Plan, DDTs and PCBs should continue be monitored in the runoff from this subwatershed. Traces of DDTs and PCBs are still detected in sediment samples collected near the mouth of the Creek, and higher concentrations are still present in mussel tissues in the area (CRWQCB, 1997).

Sources and Loadings

Ballona Creek

Early Mass Loading Studies Because of its large size and urban land use, Ballona Creek contributes significantly to total loadings of several pollutants to the Bay and to Marina del Rey Harbor. In 1993, the SMBRP estimated that Ballona Creek is the largest loading source among 28 catchment basins for lead, copper, zinc, total suspended solid, and oil and grease. A reconnaissance study performed by the Army Corps of Engineers in 1995 estimated that Ballona Creek yielded about 46,000 cubic yards of sandy material and about 5,300 cubic yards of silt annually (CRWQCB, 1997).

Sampling and analysis conducted during the 1995/96 wet season indicated that the metals (Ag, Cd, Cu, Cr, Ni, Pb, and, Zn) mass load contributed by the three main tributaries is proportional to their flow (Ballona main channel>Sepulveda channel>Centinela channel). However, the load from each channel was a significant contributor to the overall pollution load from this subwatershed (CRWQCB, 1997).

Current MS4 Monitoring The 2008-2009 mass emissions monitoring station on Ballona Creek is located at Sawtelle Blvd., above the area of tidal influence. Approximately, 89 square miles of land drains to this site; 40% of the area is used as single family high density residential, 12% is multi-family residential, 11% is vacant, 10% is retail/commercial, nearly 7% is mixed residential, 3.5% is light industrial, and 12% is designated as other uses. Despite this subwatershed's prevalence of impervious surfaces, Ballona Creek produced much more sediment per square mile compared to Malibu Creek, even though the two watersheds have comparable areas (LACDPW website).

Mass loading Not surprisingly, there are very large loading differences between results for wet- and dry-weather sampling events as well as between the various wet-weather events which can have very different rainfall amounts and patterns. For example, during 2008-2009, copper varied from a low of 1.24 lbs during one dry-weather sampling event to a high of 1,163.29 lbs during a wet-weather event. Within the dry-weather sampling events, copper loads ranged up to 11.52 lbs. Other metals followed a similar pattern with zinc loading ranging from a low of 2.53 lbs during dry-weather to a high of 4385.44 lbs during a wet-weather sampling event (LACDPW website).

Toxicity testing Two dry-weather toxicity sampling events during 2008-2009 resulted in no acute or chronic toxicity to a freshwater organism (*Ceriodaphnia*); a toxic effect was seen with the chronic sea urchin fertilization test. Similar results were found during the two wet-weather sampling events. 42

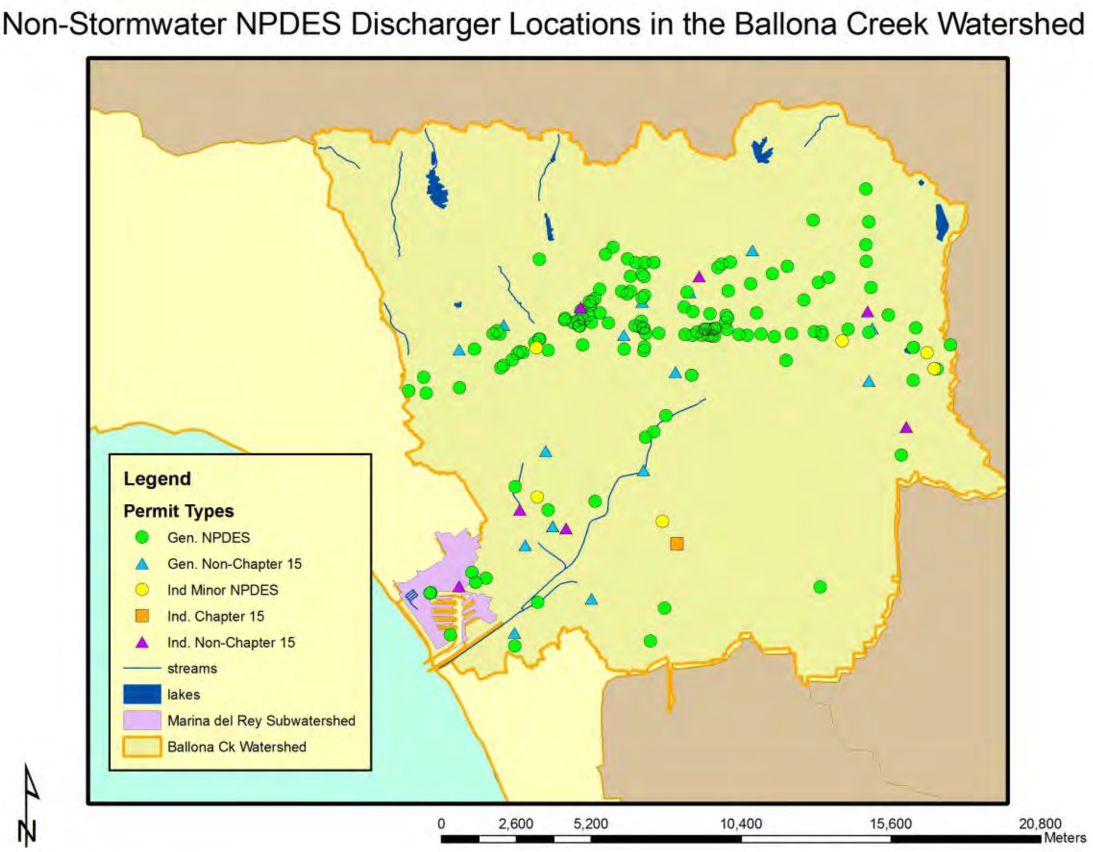
Chemical/bacteriological testing During the three dry-weather sampling events, fecal coliform bacteria did not attain the applicable water quality objective (400 mpn/100 ml) two out of three times sampled during dry weather (LACDPW website).

During the five wet-weather sampling events, two constituents were at excessive concentrations for most or all of the events: fecal coliform and zinc. Fecal coliform bacteria did not attain the applicable water quality objective five out of five times sampled during wet weather in Ballona Creek which is subject to the wet weather suspension of the REC-1 beneficial use during high flow periods. Dissolved copper did not attain the hardness-based water quality objective during wet weather at Ballona Creek for three of the five events measured. Dissolved copper concentrations were fairly consistent but the hardness at Ballona Creek was quite variable. Dissolved zinc did not attain the hardness-based water quality objective during one of the five wet-weather sampling events (LACDPW website).

Dry Weather Metals and Bacteria Loading Distribution into Ballona Creek A study conducted by SCCWRP and reported on in 2004 characterized the spatial distribution of sources of dry weather metals and bacteria loading to Ballona Creek. Metals concentrations in Ballona Creek were below chronic criteria under the California Toxics Rule between 96% and 100% of the in-river samples. In contrast, bacteria concentrations at the majority of storm drains and in-river sites were consistently above AB411 water quality standards. In general, Ballona Creek exhibits a bimodal distribution of elevated metals and bacteria, with the highest levels occurring between km 3 and 6, immediately upstream of the tidal portion of the creek and between km 9 and 12, below the portion of the watershed where Ballona Creek daylights from an underground storm drain to an exposed channel. These two portions of Ballona Creek correspond to locations where storm drains with consistently high concentrations and loads discharge to the creek. Of the 40 drains sampled, four account for 85% of the daily storm drain volume. Between 91% and 93% of the total daily load for metals is contributed by eight drains. Nine drains consistently have the highest concentrations of metals and bacteria. Metals concentrations may vary by 5-fold and bacteria concentrations may vary by up to five orders of magnitude on an intra- and inter-annual basis. The authors report that despite this variability, managing a relatively small number of storm drain inputs has the potential to result in substantial improvement in water quality in Ballona Creek (Stein and Tiefenthale, 2004).

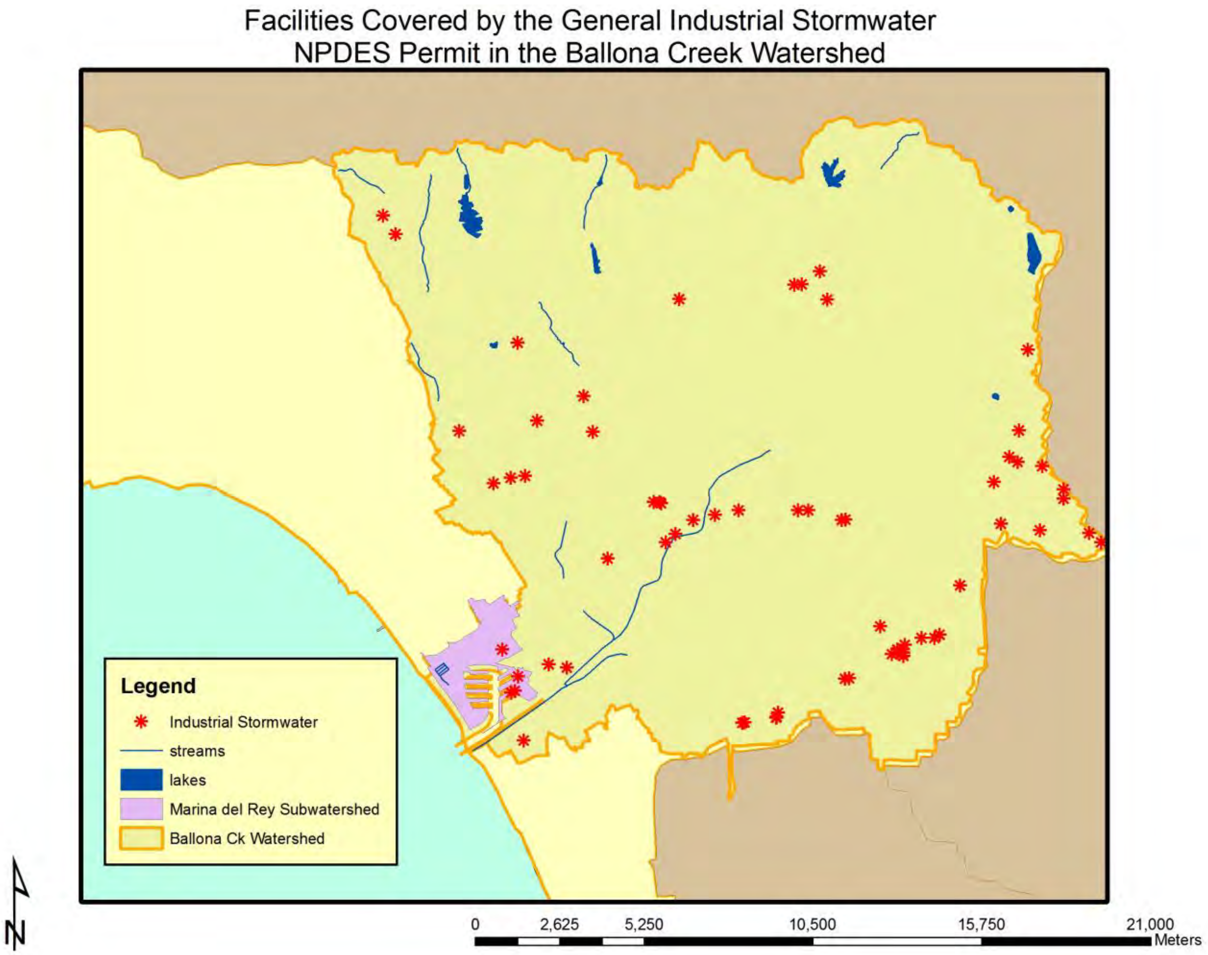
Permitted Discharges There are 170 permitted non-stormwater discharges in the Ballona Creek Watershed; six are into the Marina del Rey Subwatershed. The majority of these permitted discharges are ground water seepage drained for construction site preparation and treated contaminated groundwater. Some are discharges of cooling water. These permitted discharges of non-stormwater into the storm drains have a combined discharge that is about 8% of the discharges from stormwater runoff (CRWQCB, 1997).

Figure 20


Non-Stormwater NPDES Discharger Locations in the Ballona Creek Watershed
Legend
Permit Types
Gen. NPDES
Gen. Non-Chapter 15
Ind Minor NPDES
Ind. Chapter 15
Ind. Non-Chapter 15
streams
lakes
Marina del Rey Subwatershed
Ballona Ck Watershed
N
0
2,600
5,200
10,400
15,600
20,800
Meters

There are 66 facilities covered by the general industrial stormwater NPDES permit. Electric, gas and sanitary services; local and interurban passenger transit; and fabricated metal products are a large component of these businesses based on their Standard Industrial Classification (SIC) code. There are approximately 70 facilities covered by the general construction stormwater NPDES permit in the Ballona Creek Watershed (CRWQCB, 2007).

Figure 21



Transportation-Related Sources There are many potential sources for pollutants of concern in this region. Among them, transportation-related activities are identified as probably the most important source for heavy metals, PAHs, and oil and grease. Monitoring of highway runoff conducted by California Department of Transportation has shown high concentrations of copper, lead, and zinc. The loading of these (heavy metals and PAHs) likely are resulting from deposition of auto fuel exhaust, an auto part wear (tires, brake pad, etc.). Other potential sources of heavy metals are fungicide and insecticide use. In addition, natural oil seeps, which are far more abundant in this region than other parts of Santa Monica Bay, may be an important contributor of oil and grease loading to Ballona Creek (CRWQCB, 1997).

Sources of Trash and Debris Littering and illegal dumping are major sources of trash and debris found in Ballona Creek. Los Angeles County Department of Beaches and Harbors collects tons of trash on adjacent beaches after major rain storm each year. Most of the trash collected by the Department are materials carried downstream by the Creek and then washed on shore by tidal action. Since 1994, the District installed a trash net near the mouth of the Ballona Creek (CRWQCB, 1997). The amount of trash collected during each month of 2002, ranged from practically zero during dry-weather months to about 95 tons during wet periods (LACDPW, 2004). Another major source of specifically plastic debris are industries that manufacture, store, process, and otherwise handle plastic pellets as raw material which is being addressed through the Santa Monica Bay Nearshore and Offshore Debris TMDL (CRWQCB website #3).

Sources of Pathogens Potential sources of pathogens to the Creek also include illegal sewer connections and sewage dumping, domestic animals, and the transient population. A study is being undertaken by the City of Los Angeles to evaluate the effects of street washing on loading of pathogenic materials into the storm drain system (CRWQCB, 1997).

Sewer leaks occurred in the past at various locations within the watershed, especially in areas where sewer lines are in parallel to the storm drain system. There were several incidences of sewer overflows during winter storms each year. In response, the City of Los Angeles has been replacing old sewer lines (CRWQCB, 1997).

Marina del Rey Harbor

There are four drainages that are located around and drain directly into Marina del Rey Harbor. Although these drainage areas constitute only about 1% of the total drainage area of Ballona Creek subwatershed, two of the drainages, Oxford Basin and Washington Drain, are significantly more industrialized than the Ballona Creek average, and thus are potentially significant sources of industrial contaminants such as heavy metals. Also, the area with surface drainage to Marina del Rey Harbor area has a high percentage of commercial use and thus is a potentially significant source for contaminants such as oil and grease in the harbor (CRWQCB, 1997). Finally, the five NPDES-permitted non-stormwater discharges to the harbor are covered by a general permit for discharges of groundwater from construction dewatering to surface waters; there is also an individual non-Chapter 15 waste discharge requirements for discharge to the ground (CRWQCB website #1).

Contaminants due to nonpoint sources from marine activities in the harbor include primarily lead, copper, zinc, PAHs, TBT and bacteria. Compared with contaminant loading in Ballona Creek, lead releases due to marine activities are essentially negligible but zinc releases may be higher. This estimate is based on the assumption that the extent of zinc anode use has remained essentially the same over the last decades. The use of TBT as an antifouling agent in vessel paints has been restricted since 1987. Monitoring data has indicated a decline in TBT concentration in sediment in the harbor (CRWQCB, 1997).

Water Quality Improvement Strategies

In accordance with the problems identified previously, greatest benefits could be achieved should water quality improvement efforts be focused on the following:

- Protect and restore remaining wetland and riparian habitats in the region.
- Prevent and reduce mass loading of pollutants that accumulate in sediments of the Creek and near shore sea floor and that are toxic and/or bioaccumulate in marine organisms.
- Prevent and reduce loading of pollutants that may deplete the recreational value of nearby beaches and nearshore water by either imposing health risk or aesthetic nuisance (CRWQCB, 1997).
- Implement TMDLs.

Protect and Restore Wetlands and Riparian Habitats

Restoration of the Ballona Wetlands Complex Acquisition of parcels within the Ballona Wetlands Complex is a completed project of the Wetlands Recovery Project (SCWRP website #2). The project site is now owned by the State of California; the California Department of Fish & Game (CDFG) owns 540 acres and the State Lands Commission (SLC) owns 60 acres. The California Fish and Game Commission also recently designated the Ballona Wetlands as an Ecological Reserve. This designation covers the land owned by CDFG and part of the land owned by SLC. The designation provides additional protection for the natural resources of the site and specifies compatible public uses for the area. A wetlands restoration plan is currently being developed for the area. More information may be found at http://www.balloanrestoration.org (SCC, 2006).

Coordinating with Ballona Wetlands restoration planning, an Army Corps-funded Ecosystem Restoration Feasibility Study is also underway. The goal of the study is to restore, enhance, and create estuarine and riparian habitat and function in the Ballona wetlands and creek and enhance endangered species habitat. Sub-goals include, 1) provide an optimal mix of coastal dependant wetland habitats in terms of ecological integrity, function, diversity, and productivity; 2) restore riparian and aquatic habitat and contribute to the regional habitat connectivity and corridors, and to future restoration activities; and 3) contribute to regional wildlife, and recreation linkages and corridors (USACE website).

Ballona Lagoon was the site of a major restoration in 1997. Activities included: dredging at the southern end of the lagoon to create a deep water pool, removal of inactive oil pipelines and an abandoned concrete structure from the middle of the lagoon, stabilizing the lagoon banks with native vegetation, and constructing a visitor's overlook (SMBRC website).

Related Studies and Plans The State Coastal Conservancy, through the Santa Monica Bay Restoration Foundation, has funded a number of studies which will aid in overall watershed/wetlands restoration. They include:

1) The Historical Ecology of the Ballona Creek Watershed - The purpose of this study is to understand the unique watershed characteristics that shape the current system and that can guide appropriate restoration work. This project requires extensive historical research as well as GIS mapping work and will result in a publication that illustrates the geologic, hydrologic and human development of Ballona Creek watershed. As was done for the San Gabriel watershed, it will identify historical reference points in the watershed, as well as factors that influence landscape change, including land use, climate, floods and fires. It will help define restoration and management options for various locations and purposes throughout the watershed (SCC website).

2) Water Budget for the Ballona Creek Watershed - This study will identify inputs and outputs for the watershed including mapping natural springs and identifying natural flows in storm drains and stream channels. The information will help guide restoration planning to maximize water quality and habitat improvement benefits. The study will help inform decisions about where to place water treatment facilities and other BMPs, to ensure greatest benefit from treating stormwater rather than treating the cleaner, natural flows, which will ultimately contribute to more efficiently and cost-effectively meeting TMDL requirements in the watershed (SCC website).

3) Ballona Greenway Plan - This project will complete the Ballona Greenway Plan. The Greenway Plan was initiated by the Ballona Watershed Task Force and preliminary design work has been done. The outcome of this project will be final designs for portions of the Greenway including landscape guidelines for a Ballona-specific plant palette. This project has proceeded in close consultation with the MRCA and Baldwin Hills Conservancy on their pocket park and bike path beautification plans (SCC website).

Restoration of Stone Canyon Creek Funding from the Coastal Conservancy has been granted to the Santa Monica Baykeeper, in cooperation with other entities, to restore a stretch of Stone Canyon Creek on the UCLA campus. Out of the estimated 419 acres of campus, less than 12 acres remain of natural native habitat. The creek banks are filled with invasive vegetation and are suffering from erosion despite artificial shoring efforts (SCC website).

This site was part of previous small-scale year restoration effort funded by the Southern California Wetland Recovery Project's small grants program. That effort removed non-native vegetation from 0.36 acres of the site. The current project will build upon that work by conducting continued weeding of invasive vegetation, maintenance of existing plants, planting of new native vegetation, and the replacement of 8 exotic trees with native trees. The project will expand the restoration effort to approximately 0.25 additional acres of area along Stone Canyon Creek making the total area restored along the creek approximately 0.60 acres (SCC website).

Recommendations for Daylighting Streams The 2001 Cal Poly Pomona graduate thesis, "Seeking Streams", provided a framework for daylighting streams within the upper Ballona Creek subwatershed through providing general design guidelines for re-creating streams in an urban setting and more detailed designs for Sacatela Creek and flows through Lafayette Park (Braa, et al., 2001).

Strategies for Reducing Mass Loading of Heavy Metals, PAHs, and Chlordane

Many storm water control BMPs have been implemented in this subwatershed, primarily under the municipal stormwater NPDES program. Most of the BMPs implemented to date are general pollution prevention measures such as public education, street sweeping, and household hazardous waste collection. Additionally, source-specific BMPs have been developed and are being implemented to address these pollutants of concern more effectively (CRWQCB, 1997).

Ballona Creek Watershed Management Plan The Los Angeles County Department of Public Works was awarded a Proposition 13 Watershed Protection Grant by the State Water Resources Control Board to prepare a watershed plan for Ballona Creek. The Ballona Creek Watershed Task Force met for about a year during Plan development and the final Plan was released in 2004. The overarching goal of the Plan was to "Set forth pollution control and habitat restoration actions to achieve ecological health." The Plan includes an extensive list of priority actions, best management practices, and potential demonstration projects to achieve that goal including those specifically related to improving water quality. Some of these activities have been accomplished including the development of a GIS-based comprehensive storm drain map for the county (LACDPW, 2004).

Ballona Creek Watershed Stormwater BMP Implementation Program The Ballona Creek Watershed Stormwater BMP Planning and Implementation Strategy was funded with Proposition 12 funds granted to the City of Los Angeles by the Coastal Conservancy in 2003 and was completed in September 2005. This study identified and prioritized locations within the Ballona Creek watershed, identified and selected specific BMPs for those locations and developed a strategic implementation plan. The study involved numerous watershed stakeholders and resulted in a short list of preferred BMP projects in the watershed. From that list, the Rain Barrels Pilot Project (Downspout Retrofit Program) was selected for implementation. The goal of this project is to significantly reduce the amount of precipitation that becomes runoff from the targeted residential areas (Jefferson, Sawtelle, and Mar Vista areas). This will be accomplished by implementing a Downspouts Disconnection Program, on private properties, to reroute roof runoff from the stormwater collection system to on-site pervious areas, infiltration planters, and/or rain barrels. This pilot program will help improve water quality and manage floods, especially in areas with limited storm drain capacity. The project is expected to control the runoff from 600 out of the 1,600 properties within the two targeted areas. Based on that and based on typical level of imperviousness associated for each land use, the estimated annual average volume that will be eliminated from discharging into Ballona Creek is 1,130,000 cubic feet. Downspouts in the targeted areas were retrofitted during summer 2009 with funding from the SMBRC. Up to 100 on-site treatment BMPs (bioretention/filtration planter boxes/rain barrels) were also proposed to be installed. Subsequent to the implementation of this program, its success will be assessed, and runoff reduction and water quality impacts will be quantified. This pilot program, if successful, will have broader application within the Santa Monica Bay region, especially on areas with limited storm drain capacity and flood-prone locations (City of LA website #1).

Critical Coastal Area Designations California's Nonpoint Source (NPS) Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. These areas include Environmentally Sensitive Habitat Areas (ESHAs) currently designated in California's Coastal Zone Management (CZM) program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), National Estuary Program (NEP), and National Marine Sanctuaries. A long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. The short-term plan to achieve this goal is to identify, educate, and promote stakeholder involvement. The State's 2002 CCA Draft Strategic Plan identifies 101 CCAs statewide of which 13 are in the Los Angeles Region (CRWQCB, 2007).

Ballona Creek is identified as CCA #68 in the Draft Strategic Plan; it is an impaired water body that flows into a Marine Protected Area. The major efforts listed to implement NPS management measures include: work by the Ballona Wetlands Foundation to preserve and protect the Ballona Wetlands ecosystem through research, educational programs and activities; activities at the Friends of Ballona Wetlands Education/Ecology Center; construction of the Ballona Creek Stormwater Trash Capture System; work undertaken by the nonprofit Ballona Creek Renaissance; implementation of the Santa Monica Bay Restoration Plan; posting of creek pollution warning signs; a metals source study; various TMDLs; implementation of the Ballona Creek Watershed Management Plan; and use of Clean Beaches Initiative funds to implement the Santa Monica Bay Restoration Plan (CRWQCB, 2007).

Water Quality Compliance Master Plan for Urban Runoff In 2007, the City of Los Angeles' Energy and the Environment/AdHoc River Committee directed the City's Bureau of Sanitation to create a Water Quality Compliance Master Plan for Urban Runoff (WQCMPUR). It was intended this plan would outline the City's strategy in achieving Clean Water Act standards as well as compliance with all urban runoff regulations and mandates (City of LA, 2009b).

The plan was asked to address how the City will incorporate public input and follow the principles:

- Identify all pollutants of concern in the City by type and location, including watershed or water body;
- Prioritize polluted areas within the City and create a compliance timetable;
- Identify existing efforts to reduce pollutants of concern and comply with all state and federal regulations;
- Identify strategies — such as on-site retention/infiltration, structural best management practices, regional multi-use benefit projects (including the identification of potential sites for such projects), and non-structural educational and regulatory measures (including ordinance changes to encourage on-site infiltration) for the City to meet Clean Water Act standards by pollutant and by water body or watershed;
- Provide a technical nexus between the strategies and water quality standards attainment and demonstrate that strategy implementation will result in standards compliance;

- Identify water quality data gaps including those that need to be filled in order to determine if the City is in full compliance with water quality requirements in the Los Angeles County stormwater permit and applicable TMDLs; and
- Identify estimated costs and sources of financial support including, but not limited to state and local bonds, stormwater pollution abatement funds, County flood control fees, and sewer service charges.

The plan was intended to integrate existing efforts already underway such as the Integrated Resources Plan, Integrated Regional Water Management Plan, and other relevant watershed management plans, and developed in partnership with stakeholders from the public, environment groups, and regulators including the Los Angeles Regional Water Quality Control Board and local municipalities (City of LA, 2009).

The plan was finalized in 2009. Its strategy is to build on ongoing successful initiatives and programs, identify common grounds (for benefits and funding), and seek new initiatives that will address complex problems. This approach will also promote water conservation and factor in objectives identified by other plans, including increased recreation opportunities and support for the greening of Los Angeles. The plan's implementation strategy is divided into three initiatives:

Water Quality Management Initiative - Describes how Water Quality Management Plans for each of the City's four watersheds and TMDL-specific Implementation Plans will be developed to ensure compliance with water quality regulations. Using the guidelines of the WQCMPUR, these Water Quality Management Plans and TMDL Implementation Plans will:

- Identify BMPs for implementation that will result in compliance with water quality regulations by using design storm and BMP performance criteria;
- Select and prioritize the BMPs for implementation in the watersheds, focusing on the BMPs outlined in the Citywide Collaboration and the Outreach Initiatives;
- Coordinate with ongoing watershed management activities where common goals exist;
- Support the urban runoff management goals of the Water IRP;
- Establish a quantitative nexus between the BMPs selected for implementation and water quality standards attainment;
- Establish metrics to measure success.

Citywide Collaboration Initiative – Recognizes that urban runoff management is closely linked with urban development and redevelopment, requiring:

- Citywide collaboration and coordination of urban runoff management;
- City policies and guidelines for urban development and redevelopment that focus on using green solutions to manage urban runoff; and
- Strategies to promote Low Impact Development (LID) and stormwater use.

Outreach Initiative – Promotes public education and community engagement with a focus on preventing urban runoff pollution and will:

- Enhance outreach activities to reach appropriate target audiences;
- Establish methods to quantify water quality benefits achieved through outreach activities; and

promote community engagement in all of the City's urban runoff management activities (City of LA, 2009).

Strategies for Reducing Trash Load and Incidence of Pathogen Contamination

Initially a trash net installed by the Los Angeles County Department of Public Works in Ballona Creek proved effective in stopping trash from entering the ocean during dry weather. However, dry-weather trash load only counts for a small portion of the annual total. Preventing trash loads during wet-weather storms must rely on thorough cleanup of the storm drain channel, the catch basins, and ultimately the streets that drain to the creek (CRWQCB, 1997).

The Ballona Creek Trash TMDL was adopted by the Regional Board in 2002 and, per the TMDL, a trash baseline load was determined in 2004. The County also monitored results obtained with Automatic Retractable Screen partial-capture devices. Eventually, in 2007 after extensive testing, a full-capture device, the connector pipe screen, was certified by the Regional Board as a full-capture device. At that point, the County changed its implementation strategy from partial capture with trash monitoring to installation of full-capture devices. A full-capture device requires no monitoring since it has been certified to trap all particles retained by a 5-millimeter mesh screen and has a design treatment capacity of no less than the peak-flow rate resulting from a one-year, one-hour storm. The County is installing full-capture systems in all Ballona Creek Watershed County-unincorporated areas. Therefore, no additional baseline and compliance monitoring is necessary. The first phase of the Full-Capture Project included retrofitting 225 of the 310 catch basins within the Ballona Creek Subwatershed with full-capture devices, yielding a 78.41 percent reduction of the trash baseline. This phase of the project was completed on December 12, 2008. The TMDL requires a 50 percent reduction of the trash baseline by September 30, 2009 (Implementation Year 6). Incorporated areas subject to the trash TMDL include the cities of Los Angeles, West Hollywood, Culver City, Santa Monica, and Beverly Hills (LACDPW website).

In 2007, the City of Los Angeles also obtained Regional Board certification for two full-capture devices, horizontal screen inserts and vertical trash capture screen inserts (City of LA website #1).

The City of West Hollywood continues to implement BMPs such as enhanced street sweeping, hand pick-up of litter, daily pickup from streetside trash containers, the addition of streetside recycling containers, and retrofit of catch basins with trash excluders. The City of Beverly Hills has similar BMPs it continues to implement with public education instead of hand pickup being the fourth BMP (LACDPW website).

The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. WLAs for plastic pellets are assigned to permittees of the Industrial Storm Water General Permit within the Santa Monica Bay WMA that have Standard Industry Classification (SIC) codes associated with industrial activities involving plastic pellets which may include, but are not limited to, 282X, 305X, 308X, 39XX, 25XX, 3261, 3357, 373X, and 2893. Additionally, industrial facilities with the term “plastic” in the facility or operator name, regardless of the SIC code, may be subject to the WLA for plastic pellets. Other industrial permittees within the Santa Monica Bay WMA that fall within the above categories, but are regulated through other general permits and/or individual industrial storm water permits are also required to comply with the WLA for plastic pellets.

Industries must comply with the Statewide Industrial Permit or other general or individual industrial permits, which require a Stormwater Pollution Prevention Plan (SWPPP) to be prepared and kept onsite at all times. The SWPPP addresses the areas where pellets tend to spill, as well as an overall plan to keep plastic pellets from being released off of the premises. The SWPPP incorporates structural and nonstructural BMPs that are implemented to keep pellets on site, including specific practices that are used to clean up incidental or large spills. Jurisdictions and agencies identified as responsible jurisdictions for point sources of trash in the Santa Monica Bay debris TMDL and in the Ballona Creek trash TMDLs shall either prepare a Plastic Pellet Monitoring and Reporting Plan (PMRP), or demonstrate that a PMRP is not required under certain circumstances. The PMRP serves to monitor the amount of plastic pellets being discharged from the MS4, establishes triggers for a possible need to increase industrial facility inspections and enforcement of SWPPP requirements for industrial facilities identified as responsible for the plastic pellet WLA, and addresess possible plastic pellet spills.

Given the ample size of the Creek and its flow, dry-weather diversion of its flow does not seem to be as feasible as it has been planned for many other storm drains for remediating the pathogen input problem. Therefore, in order to reduce the pathogen input from the creek, public agencies must explore upstream options such as a better surveillance system, an effective sanitary survey tool, and an expanded public education campaign (CRWQCB, 1997).

Here, again, many actions and practices described in the Ballona Creek Watershed Management Plan if implemented would serve to reduce trash loading and the incidence of pathogen contamination (LACDPW, 2004).

Implement TMDLs

Ballona Creek Trash TMDL The Regional Board adopted the Ballona Creek Trash TMDL in 2002. The implementation schedule requires a 10 percent progressive reduction of the trash baseline load each year starting two years (2004) after the establishment of the TMDL until the numeric target of zero trash is achieved (2015) (CRWQCB website #3).

Santa Monica Bay Beaches Wet- and Dry-Weather Bacteria TMDLs For the purpose of implementing those TMDLs, the area has been divided up into “jurisdictional groups” (JG) – the Ballona Creek area falls into JG8. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing “end-of-pipe” treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the TMDLs’ responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

Ballona Creek Bacteria TMDL The TMDL has multi-part numeric targets for wet-weather and winter dry-weather based on the updated bacteria objectives for marine and fresh waters designated for contact recreation (REC-1), and fresh waters with Limited REC-1 and REC-2 beneficial use designations. However, in all cases, there are zero summer dry-weather exceedance days allowed. Ballona Creek is subject to the high flow suspension of recreational beneficial uses for engineered channels during and immediately following large wet-weather events. The bacteria water quality objectives do not apply during these periods. Historical rainfall data for the watershed indicate a median value of 16 days per year during which the suspension of the recreational beneficial uses would apply. The “natural sources exclusion” approach may be used if an appropriate reference system cannot be identified due unique characteristics of the target water body. Del Rey Lagoon and the Ballona Wetlands are connected to Ballona Estuary via connecting tide gates. Preliminary data suggest that Ballona Wetlands is a sink for bacteria from Ballona Creek and it is therefore not considered a source in this TMDL. Inputs to Ballona Estuary from Del Rey Lagoon are considered nonpoint sources of bacterial contamination. Del Rey Lagoon may be considered for a natural source exclusion if its contributing bacteria loads are determined to be as a result of wildlife in the area, as opposed to anthropogenic inputs. The TMDL will require a source identification study for the lagoon in order to apply the natural source exclusion (CRWQCB website #3).

Two different strategies for achieving compliance with the TMDL were developed by the stakeholders using a combination of treatment and control options. The “Preferred Strategy” provides an integrated resources approach to the TMDL implementation and meets a range of other long-term watershed planning goals. This "Preferred Strategy" relies on a combination of options, including flow and bacteria source control, with limited treatment and discharge as well as small amount of diversion to the Hyperion

Treatment Plant. Some of the activities and projects that can begin to address this strategy are already in the planning phase by certain stakeholder groups in some areas of the watershed. An "Alternative Strategy" was also developed that relies more heavily on the capture, treatment and discharge of stormwater. This strategy was developed to compare the preferred strategy against an alternative based on more conventional engineering and construction with potentially lower risk but much greater investment in infrastructure and much less opportunity to achieve multiple objectives. Implementing some of these strategies is likely to require investigative studies to determine their potential environmental impact to the Creek and Estuary. In addition, various environmental and regulatory feasibility issues would need to be addressed early in the implementation phase when stakeholders develop the Implementation Plan (CRWQCB website #3).

The City of Los Angeles has funded the Cleaner Rivers through Effective Stakeholder-led TMDLs (CREST) for the purpose of developing plans to restore impaired waters and protect water quality. CREST was formed in 2004 through a partnership initiated by the City of Los Angeles, the Regional Board, and US EPA Region 9. CREST began focusing on the Ballona Creek Bacteria TMDL in Spring of 2005. CREST partners were closely involved with many aspects of the TMDL during its development and worked on the details of compliance strategies (CRWQCB website #3).

Ballona Creek Metals TMDL The metals TMDL for Ballona Creek contains both wet- and dry-weather allocations for point and nonpoint sources. The County of Los Angeles, City of Los Angeles, Beverly Hills, Culver City, Inglewood, Santa Monica, West Hollywood, and Caltrans may jointly decide how to achieve the necessary reductions in metals loading by employing one or more potential implementation strategies. Examples of non-structural controls include more frequent and appropriately timed storm drain catch basin cleanings; improved street cleaning by upgrading to vacuum type sweepers; and, educating industries of good housekeeping practices. Structural BMPs may include placement of storm water treatment devices specifically designed to reduce metals loading such as infiltration trenches or filters at critical points in the storm water conveyance system. The diversion and treatment strategy includes the installation of facilities to provide capture and storage of dry- and/or wet-weather runoff and diversion of the stored runoff to the wastewater collection system for treatment at the City's Hyperion Treatment Plant during low flow conditions at the plant, if possible. Other strategies such as small dedicated runoff treatment facilities such or alternative BMPs may be implemented to meet the TMDL requirements (CRWQCB website #3).

Ballona Creek Estuary Toxic Pollutants TMDL The TMDL is for toxic pollutants, such as metals, legacy pesticides, and toxicity in the sediments of the estuary. Numeric targets for the Ballona Creek Toxics TMDL are based on sediment quality guidelines compiled by the National Oceanic and Atmospheric Administrations (NOAA) Effects Range-Low (ER-L) guidelines. Potential implementation strategies for this TMDL are similar to those of the Ballona Creek Metals TMDL (CRWQCB website #3).

A coordinated monitoring plan has been developed by the cities in the watershed, along with the County of Los Angeles and CalTrans, for the Ballona Creek Metals TMDL and Ballona Creek Estuary Toxic Pollutants TMDL. Testing of dry- and wet-weather water quality and sediment quality effectiveness monitoring is included (CRWQCB website #3).

Marina del Rey Harbor Bacteria TMDL The TMDL covers the area of Marina del Rey Harbor called Mothers' (Marina) Beach and the Back Basins. While there are no allowable exceedance days at any of the locations during dry-weather, the allowable number of winter dry-weather exceedance days is three at most locations (except it is zero at one location near Mothers' Beach). The allowable number of winter wet-weather exceedance days varies by location but is no more than seventeen. An implementation plan was by the County of Los Angeles, Cities of Los Angeles and Culver City, and California Department of Transportation through a collaborative effort with interested stakeholders. A hybrid of three different compliance approaches was eventually selected. It utilizes an iterative adaptive process and features the following Control Programs: Public Information and Participation Program, Institutional Control Program, and Structural BMPs Program (CRWQCB website #3).

Santa Monica Bay Nearshore and Offshore Debris TMDL The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Marina del Rey Harbor Toxics

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_32_2005-012_td.shtml

Marina del Rey Back Basins

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_19_2003-012_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_43_2006-009_td.shtml

Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_45_2006-011_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2006-011/2006-011_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2006-011/2006-011_RB_BPA.pdf

Ballona Creek Metals

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_28_2005-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_60_2007-015_td.shtml

Ballona Creek Estuary Toxic Pollutants

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_29_2005-008_td.shtml

Ballona Creek Trash

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_7_2001-014_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_document s/bpa_25_2004-023_td.shtml

Santa Monica Bay Nearshore and Offshore Debris TMDL

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility such as the SMURRF, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean or is reused (City of LA website #2). Low flow diversions found within the Ballona Creek subwatershed are show in the table below.

Table 13. Low flow diversions within the Ballona Creek subwatershed

Low Flow Diversion	Year Operational	Agency
Boone Olive PP	2007	District
Oxford Basin (Berkley at Yale)	2008	District
Washington Blvd	2007	District

El Segundo/LAX Area

The El Segundo subwatershed drains an area of about 6,680 acres. The subwatershed extends from Playa del Rey to the north, Westchester, the Los Angeles International Airport (LAX) area of the City of Los Angeles, the City of El Segundo, the area adjacent to Chevron refinery and adjacent area and a small portion of the City of Manhattan Beach to the south. Major subdrainage areas in this region include, in order of size starting with the largest, North Westchester, Imperial Highway, Chevron Refinery, El Segundo Boulevard, Playa del Rey, the Hyperion Treatment Plant, and the Scattergood Power Plant (CRWQCB, 1997).

Land Uses

Land use in this region is a mixture of residential, industrial and commercial development and public beaches. The land use can be broken down as 54% commercial/industrial and other urban use, 29% residential use, 14% vacant/open space, and 3% public use (CRWQCB, 1997).

Major Industrial and/or Commercial Facilities

There are several major industrial and/or commercial facilities of regional significance in this area, including an airport, a wastewater treatment plant, two electrical power generation stations, and an oil refinery. There are also some aerospace-related industries located in this region (CRWQCB, 1997).

LAX The Los Angeles International Airport that serves as the hub of the regional airport system is in this area. It also represents one large contributor to runoff which in the past discharged to Santa Monica Bay largely via the Imperial drain. However, in late 1989 a retention basin and pretreatment facility was completed that handles about 1.8 million gallons of storm water "first flush" as well as dry weather low flow (CRWQCB, 1997).

Hyperion Treatment Plant The Hyperion Treatment Plant is also located in the area. It is one of the largest POTWs in the country that serves over three million residents in a 480 square mile area. It also provides solids treatment for sludge discharged from two upstream facilities located in the San Fernando Valley. LAX and the Hyperion plant comprise a large percentage of the commercial and other urban land use in this region. Both facilities are either in the planning stage for or undergoing expansion and capital improvement of its treatment works (CRWQCB, 1997).

Power Stations There are two power generation stations in this area: Los Angeles Department of Water and Power's Scattergood Generating Station, and Southern California Edison's El Segundo Generating Station. The power generating stations use seawater from Santa Monica Bay to cool steam condensers. Cool seawater is pumped into the station, circulated through a non-contact heat exchanger, and discharged at temperatures above the intake temperature. Chlorine *is* also injected periodically to control biological growth (CRWQCB, 1997).

El Segundo Refinery The Chevron El Segundo Refinery has been in operation since 1911 and now manufactures various petroleum products including gasoline, jet fuel, kerosene, solvent, coke, fuel oil, liquefied petroleum gases and propylene polymer. Since the early 1970s, Chevron had discharged secondary treated wastewater through an outfall 300 feet offshore. In September 1994, the outfall pipe was extended to 3,500 feet which effectively removed the last point source discharge from the near shore environment (CRWQCB, 1997).

Parks and Beaches

The major beach in the area is the Dockweiler State Beach which extends from Playa del Rey in the north to Manhattan Beach in the south. The beach is heavily used on weekends and in the summer (CRWQCB, 1997).

Beneficial Uses

The major beneficial uses identified for this subwatershed are use of seawater as industrial cooling water for power generation, use of the Bay to transport crude and refined petroleum, and use of seawater for swimming, boating, and sport fishing (CRWQCB, 1994).

Table 14. Beneficial uses of the waters within the El Segundo/LAX area

Coastal Feature or Waterbody	Hydro Unit #	IND	NAV	REC1	REC2	COM M	MAR	WIL D	SPWN
Dockweiler Beach	405.12	E	E	E	E	E	E	E	P

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Evidence of Impairments

Sewage Spills

Over the years, there were many incidents of untreated or partially treated wastewater overflowing from the Hyperion Treatment Plant or spills flowing through storm drain channels to the Bay due to either broken pipes, excessive quantity of flow or waste processing errors. The incidents caused beach closure or swimming warning for a period of time (CRWQCB, 1997).

Oil Spills /Seepage

Crude oil and refined petroleum products can enter the marine environment through tanker accidents, fueling, tank cleaning, bilge pumping, improper disposer or on-land spills into storm drains. Possible seeping of crude oil or the refined petroleum products from the pipelines as well as spills of oil occur every year in the Bay (including the ocean area adjacent to this subwatershed), each with the potential for serious impacts on the water quality and marine resources (CRWQCB, 1997).

Wildlife Habitat

The El Segundo Dunes are a remnant of a once-vast coastal ecosystem. The physical features of the dunes themselves constitute an endangered landform. Nine hundred species of plants and animals have recently been recorded on these dunes, 35 of which are limited in range to Southern California. At least eleven species exist only within the boundaries of the El Segundo Dunes and all of them are in danger of extinction. The best example is the El Segundo blue butterfly which is a federal and state-listed endangered species (CRWQCB, 1997).

Pollutants of Concern

The pollutants of concern identified for the El Segundo/LAX sub-watershed area include pathogens, debris, heavy metals, oil and grease, PAHs and chlordane (CRWQCB, 1997).

Source and Loading

Potential sources of pathogens to storm drains include illegal sewer connections and sewage dumping, sewer leaks, domestic animals, food service business, and outdoor camping. During major sewage spills, the Hyperion Treatment Plant also becomes the source of pathogen inputs into the Bay (CRWQCB, 1997).

Sources of debris include illegal waste dumping into storm drains, improper solid waste disposal, and construction activities. Sources for pollutants such as heavy metals, PAHs, oil and grease are more likely from transportation-related activities. The waste jet fuel from LAX and petroleum piping activities from the oil refinery are also considered possible pollutant sources (CRWQCB, 1997).

Chlordane found in the runoff is believed to be from the unauthorized usage and dumping of stocked chemicals into storm drains (CRWQCB, 1997).

Water Quality Improvement Strategies

Source reduction of pathogen inputs in near shore waters should be the priority for water quality improvement in this region. Other pollutants of concern should also be monitored regularly. Source control BMPs should be implemented to reduce the sources of pollutants loading into storm runoff. If feasible, diversion of some problematic storm drains into the sewer system should also be pursued (CRWQCB, 1997).

Another priority is augmenting the ongoing restoration of the El Segundo Dunes and creating an El Segundo Dunes Habitat Preserve. Restoration is urgently needed in order to halt the spread of invasive species, and avoid further extinctions and the extirpation of native species. The long-term goal of the restoration program is to create a Dunes Habitat Preserve of approximately 200 contiguous acres and to restore and preserve the natural ecology of the area (including the adjacent acreage owned by Chevron (CRWQCB, 1997).

Implement TMDLs

The TMDLs in effect which impact the El Segundo/LAX area are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay Nearshore and Offshore Debris TMDL. Dockweiler Beach is listed as impaired for indicator bacteria. For the purpose of implementing the bacteria TMDLs, the area has been divided up into "jurisdictional groups" (JG) – the El Segundo/LAX area falls into JG2. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the bacteria TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather TMDLs (CRWQCB website #3).

The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). Low flow diversions found within the El Segundo-LAX area are show in the table below.

Table 15. Low flow diversions within the El Segundo/LAX area

Low Flow Diversion	Year Operational	Agency
Arena Pump Plant	2006	District
El Segundo Pump Plant	2006	District
Imperial Highway	2003	City of LA
Pershing Drive, Line C	2006	District
Playa del Rey	2001	District
Westchester	2004	District

South Bay

The South Bay subwatershed drains an area of approximately 7,054 acres. The subwatershed includes major portions of the City of Manhattan Beach, the City of Hermosa Beach, the City of Redondo Beach, and the City of Torrance. Storm drains in the area are all narrow and rather small. The notable drains include the Redondo Pier and Herondo Drains (CRWQCB, 1997).

Land Uses

The major land use of the region is high density single- or multiple-family residential use. The land uses include 81% residential use, 9 % commercial/industrial and other urban use, 8% public use, and 3% vacant/open space (CRWQCB, 1997).

Major Industrial/Commercial Facilities

Although most land uses are residential, the Redondo Generating Station, a major industrial facility operated by Southern California Edison, is located in this area. There are also some aerospace-related industries established in various places within the region (CRWQCB, 1997).

Parks, Beaches and Harbors

There are three very popular beaches in this subwatershed: Redondo Beach, Hermosa Beach, and Torrance Beach. Three piers are located at Manhattan Beach, Redondo Beach, and Hermosa Beach respectively. These piers draw large crowds on weekends and in the summer time. King Harbor, located in Redondo beach, docks 1,500 recreational boats (CRWQCB, 1997).

Beneficial Uses

The major beneficial uses identified for this sub-watershed are use of seawater as industrial cooling water for power generation, and various recreational uses including swimming, boating and sport fishing. Marine and wild life habitats also exist in beach and nearshore areas. For example, beaches in the area provide spawning ground for California grunion each year. Shallow nearshore protected areas such as King Harbor serve as important nurseries for local marine fishes (e.g., California halibut, white seabass) (CRWQCB, 1994).

Table 16. Beneficial uses of the waters within the South Bay area

Coastal Feature or Watershed	Hydro Unit #	IND	NAV	REC1	REC2	COMM	MAR	WILD	RARE	MIGR	SPWN	SHELL
Redondo Beach	405.12	E	E	E	E	E	E	E	E	E	E	E
King Harbor	405.12	E	E	E	E	E	E	E	E			
Manhattan Beach	405.12		E	E	E	E	E	E			P	E
Hermosa Beach	405.12		E	E	E	E	E	E			E	E

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Evidence of Impairments

Enteric viruses were found in the Herondo drain in a SMBRP study. Beaches in the area were infrequently closed due to sewage spills in storm water drains (CRWQCB, 1997).

Data collected over the years have shown that contaminants are accumulated in marine organisms in the nearshore area of the watershed (CRWQCB, 1997).

Trash and debris were often found on the beaches and there is continuous need for beach cleanup (CRWQCB, 1997).

Pollutants of Concern

The major pollutants of concern within the South Bay subwatershed are debris, pathogens, oil and grease, heavy metals, and PAHs (CRWQCB, 1997).

Source and Loading

Potential sources of pathogens to storm drains include illegal sewer connection and sewage dumping, sewer leaks, domestic animals, food service business, and outdoor camping. During major sewage spills, the Hyperion Treatment Plant also becomes the source of pathogens to surfzone in this area (CRWQCB, 1997).

Sources of debris include illegal waste dumping into storm drains, improper solid waste disposal, and construction activities. Sources of pollutants such as heavy metals, PAHs, oil and grease are more likely from transportation-related activities in the area. Advection from the adjacent wastewater treatment facility outfall is also a potential source (CRWQCB, 1997).

Water Quality Improvement Strategies

The reduction of the pathogens input in the near shore water should be the priority for pollution control measures in this region. Implementation of storm water source control BMPs will likely to reduce the loading of pollutants of concern. Alternatively additional problematic storm drains can be diverted into sewer system (CRWQCB, 1997).

Implement TMDLs

The TMDLs in effect which impact the South Bay are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. Redondo, Manhattan, and Hermosa Beaches are listed as impaired for indicator bacteria. For the purpose of implementing the bacteria TMDLs, the area has been divided up into “jurisdictional groups” (JG) – the South Bay falls into JG5 and JG6. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31). This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing “end-of-pipe” treatment. The District, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the TMDLs’ responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather bacteria TMDLs (CRWQCB website #3).

The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4.

Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean or reused (City of LA website #2). Low flow diversions found within the South Bay area are show in the table below.

Table 17. Low flow diversions within the South Bay area

Low Flow Diversion	**Year Operational**	**Agency**
Herondo Street	2005	District
Manhattan Beach at 28th Street (The Strand)	2006	District
Manhattan Beach Pump Plant	2004	District
South of Dockweiler Jetty	2001	District
Manhattan Beach Pier	1990	Manhattan Beach
Hermosa Beach Pier	2010	Hermosa Beach
Redondo Beach Pier	2005	Redondo Beach
Sapphire (at Esplande Ave)	2010	Redondo Beach
Bryant and Voorhees Sump	2008	Manhattan Beach
Alta Vista Park	2010	Redondo Beach

Palos Verdes Peninsula

The Palos Verdes Peninsula subwatershed extends from near the southern boundary of the City of Redondo Beach to Point Fermin along the coastline. Inland, the subwatershed consists of a 10,977 acre area on the north west slope of the Palos Verdes Peninsula. Municipalities in this area include the Cities of Palos Verdes Estates, Rolling Hills Estates, and Rancho Palos Verdes (CRWQCB, 1997) and portions of Redondo Beach and Torrance. The notable drain is Avenue I.

Land Uses

The majority of land uses in this region is low-density residential development with some horse properties; There are some open spaces including beaches, wildlife habitats and natural preserves. Only limited areas within this region are identified for commercial or industrial uses. The land uses include 59% residential use, 36% vacant/open space, 3% commercial/industrial use, and 3% public use (CRWQCB, 1997).

Beaches and Coves

Along the rugged coast there are several coves and bays including Malaga Cove, Bluff Cove, Lunada Bay, and Abalone cove. These coves and bays provide the habitats for a variety of marine life. In addition, areas such as Pt. Vicente, Abalone Cove County Beach, Portuguese Pt., Inspiration Pt., Portuguese Bend, Royal Palms Beach, and Whites Point County Beach are popular destinations that attract tourists or residents for recreational purposes (CRWQCB, 1997).

Beneficial Uses

Beneficial uses identified in this subwatershed are primarily recreational uses including swimming, diving, boating and sport fishing. The waterbodies in this region also contain important marine and wild life habitats. The rocky tidal and nearshore zones provide unique habitats for filter-feeding shellfish (e.g., clams, oysters, abalone, and mussels). With the biodiversity of tidepools, spawning ground for the California grunions and other marine organisms, the whole coastal area of this region is designed as "significant ecological area" by the County of Los Angeles (CRWQCB, 1994).

Table 18. Beneficial uses of the waters within the Palos Verdes Peninsula

Coastal Feature or Waterbody	Hydro Unit #	MUN	GWR	NAV	REC1	REC2	COMM	WARM	MAR	WILD	RARE	SPWN	SHELL
Coastal Streams of Palos Verdes	405.11	P	I		I	I		I		P	E		
Canyon Streams Trib. To Coastal Streams of Palos Verdes	405.12	P	I		I	I		I		E	E		
Port Vicente Beach	405.11			E	E	E	E		E	E		P	E
Royal Palms Beach	405.11			E	E	E	E		E	E		P	E
Whites Point County Beach	405.11			E	E	E	E		E	E		P	E

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial use

Evidence of Impairments

Elevated concentrations of contaminants such as PCBs, DDT, and heavy metals including: lead, copper, chromium, nickel, silver, zinc and mercury were found in the Bay sediments in this region. Highly contaminated discharges through the JWPCP's White Point outfall prior to the 1980s left a contamination zone of several square miles with approximately 100 tons of DDT deposition (CRWQCB, 1997).

The accumulation and biomagnification of such contaminants have been observed in various. species of fish and shellfish. According to a comprehensive seafood contamination study and risk assessment conducted by the State Office of Environmental Health Hazard Assessment (OEHHA) and SMBRP, elevated concentrations of several contaminants (including PCBs and DDTs) in fishes was found, especially from this region. White croaker was found to be the most contaminated fish from this area as well as in other areas of the Bay. Other species found to be relatively contaminated are California corbina, queenfish, surfperches and California scorpionfish (CRWQCB, 1997).

Land slides in the area have destroyed some coastal habitats. Population declines of some bird species and certain species of shellfish such as black abalone have also been observed in this region (CRWQCB, 1997).

Pollutants of Concern

The main pollutants of concern in this subwatershed are total suspended solid (TSS) and nutrients. Historical deposits of PCBs and DDT on the Palos Verdes Shelf continue to be of concern because the risk that it poses to marine organisms and individuals who consume seafood from this area (CRWQCB, 1997).

Sources and Loading

TSS originate primarily from the erosion of hillsides. Nutrients originate from application of fertilizers. Some horse properties may also be sources of excessive nutrient inputs in this region. Historic deposits are the primary sources of DDT, PCBs, and heavy metals in sediments offshore of the Peninsula (CRWQCB, 1997).

Water Quality Improvement Strategies

Nonpoint source best management practices (BMPs) should be implemented to reduce the nutrients and TSS inputs to the Bay from this subwatershed. Restoration and protection of intertidal habitats and protection of endangered species (either from over harvesting or water pollution) should continue to be water quality improvement priorities (CRWQCB, 1997).

In 2009, USEPA released a feasibility study which describes the development, evaluation, and comparison of remedial action alternatives to manage the contaminated sediment at the Palos Verdes Shelf site. The report also presents potential remediation goals for the protection of human and ecological health and presents remedial alternatives including dredging and capping of various amounts of contaminated sediment. USEPA announced their preferred alternative for remediating the Palos Verdes Shelf Superfund site in June 2009. The alternative is an interim remedy that proposes institutional controls, monitored natural recovery and a containment cap. Construction is expected to take three years and cost an estimated $36,000,000 (USEPA and CH2M Hill, 2009).

Implement TMDLs

The TMDLs in effect which impact the Palos Verdes Peninsula are the dry- and wet-weather bacteria TMDLs for Santa Monica Bay beaches and the Santa Monica Bay nearshore and offshore debris TMDL. Whites Point, Point Vicente, and Royal Palms Beaches are listed as impaired for indicator bacteria. For the purpose of implementing the bacteria TMDLs, the area has been divided up into “jurisdictional groups” (JG) – the Palos Verdes Peninsula falls into JG7. Compliance measures include a number of activities that in combination would result in reducing the number of days in which water quality objectives are exceeded to less than or equal to that of the reference watershed (CRWQCB website #3).

The wet-weather bacteria TMDL stipulates a threshold number of exceedance days based on daily monitoring activities. The number of allowed exceedance days varies somewhat among the beaches but is no more than seventeen. The TMDL features a reference system/anti-degradation approach. The purpose of utilizing this approach is to ensure that bacteriological water quality is at least as good as that of a reference site and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of a reference site (CRWQCB website #3).

The dry-weather bacteria TMDL also stipulates compliance targets. The general implementation schedule includes two phases:

Phase I: Compliance during Summer Dry Weather. Within three years of the effective date of the TMDL, there may be no exceedances at any location during summer dry weather (April 1 to October 31).

This compliance target may be achieved by employing a number of strategies, including diverting storm drain flows to treatment plants, eliminating illicit discharges, controlling sources of bacteria, or implementing "end-of-pipe" treatment. The County of Los Angeles, City of Los Angeles and several other cities adjacent to Santa Monica Bay have been implementing aggressive summer, dry-weather storm drain diversion programs. All 27 priority storm drains have been diverted; additional diversions have been completed and others are planned (CRWQCB website #3).

Phase II: Compliance during Winter Dry Weather. Within six years of the effective date of this TMDL, compliance with the allowable number of exceedance days (varies by beach) during winter dry weather must be achieved (CRWQCB website #3).

A Coordinated Shoreline Monitoring Plan was developed by a Technical Steering Committee, co-chaired by the County and City of Los Angeles and consisting of representatives from many of the TMDLs' responsible agencies. In addition, other area stakeholders provided input. The plan is designed to comply with the monitoring requirements of both the dry- and wet-weather bacteria TMDLs (CRWQCB website #3).

The Santa Monica Bay Nearshore and Offshore Debris TMDL was adopted by the Regional Board in 2010 and requires that industries that manufacture, store, transport, or otherwise handle plastic pellets as raw material comply with a waste load allocation (WLA) of zero plastic pellets. The zero WLA for the plastic pellets requires that no plastic pellets are allowed to be released, found, or accumulated outside of the premises of the industries or in any stormwater capture device that may be connected with the MS4. Various tasks are required to be completed within a certain time period after the effective date of the TMDL. Key tasks range from achieving 20% reduction of trash from the baseline WLA within four years from the effective date of the TMDL to achieving 100% reduction of trash from the baseline WLA within eight years of the effective date of the TMDL.

Implementation plans and other information for these TMDLs are available on the Regional Board website as follows:

Santa Monica Bay Beaches Dry Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_9_2002-004_td.shtml

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/2002-004/2002-004_RB_BPA.pdf

Santa Monica Bay Beaches Wet Weather

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_14_2002-022_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_39_2006-005_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_40_2006-006_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_41_2006-007_td.shtml

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/bpa_42_2006-008_td.shtml

Santa Monica Bay Nearshore and Offshore Debris

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_RSL.pdf

http://63.199.216.6/larwqcb_new/bpa/docs/R10-010/R10-010_RB_BPA.pdf

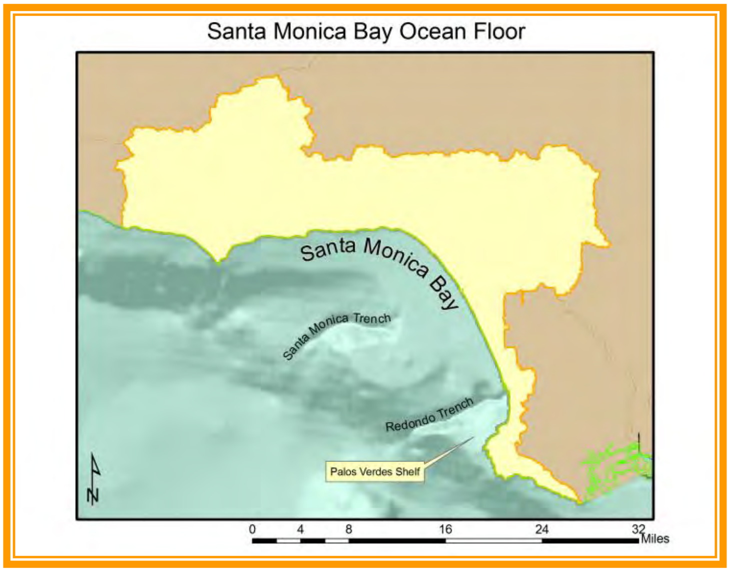
Low Flow Diversions/Treatment Facilities

An increasingly utilized approach to eliminating bacteria from storm drains at its source is the installation of low flow diversions or treatment facilities. A low flow diversion is a structural device that routes urban runoff from canyons, streets and small watersheds away from the storm drain system or waterway, and redirects it into the sanitary sewer system or to a local treatment facility, where the contaminated runoff then receives treatment and filtration before being discharged into the ocean (City of LA website #2). Low flow diversions found within the Palos Verdes area are show in the table below.

Table 19. Low flow diversions within the Palos Verdes area

Low Flow Diversion	Year Operational	Agency
I Street	2006	District
Alta Vista Park	2010	Redondo Beach

Pacific Ocean



This section provides characterization of the nearshore and offshore regions of Santa Monica Bay (from the low-tide line to the outer boundary of the Bay). The areas surrounding the two POTW outfalls are highlighted in this section because more information is available and/or more impacts have been observed (CRWQCB, 1997).

Santa Monica Bay is the submerged portion of the Los Angeles Basin. The sea floor of the Bay is primarily soft bottom which consists of fine to moderately coarse sediments. Far less in acreage than soft bottom, hard bottom areas are generally restricted to the subtidal regions at 20 to 70 feet west of Malibu and around the Palos Verdes Peninsula. There is only one naturally occurring deep rocky area. Called Short Bank, it is located approximately six miles offshore of Ballona Creek, between Santa Monica and Redondo Submarine Canyons (CRWQCB, 1997).

The two largest POTWs in the region have for years discharged treated municipal wastewater directly into the Bay through their ocean outfalls. Over the last 50 years, the City of Los Angeles' Hyperion Treatment Plant has constructed and used three offshore pipes into Santa Monica Bay. A 1-mile offshore pipe was used between 1950 and 1960s at a water depth of 50 ft. to discharge approximately 190 mgd of chlorinated secondary effluent. This pipe is still used occasionally to divert overflows from a 5-mile offshore pipe. The 5-mile offshore pipe has been in full service since 1960 discharging, at a water depth of 190 ft, primary-treated effluent in the early years, and secondary-treated effluent at the present time. Finally, a 7-mile long sludge pipe was constructed to discharge at the head of Santa Monica Canyon to a depth of 320 ft. The pipe became operational in 1957 but use was discontinued in 1987. Since that time all sludge has been either transported to a landfill or used to produce a claylike product (CRWQCB, 1997).

The Los Angeles County Sanitation Districts' Joint Water Pollution Control Plant (JWPCP) began ocean disposal of wastewater onto the Palos Verdes Shelf in 1937 through a 5-ft diameter pipe; a 6-ft. diameter pipe was added in 1947. These outfalls discharged at water depths of 110 and 160 ft., respectively. Today these two pipes are only used as standbys for hydraulic relief during heavy rains. The current outfalls are a 7.5 ft. diameter pipe completed in 1956 that ends in a Y-shaped multiport diffuser, and a 10 ft. diameter pipe added in 1966 with a dog-legged, multi-port diffuser. Both are discharging secondary-treated effluent 1.9 mile offshore at 200 ft. depth (CRWQCB, 1997).

In addition to the two ocean POTW outfalls, the Chevron El Segundo Refinery has an outfall pipe 3;500 ft. offshore which discharges primary and secondary-treated wastewater. The pipe was extended from a 300 ft. pipe in 1994 (CRWQCB, 1997).

Chevron also maintains, a two-berth offshore tanker mooring facility in 42 to 66 feet of water. This facility transports crude oil and refined products to tankers at a frequency of approximately 20 tankers per month. Except for this tanker movement, most commercial and naval shipping activities occur outside Santa Monica Bay, in the shipping lanes offshore, and in nearby Los Angeles and Long Beach Harbors (CRWQCB, 1997).

Three power generating stations (the City of Los Angeles Department of Water and Power's Scattergood Plant, El Segundo Power's El Segundo Plant, and AES' Redondo Beach Plant) use seawater from Santa Monica Bay to cool steam condensers. Cool seawater is pumped into the station, circulated through noncontact heat exchangers, and discharged at temperatures above the intake temperature. In addition to elevated temperatures, the once-through cooling water may include treated wastewater which is determined to be non-hazardous as defined. by state and federal regulations. Chlorine is also injected periodically to control biological growth (CRWQCB, 1997).

Although oil and gas reserves are believed to occur on the Santa Monica Bay shelf, oil and gas development in or near Santa Monica Bay has been limited However, two natural. oil seeps are known in Santa Monica Bay. One, with three seepage zones, is located about 2 3 miles off Redondo Beach, near the head of the Redondo Submarine Canyon; the other has two seepage zones and is located about 4 6 miles off Manhattan Beach. The daily flow (to the surface) is estimated to range from 64 to 756 gallons per day, but maybe several times this amount during and after local earthquakes (CRWQCB, 1997).

At present, there is one permitted dump site (LA2) near, but outside of, Santa Monica Bay. The material disposed of at this site originates from maintenance and construction dredging in Los Angeles and Long Beach Harbors; material deposited here must be very clean.

Beneficial Uses

Twelve beneficial uses are identified for nearshore and offshore areas of Santa Monica Bay, including industrial and navigational uses, recreational uses, and biological/ecological uses (CRWQCB, 1994).

Table 20. Beneficial uses of the nearshore and offshore areas of the Santa Monica Bay

Coastal Feature or Waterbody	IND	NAV	REC1	REC2	COMM	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL
Nearshore Zone	E	E	E	E	E	E	E	E	E	E	E	E
Offshore Zone	E	E	E	E	E	E	E		E	E	E	E

E: Existing beneficial use; **P:** Potential beneficial use; **I:** Intermittent beneficial us

The Bay provides a variety of habitats for a great diversity of plant and animal species at least 5,000 at last count. Soft bottom, the dominant benthic habitat in Santa Monica Bay, has few attached plants as residents but has an abundant and diverse invertebrate population. Kelp beds, located in hard bottom areas in the subtidal regions west of Malibu and around the Palos Verdes Peninsula, provide cover and protection and thus habitat for more than 800 species of fishes and invertebrates, some of which are uniquely adapted for life in the beds. Consequently, kelp beds are important for sport fishing, commercial harvesting of abalone and sea urchins, and recreational diving. Short Bank, the only naturally occurring deep rocky area, thrives with populations of several rockfish species and unique invertebrates (CRWQCB, 1997).

The pelagic, or open-ocean habitat is the primary home to fish such as Pacific sardine, northern anchovy, Pacific mackerel, and Pacific bonito; as well as marine mammals such as seals and sea lions. Many species of whales and dolphins are also observed in Bay waters; passing through the Bay during the winter/spring migration. The pelagic habitat (microlayer) is also home to the eggs and larvae of many invertebrates. One of the unique habitats is the shallow nearshore protected areas of the Bay (e.g., Malibu Lagoon, Marina del Rey Harbor), which serve as important nurseries for local marine fishes such as California halibut and white seabass). Finally, the pelagic habitat is utilized for foraging by several endangered bird species such as California brown pelican and California least tem (CRWQCB, 1997).

Tankers travel in and out of the Bay to transport oil at Chevron's mooring facility. Otherwise, no major shipping lanes cross into the Bay. Commercial fishing has been prohibited in about 62% of the Bay proper to protect local fish populations. Since December 1993, commercial fishing using gill and trammel nets are banned within three nautical miles of the mainland (CRWQCB, 1997).

Evidence of Impairments

The marine habitats of Santa Monica Bay have historically experienced severe impacts from human activities. The most obvious impacts are changes observed in benthic habitats as a result of POTW ocean discharges. Overfishing has been linked to depletion and/or decline of many marine species. Finally, natural phenomena such as El Nino have also played an important role in downturn and upturn of habitat conditions in the Bay (CRWQCB, 1997).

Over the years, discharge of biosolids from the Hyperion Treatment Plant and the JWPCP created a large sludge field around outfalls. These sludge fields, especially those formed before the 1980s, contain high concentrations of toxic chemicals. Between 1950 and 1970s, large amounts of DDT and PCBs from local chemical manufacturers and other industrial facilities were dumped into the ocean through the POTW outfalls. What remains today is a heavily contaminated zone of approximately 320 acres on the Palos Verdes Shelf near the JWPCP outfall where the median total DDT concentration exceeds 2 ppm and median total PCBs concentration exceeds 200 ppb. Besides DDT and PCBs, there has been little evidence that the concentrations of toxic organic, compounds such as PAHs, and heavy metals (including cadmium, copper, chromium, nickel, silver, zinc, and lead) are at levels, deemed harmful to marine organisms. However, the concentrations of these metals are significantly higher than the background levels in most parts of Santa Monica Bay. They are also relatively higher than the rest of the Southern California Bight (CRWQCB, 1997; USEPA and CH2M Hill, 2009).

DDT in white croaker, Dover sole, and brown pelicans are well-known examples of the damage caused by sediment contamination. High concentrations of DDT were found in muscle tissues of these organisms. In the 1970s, biomagnifcation of DDT in these organisms resulted in fin erosion and other diseases in fish, and eggshell thinning and a subsequent decline in the population of California brown pelicans. Although fish tissue concentrations of DDT have declined since the 1970s, consumption of fish from the shelf area remains a problem (CRWQCB, 1997). The State of California Office of Environmental Health Hazard Assessment (OEHHA) website at http://www.oehha.ca.gov/fish/so_cal/socal061709.html provides updated information from June 2009 regarding a health advisory and safe eating guidelines for marine fish caught along the southern California coastline from Ventura Harbor to San Mateo Point (OEHHA website).

In addition to the risks posed to human and animals by contaminated sediment, the health of benthic community has been affected by discharge of solids from wastewater treatment plants. Assemblages of benthic fauna in sludge fields near the outfalls had relatively lower diversity compared with other areas in the Bay and were dominated by several opportunistic species. There has been substantial improvement of the benthic community from the conditions of the mid-1980s in the vicinity of the Hyperion 5-mile outfall since the elimination of solids discharge through this outfall (CRWQCB, 1997).

Pollutants of Concern

The pollutants of concern identified for the ocean area of Santa Monica Bay include TSS, DDT, PCBs, heavy metals (Pb, Cu, Zn, Ni, Cd, Cr, and Ag), PAHs, and trash and debris (marine debris). Although not identified as a pollutant of concern in this area, pathogens should continue to be monitored in popular nearshore recreational areas (CRWQCB, 1997).

Sources and Loadings

The region's two largest POTWs used to contribute significant mass loadings of TSS to areas adjacent to their outfalls. However, the annual mass emissions of TSS have decreased steadily, from 160,000 metric tons (combined) in the early 1980s to approximately 43,000 metric tons in 1994, due to advances in treatment technologies and land disposal of solids (CRWQCB, 1997).

The mass load of TSS estimated for storm water in 1994 was 54,000 metric tons. However, it is unknown to what extent the mass load in storm water should be considered a natural phenomenon (CRWQCB, 1997).

Since DDT and PCBs were banned in early 1970s, sediment resuspension of historical deposition has been and will continue to be the major loading source for these toxic chemicals, especially on and near the toxic "hot spot" on the Palos Verdes Shelf though the exact amount of DDT and PCB loading through resuspension and other process is not well understood. Concentrations of DDT and PCBs in surface sediments on the PV Shelf has shown a decrease as the heavily contaminated layer, produced principally in the 1950s to early 1970s, as these sediments have gradually been covered by less contaminated effluent and natural sediment. However, the concentrations of DDTs and PCBs in the surface sediments have remained relatively high since late 1980s in the area of the JWPCP outfall. This suggests that a portion of the "historical" DDT (largely as the metabolite p,p'-DDE) as well as PCBs are being brought to the sea floor surface by a combination of natural physical, chemical or biological processes that operate within or on the sediment. In 1992, the maximum concentration of buried DDTs exceeded 300 ppm near the outfall pipes while maximum buried PCBs exceeded 20 ppm. Sampling conducted in 2001 revealed the maximum concentration of buried DDE exceeded 200 ppm near the outfall pipes with similar maximum surface concentrations. Combined data from 1992 – 2004 showed surface concentrations of DDTs in the area of the outfalls up to 155 ppm while 1992 data showed PCBs up to 2 ppm in surface sediments. The subareas with surface concentration of DDTs greater than 1 ppm covered 11,000 acres in 1992 while during 2002/2004 they covered 9,660 acres, a decrease of 12%. Subareas with surface concentrations of DDTs greater than 10 ppm decreased 56% during the same time period, from 2,000 acres to 8,900 acres. The subareas with surface concentrations of PCBs greater than 0.3 ppm decreased 49% between 1992 and 2002/2004, going from 5,560 acres to 3,385 acres. Subareas with surface concentrations of PCBs greater than 1 ppm decreased 26% during the same time period, from 2,075 acres to 1,532 acres. The mass of DDT in surface sediments remaining in the most heavily contaminated subarea is estimated to be approximately 5,000 lbs; the PCBs mass in this are is estimated to be 188 lbs (CRWQCB, 1997; USEPA and CH2M Hill, 2009).

Current loading of DDT and PCBs from effluents of POTWs and storm water is considered minimal (below detection limits most of the time). Atmospheric deposition and advection (from LA Harbor which receives runoff from the Dominguez Channel drainage area, where many DDT-contaminated land sites are located) are considered potential sources of DDTs (CRWQCB, 1997).

As for TSS, the two POTWs used to be the largest source of loading for the six heavy metals of concern. However, mass emissions of most metal constituents have decreased in recent years due to better source control and an upgrading of treatment levels at the two POTWs (CRWQCB, 1997). As a result, stormwater runoff of trace metals from urban watersheds now produce a similar range of annual loads as those from point sources such as the large POTWs. However, when combined with dry estimates of pollutant loading, the total nonpoint source contribution from all watersheds in the greater Los Angeles area far exceeds that of the point sources (Stein, et al., 2007). In general, sediment concentrations of lead, copper, zinc, and cadmium are higher in areas influenced by POTW effluent, primarily due to historical discharges. There is also evidence of enrichment of these metals in nearshore areas impacted by storm water runoff. If the current trend in metal loading continues, the distribution of metal concentration in sediments may be different in the future (CRWQCB, 1997).

Sources of PAH loadings are more diverse. POTWs are a significant (but probably not the largest) source of PAHs to the Bay. A larger portion of PAHs likely originates from nonpoint sources such as storm water runoff and atmospheric deposition. A portion of loadings measured in storm water runoff may originate from indirect atmospheric deposition as well. PAHs are also an important component of oil and grease (CRWQCB, 1997).

Sources of marine debris include storm water runoff, beach litter, boating activities, illegal dumping, and occasionally, discharge from POTWs. Besides fragmentary information collected on beach litter and trash and debris carried by storm runoff, very little is known about the current loading and deposition of trash and debris in Santa Monica Bay (CRWQCB, 1997).

Water Quality Improvement Strategies

Progressive water quality improvement efforts over the last two decades have brought many significant improvements. There are many signs that the Bay has been recovering and no longer deserves its reputation as one of the most contaminated ocean areas in the nation. However, two of the major challenges remaining are how to continue the trend of pollutant loading reductions as projected population growth occurs in the region, and how to effectively remediate the historical deposition of DDT and PCBs in the Bay's sediment (CRWQCB, 1997).

With information provided by long-term, extensive compliance monitoring conducted by POTWs and industrial dischargers, the general environmental conditions of the Bay are relatively well-understood. However, the information is still limited; far more data have been gathered from soft and hard bottom benthic habitats where the POTW and industrial discharge outfalls are located, while much less is known about the conditions of habitats (primarily hard bottom and rocky intertidal) in other areas of the Bay where no direct discharges occur. On the other hand, mass loadings of pollutants from sources other than POTWs and direct industrial dischargers cannot be reliably made due to lack of monitoring data (CRWQCB, 1997).

Aimed at solving the identified problems, marine water quality improvement efforts should focus on the following areas:

- Continue to prevent and reduce mass loading of pollutants that accumulate in the Bay's sediments through completion of the treatment upgrades at POTWs and implementation of storm water runoff BMPs;
- Implement a mass emissions policy for pollutants of concern that accumulate in marine environment and integrate the approach into NPDES permits;
- Implement the identified preferred alternative for remediation of historic DDT/PCBs deposits in the Palos Verdes shelf's sediments; and
- Develop TMDLs for impairments
- Implement the Comprehensive Bight-wide monitoring program developed in 2007.

  The monitoring program is was developed to collect information on the relative loading, distribution, and impacts of pollutants of concern, which are crucial for determining the best pollutant management approach. Generally, the program focuses on ecosystem resources rather than on anthropogenic inputs and impacts and seeks to put together a picture of the overall conditions in the Bay. It lays out new monitoring designs for five major habitat types within the Bay. Each includes a core motivating question, a number of related objectives, specific monitoring approaches, indicators, and data products, and sampling designs detailing number and locations of stations, sampling frequency, and measurements to be collected. The program incorporates key monitoring efforts that extend from the outer Bay to the high tide line along the shore and is intended to complement other efforts, such as TMDLs, that link land and marine environments. Five major habitat (or ecosystem) types are covered in the Comprehensive Monitoring Program:

- Pelagic Ecosystem
- Soft Bottom Ecosystem
- Hard Bottom Ecosystem
- Rocky and Sandy Intertidal
- Wetlands (SMBRC website)

Watershed Restoration Plans in the WMA

Some items in this section may also function as assessment and improvement strategies which are discussed in the next section. Some of the more planning-oriented documents below eventually led to improvement strategies or set the stage for active implementation work. The emphasis is on plans which contain either a large water quality improvement/restoration component or some other actions which indirectly lead to water quality improvement; the list is not meant to be an exhaustive documentation of all planning documents.

- Santa Monica Mountains Comprehensive Planning Commission, 1979. Santa Monica Mountains Comprehensive Plan.

  The natural resource value of the Santa Monica Mountains was recognized as early as the 1930s. By 1972, the Ventura-Los Angeles Mountains and Coastal Study Commission recommended establishing a continuing planning and permit-issuing agency to assure environmentally sound use. Four years later, the Legislature passed AB 163 that would, in part, carry out that recommendation. The bill created the Santa Monica Mountains Comprehensive Planning Commission and empowered it to prepare "a comprehensive and specific plan which is capable of implementation, for the conservation and development of (the mountains) consistent with the preservation of the resource."

  The Preliminary Comprehensive Plan, consisting of the land use, conservation, recreation, transportation, scenic parkways and corridors, and public services and facilities elements, was adopted in July 1978. Following final adoption of the policy and economic elements of the plan, the Commission identified alternative implementation strategies and potential responsible implementation agencies in February 1979.

  In 1978, Congress created the Santa Monica Mountains National Recreation Area, in part implementing policies recommended in the Commission's Preliminary Report. The National Parks and Recreation Act of 1978 authorized the appropriation of $125 million for National Park Service land acquisition within the National Recreation Area, $500,000 for National Park Service park development, and $30 million in grants to the State of California for specific uses in the Santa Monica Mountains Zone. Furthermore, Congress recognized the Santa Monica Mountains Comprehensive Planning Commission as the planning entity for the Santa Monica Mountains Zone and required that the Commission identify agencies responsible for implementing the Comprehensive Plan.

  The Santa Monica Mountains Conservancy Act was enacted in 1979 by AB 1312 based on the recommendations of the Santa Monica Mountains Comprehensive Planning Commission. The Santa Monica Mountains Conservancy was established by the California State Legislature in 1980. For more information, see the Santa Monica Mountains Conservancy webpage http://www.smmc.ca.gov.

- Santa Monica Bay Restoration Project, 1995. The Bay Restoration Plan.
  http://santamonicabay.org/smbay/AboutUs/TheBayRestorationPlan/tabid/55/Default.aspx

The Bay Restoration Plan outlined actions to promote pollution prevention and source reduction, integrate pollution management, more effectively manage of storm water and urban runoff, cleanup contaminated sediments, address oil and hazardous materials spills, improve information about risks associated with seafood consumption and swimming in the Bay, and continue improvement of municipal wastewater discharges.

- Las Virgenes/Malibu/Conejo Council of Governments. 2001. Watershed Management Area Plan for the Malibu Creek Watershed. Prepared by PCR Services Corporation and WaterCycle LLC

  The goals of the Watershed Management Area Plan (WMAP) report are to establish a framework for sustainable watershed management and to recommend further actions to be carried out, in order to:

  - Identify and manage processes contributing to water quality degradation and water quantity problems;
  - Identify protection, conservation, enhancement, restoration, and retrofit opportunities that support biodiversity and improve water quality;
  - Develop long-term programs for evaluating natural resources, water quantity issues and water quality data collection and analysis; and
  - Restore natural processes with respect to the hydrological cycle, which can result in better overall water quality.

- Owens, Bradley. 2001. A Protection Revitalization Plan for Las Virgenes Creek. California State Polytechnic University, Pomona Graduate Program in Landscape Architecture.

  The purpose of this report was to provide a document with which to manage Las Virgenes Creek watershed with regard to biodiversity and human use, provide a tool on which to base grant requests for related projects, expand the existing educational base, and to provide a model from which to draw from in other similar geographic areas. It provided specific recommendations to improve water quality, increase habitat connectivity, and provide educational opportunities. A copy can be obtained at http://www.owenswatershedplanning.com/LV/.

- City of Calabasas, 2003. Las Virgenes, McCoy, and Dry Canyon Creeks Master Plan for Restoration, Phase I: Comprehensive Study. Prepared by EDAW, Inc.

  The overall objectives of the Clean Water Act 205(j) grant study were to: establish baseline environmental conditions; evaluate historical changes in the watershed; define opportunities and constraints for improving water quality (related both to Total Maximum Daily Loads and aquatic habitat); assess opportunities and constraints to restore creek and riparian habitat; and identify recreational and educational facilities and opportunities. The Phase I report can be downloaded at http://www.cityofcalabasas.com/environmental/water-resources.html

- Los Angeles County Department of Public Works, Watershed Management Division, 2004. Ballona Creek Watershed Management Master Plan. Prepared by EIP Associates.

  The Los Angeles County Department of Public Works was awarded a Proposition 13 Watershed Protection Grant by the State Water Resources Control Board to prepare a watershed plan for Ballona

Creek. The Ballona Creek Watershed Task Force met for about a year during Plan development and the final Plan was released in 2004.

http://www.ladpw.org/wmd/watershed/bc/bcmp/masterplan.cfm

- Santa Monica Bay Restoration Commission, 2004. State of the Bay. http://santamonicabay.org/smbay/Library/DocumentsReports/tabid/97/Default.aspx

  The 2004 State of the Bay report described the environmental health of the Bay and measured progress towards achieving the goals of the Bay Restoration Plan which outlines 74 priority actions that address critical environmental problems facing the Bay.

- City Of Calabasas, 2005. Las Virgenes, McCoy, and Dry Canyon Creeks Master Plan for Restoration, Phase II: Feasibility Study. Prepared by Willdan.

  In 2005 the City of Calabasas wanted to complete the next step toward implementing the projects identified in the Phase I study and investigate the cost and feasibility of implementing the projects. The Phase II study provides this information. It can be downloaded at http://www.cityofcalabasas.com/environmental/water-resources.html.

- California State Coastal Conservancy and California Department of Parks and Recreation, 2005. Malibu Lagoon Restoration and Enhancement Plan. Prepared by Moffatt & Nichol and Heal the Bay.

  The Malibu Lagoon Restoration and Enhancement Plan presents detailed information to implement and monitor the preferred restoration alternative, the Modified Restore and Enhance Alternative (Alternative 1.5), as specified in the Malibu Lagoon Feasibility Study Final Alternatives Analysis. Implementation details are provided in the form of plans for water management, habitat management, access, and monitoring to facilitate implementation of the monitoring program and subsequent environmental review and permitting. Alternative 1.5 includes relocating the existing parking lot to the northwest while installing BMPs to minimize or eliminate runoff, leaving the main channel essentially untouched, deepening and recontouring the channel on the east side In order to create a new avian island, and changing the layout of the west lagoon system of channels. The Plan may be downloaded at http://www.healthebay.org/assets/pdfdocs/mlhep/issues_mlhep_finalplan.pdf.

- Los Angeles County Department of Public Works, 2007. North Santa Monica Bay Watersheds Regional Watershed Implementation Plan, 3rd Draft. Prepared by CDM.

  There are three water quality regulations of concern in the mostly rural North Santa Monica Bay Watersheds area – NPDES permits, particularly the ones for municipal separate storm sewer systems (MS4); TMDLs; and AB 885 which will regulate on-site wastewater systems (septic systems). To address these regulations, municipalities and agencies within the NSMBW are developing a Regional Watershed Implementation Plan (RWIP). The goal of the NSMBW RWIP is to address watershed management principles through strategic implementation of best management practices (BMPs) to obtain optimal regional benefits in a cost-efficient manner.

The objectives of the RWIP are:

- To improve and maintain water quality within the NSMBW consistent with MS4 NPDES permits, TMDLs, and AB 885 regulations;
- To recommend a plan of action to address compliance with the MS4 NPDES permits, TMDLs, and AB 885 regulations;
- To compile and link all relevant existing plans and documents in the North Santa Monica Bay and address any information gaps among these documents;
- To integrate all existing and future TMDLs in the NSMBW into the RWIP; and
- To be a living document that is updated as the RWIP is implemented and as requirements in the NPDES permits, TMDL requirements, and AB 885 evolve.

- Santa Monica Bay Restoration Commission, 2008. Bay Restoration Plan 2008 Update. http://santamonicabay.org/smbay/AboutUs/TheBayRestorationPlan/tabid/55/Default.aspx

  The 2008 Update of the Bay Restoration Plan noted that significant progress had been made in improving water quality in the WMA. Major milestones accomplished included the upgrade to full secondary treatment of the two largest wastewater treatment facilities in the region; the development and implementation of TMDLs for waterbodies impaired by poor water quality; and adoption and implementation of the standard urban storm water mitigation plan under the municipal storm water permit. The report also noted that despite this progress, significant amounts of pollutants such as trash, pathogens, and heavy metals continue to reach receiving waters. New challenges include addressing the loading and impacts of nutrients and emerging contaminants.

- Santa Monica Bay Restoration Commission, 2009 draft. A Ballona Greenway Plan.

  The Greenway Plan was initiated by the Ballona Watershed Task Force and preliminary design work has been done. The outcome of this project will be final designs for portions of the Greenway including landscape guidelines for a Ballona-specific plant palette. This project has proceeded in close consultation with the MRCA and Baldwin Hills Conservancy on their pocket park and bike path beautification plans. The final plan will be a vision of how needs for flood management, water quality improvements, habitat, and recreational access might be accomplished. http://www.santamonicabay.org/smbay/Library/DocumentsReports/tabid/97/grm2id/405/Default.aspx

- Santa Monica Bay Restoration Commission, 2010. State of the Bay Report.

  The 2010 State of the Bay Report observed that the pollutants of greatest concern, due to their adverse or potentially adverse impacts on the Bay's beneficial uses, are pathogens, trash, metals, DDT, PCBs, and nutrients. Known impacts of these pollutants include health hazards for humans due to pathogens in the surf zone, aesthetic impacts of trash along the Bay's beaches and streams, and chemical contamination of local fish. The report described the reduction of pollutant loads from wastewater treatment facilities with the greater relative contribution of pollutants through the storm drain system with, in particular, trash, pathogens, metals, and nutrients washing off the urban landscape, into storm drains, and out to the Bay. In addition, historical deposits of toxic pollutants in

Bay sediments, such as DDT and PCBs, continue to be released into the environment through biological processes and resuspension, thus contaminating local marine life. Atmospheric deposition, boating activities, and septic systems are also known to contribute to contaminants to the Bay.

The development and adoption of TMDLs by the Regional Board which serve to assign load reductions needed to prevent impairment of beneficial uses, and their implementation largely through new control measures incorporated into existing NPDES permits was acknowledged. With regards to bacteria for example, the effort began with multiple low-flow diversions to the sanitary sewer at those drains with the most indicator bacteria exceedances. In some cases, year-round diversions have been necessary or installation of disinfection systems.

Impacts from invasive species is a growing concern in this WMA. The invasive plant, giant reed, and the invasive animals, crayfish and New Zealand mudsnails, in particular, are displacing native biota and degrading habitat. The report can be downloaded at http://santamonicabay.org/smbay/NewsEvents/StateoftheBay/StateoftheBayReport/tabid/176/Default.aspx.

Summaries of Key Assessment and Improvement Strategies Affecting Water Quality Issues and Beneficial Uses

Much has happened in the Region since the first edition report was produced. While the precursor of today's Santa Monica Bay Restoration Commission (the Santa Monica Bay Restoration Project) led much of the active restoration work in the WMA then, today a multitude of efforts are underway – some specific to the WMA (or subwatersheds) and some that affect the entire State. More information on these activities are presented elsewhere in the subwatershed sections as relevant; however, below is a listing of major efforts underway that may span several subwatersheds along with the lead agencies/partners. Virtually all of these efforts have engaged multiple stakeholders active on multiple fronts. Additionally, many of the projects/studies described below overlap or coordinate at some level with each other. Also, they may be part of watershed restoration strategies described in the previous section. For instance, a number of fairly watershed-specific activities are underway in the Ballona Creek Watershed including wetlands restoration, watershed plan implementation, and ecosystem restoration. But all of these watershed-specific activities occur within a larger regional context such as the Santa Monica Bay Restoration Commission's area of influence which is itself embedded within the Los Angeles Regional Water Quality Control Board's area which in turn is part of the area being addressed through the Southern California Wetlands Recovery Project. Along the way, there's a mix of jurisdictions (federal/state/local), a mix of regulatory authority (from no regulatory mechanisms in place to those mandated by regulation), and a mix of focus on land versus ocean.

Wetlands Recovery Project – multiple partners

The Southern California Wetlands Recovery Project (WRP) was formed in 1998 to develop and implement a regional strategy to increase the pace and effectiveness of wetlands recovery in the region. It is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the International border with Mexico. Using a non-regulatory approach and an ecosystem perspective, the WRP works to identify wetland acquisition and restoration priorities, prepare plans for these priority sites, pool funds to undertake these projects, implement priority plans, and oversee post-project maintenance and monitoring.

The WRP Regional Strategy involves long-term goals and specific implementation strategies to guide the efforts of the WRP and its partners. The Regional Strategy was developed through a multi-year planning process involving all the WRP partners, including the Science Advisory Panel and County Task Forces, As such, the Strategy articulates a shared vision that each partner – at the federal, state, and local level – can turn to for guidance in how to manage staff effort, direct resources, and measure progress. Information on the WRP can be found at http://www.scwrp.org.

The WRP is headed by a Board of Governors (BOG) comprised of top officials from each of the participating agencies. The Wetlands Managers Group and the Public Advisory Committee serve as advisory groups to the Board. The Wetlands Managers Group consists of staff-level personnel from the participating agencies and is responsible for drafting the regional restoration plan and advising the Governing Board on regional acquisition, restoration, and enhancement priorities.

County Task Forces help solicit projects for consideration for WRP funding by the Managers Group and Board of Governors. The program provides funding for acquisition, restoration, and enhancement projects for coastal wetlands and watersheds in Southern California.

The WRP also has a Science Advisory Panel (SAP) and a wetlands ecologist who acts as liaison with the SAP. Recent activities have focused on coordination with a statewide effort to develop methods for rapid assessment of wetlands and development of a wetlands regional monitoring program. A paper on the habitat value of treatment wetlands has also been written and is available on the WRP's webpage at http://www.scwrp.org/documents/SAP/Treatment_wetlands/LitReviewWebCover.pdf. Additionally, the SAP developed the general framework for an Integrated Wetlands Regional Assessment Program (IWRAP) – a regional wetlands monitoring program - as well as detailed recommendations for estuarine and coastal lagoon monitoring.

Wetlands Mapping - multiple partners

Describing the extent and distribution of current-day wetlands, in the form of wetland and riparian inventories, is essential to long-term protection of wetland resources. The WRP, as well as other partners in coastal Northern and Central California, have embarked on detailed mapping of the State's coastal wetlands. These maps will serve as the foundation for the IWRAP within the WRP's area of influence. Work on these maps is expected to finish in 2010 and is being funded primarily through grant monies. More information, including downloads, can be found at the following website: http://www.socalwetlands.com/website/main.htm. In parallel with this work is a project which is digitizing coastal survey maps from the 1800s in order to document the extent and type of wetlands present in southern California before much of the major development took place in the area. In certain areas, such as Ballona, more intensive "historical ecology" work is underway and is expected to finish in 2010. In these areas, in addition to the digitized historic maps, other historical documents are researched to portray a more accurate and complete picture of an area's wetlands and events which affected them such as floods and droughts, as well as, narrative anecdotal information describing in the first person activities and events in the watershed. This historical information eventually will be available via a website for download.

Wetlands Policy – State

In April 2008, the State Water Resources Control Board (State Water Board) adopted Resolution No. 2008-0026. The resolution gave the Wetland Policy Development Team (staff from the State Water Board and the North Coast and San Francisco Bay Regional Water Quality Control Boards), specific directions on the process to follow as they developed a statewide policy to protect wetland and riparian areas (Policy). The Team's Charter states it will develop the Policy in three phases:

Phase 1 – establish a Policy to protect wetlands from dredge and fill activities. The Development Team is directed to develop and bring forward for State Water Board consideration: (a) a wetland definition that would reliably define the diverse array of California wetlands based on the U. S. Army Corps of Engineers' existing wetland delineation methods to the extent feasible, (b) a wetland regulatory mechanism based on the existing Federal Clean Water Act 404 (b)(1) guidelines that includes a watershed focus, and (c) an assessment method for collecting wetland data to monitor progress toward wetland protection and to evaluate program development.

Phase 2 – Amend the Policy to protect wetlands from all other activities potentially impacting water quality. The Development Team is directed to develop and bring forward for State Water Board consideration: (a) new and/or revised beneficial use definitions, (b) water quality objectives, and (c) a program of implementation to achieve the water quality objectives, as necessary, to protect wetland-related functions.

Phase 3 – Amend the Policy to protect surface waters from impacts that may result from riparian areas disturbances. The Development Team is directed to develop, and bring forward for State Water Board consideration: (a) new and/or revised beneficial use definitions, (b) water quality objectives, and (c) a program of implementation to achieve the water quality objectives, as necessary, to protect riparian area water quality related functions.

As of the date of this report, Phase 1 is underway and the Team has proposed a wetlands definition. More information may be found at
http://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.shtml.

Once-through Cooling Water Policy – State

A draft policy, entitled Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling has been developed by the State Water Resources Control Board and applies to the State's thermal power plants that currently withdraw water from the State's navigable waters using a single-pass system, also known as once-through cooling (OTC). Adoption of technology-based standards will address the adverse effects associated with cooling water withdrawals from the State's coastal and estuarine waters. The federal Clean Water Act addresses OTC's adverse impacts in Section 316(b), which mandates technology-based measures to minimize adverse environmental impacts from cooling water intake structures.

OTC can cause adverse impacts when aquatic organisms are trapped against a facility's intake screens (impinged) and cannot escape, or when they suffer injuries that increase mortality. Smaller organisms, such as larvae and eggs, can be drawn through a facility's entire cooling system (entrained) and subjected to rapid pressure changes, chemical treatment systems, and violent shearing forces, only to be discharged along with the now heated cooling water and other facility wastewaters. The State's active coastal power plants that use OTC maintain the capacity to withdraw more than 16 billion gallons of cooling water per day. Over the course of a year, billions of eggs and larvae are effectively removed from coastal waters, while millions of adult fish are lost due to impingement. These OTC systems, many of which have been in operation for 30 years or more, present a considerable and chronic stressor to the State's coastal aquatic ecosystems by reducing important fisheries and contributing to the overall degradation of the State's marine and estuarine environments.

The Policy adopts appropriate technology-based standards that will significantly reduce these adverse impacts and implements a statewide process by which this goal can be achieved without disrupting the critical needs of the State's electrical generation and transmission system. This approach further reduces the permitting burden on the Regional Water Boards by coordinating implementation at the state level.

More information concerning the Policy may be found at http://www.waterboards.ca.gov/water_issues/programs/npdes/cwa316.shtml.

Recycled Water Policy – State

The State Board's Recycled Water Policy was adopted on February 3, 2009, and became effective on May 14, 2009. The overarching goal of the policy is to increase the use of recycled water while protecting water quality. More specifically the Policy looks to:

- Increase the use of recycled water over 2002 levels by at least one million acre-feet per year (afy) by 2020 and by at least two million afy by 2030.
- Increase the use of stormwater over use in 2007 by at least 500,000 afy by 2020 and by at least one million afy by 2030.
- Increase the amount of water conserved in urban and industrial uses by comparison to 2007 by at least 20 percent by 2020.
- And, substitute as much recycled water for potable water as possible by 2030.

Additionally, it is the intent of the Policy that local water and wastewater entities, together with salt/nutrient contributing stakeholders, will fund locally driven and controlled collaborative processes open to all stakeholders to prepare salt/nutrient management plans for each groundwater basin/sub-basin in California. It is also the intent of the State Board that because stormwater is typically lower in nutrients and salts and can augment local water supplies, inclusion of a significant stormwater use and recharge component within the salt/nutrient management plans is critical to the long-term sustainable use of water in California. A copy of the policy may be downloaded at http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf .

Proposed Regulations and Waiver For Onsite Wastewater Treatment Systems (OWTS) – State

The State Water Board proposes to adopt regulations and a statewide conditional waiver (waiver) that establish minimum requirements for the permitting, monitoring, and operation of OWTS, as required by AB 885. The waiver allows owners of OWTS to discharge wastewater without having to file a report of waste discharge (and obtain WDRs) with a Regional Water Board as long as the existing or new OWTS and its owner comply with the applicable minimum requirements set forth in the waiver. The regulations and waiver contain requirements that are substantially the same. On February 23, 2009, the State Board closed the public comment period for draft regulations regarding OWTS. During the comment period (Nov. 7, 2008 to Feb. 23, 2009), the State Board received more than 2,500 e-mail comments and hundreds of comment letters, and recorded many hours of oral comments from 12 public workshops held throughout the State. Board Staff will be recommending substantial changes based on all of the input from the public, will draft revised regulations based on the public comments received, will work with the agencies and groups identified in the enabling legislation (AB 885), and when a new set of draft regulations is written, will notice another public comment period so that all stakeholders have a chance to provide input. More information on the proposed regulations may be found at http://www.waterboards.ca.gov/water_issues/programs/septic_tanks/

Report on Discharges into State Water Quality Protection Areas - State

In the mid-1970's, thirty-four areas on the coast of California were designated as areas requiring protection by the State Water Resources Control Board, and were called Areas of Special Biological Significance (ASBS). As of January of 2003, these areas have been re-designated as State Water Quality Protection Areas (SWQPAs). The Public Resources Code states that point source waste and thermal discharges into SWQPAS are prohibited or limited by special conditions, and nonpoint sources discharging into SWQPAs must be controlled to the extent practicable.

Despite the designation of these areas for protection, little was known about the presence and types of discharges that occurred in these areas. The goal of the survey was to document the number and types of discharges into each of the thirty-four SWQPAs. Of relevance to this WMA is the Mugu Lagoon to Latigo Point SWQPA which runs along the northern end of the Santa Monica Bay coastline covering approximately 22.5 miles and is the largest of the SWQPAs adjacent to the mainland. The survey revealed 444 outlets and discharges, the most of all the SWQPAs. An outlet is defined as any naturally occurring water body that drains into or immediately adjacent to a SWQPA. This includes the following: perennial streams (or their estuaries), ephemeral streams, naturally occurring gullies in coastal bluffs and cliffs, and naturally occurring springs or seeps in wild areas (not associated with anthropogenic activities). Some of naturally occurring streams surveyed were modified with bridges, culverts or other road crossings, but the determination was made to still classify these as outlets and not discharges. It should be noted that many of the outlets, while naturally occurring, were known or suspected to be impacted from pollution sources upstream, and therefore may be contributors to pollution in the SWQPAs.

Storm water discharges that occupied what previously were natural drainage channels, but which are now heavily urbanized and modified to carry urban runoff, were not considered natural outlets and were instead labeled as "discharges"; 410 of the 444 total in the Mugu Lagoon to Latigo Point SWQPA were labeled as discharges rather than natural outlets. More information may be found at http://www.waterboards.ca.gov/water_issues/programs/ocean/asbs.shtml.

Santa Monica Mountains Steelhead Habitat Assessment Project, 2006 – multiple partners

Steelhead are migratory rainbow trout that are born in freshwater streams and spend a portion of their lives in the ocean before returning to freshwater to spawn. During the early 1900's steelhead were abundant in some coastal streams of the Santa Monica Mountains. Over the past century, human modification of riverine habitat greatly reduced steelhead populations in southern California and the National Marine Fisheries Service (NMFS) listed the southern steelhead Ecologically Significant Unit (ESU) as a federally endangered species in 1997. The NMFS estimates the southern steelhead population to be less than 1% of its historic population size (it has decreased from 50,000 prior to the 1950's to fewer than 500 today). The loss of freshwater habitat due to the construction of migration barriers such as road crossings, dams, and flood control structures presents the single greatest limiting factor for steelhead in the Santa Monica Mountains. Ultimately, NMFS seeks to recover the southern California steelhead population. The purpose of this 2006 assessment was to identify the best opportunities for restoring habitat to recover the Santa Monica Mountains population of steelhead. The project was funded by the SMBRC and the California Department of Fish and Game with in-kind services provided by multiple agencies and individuals.

There were two major goals of the assessment; one was identification and prioritization of the streams within the 23 watersheds of the Santa Monica Mountains that should be selected for steelhead restoration actions. Experts familiar with the region then selected thirteen focal watersheds based on hydrology, historic and current steelhead distribution, and best professional judgment. The second goal, within each focal watershed, was to recommend what specific actions could be implemented, where, and at what cost.

To evaluate the benefit of restoration actions, project objectives sought to determine:

- The amount of high quality steelhead habitat for spawning and rearing that currently exists;
- The amount of degraded steelhead habitat for spawning and rearing and the types of degradation; and
- The potential causes of degraded habitat quality.

In order for decision makers to achieve cost effective restoration projects, three prioritization analyses were developed. The results of applying these three evaluation analyses point to three general ranking categories, and thus three groups of prioritized watersheds on which to potentially focus prime steelhead restoration activities:

1. Top Priority: The Malibu, Topanga, and Arroyo Sequit watersheds were consistently identified as the highest priority watersheds. Of these, Arroyo Sequit is receiving the least amount of restoration attention or activity.

2. Middle Priority: The prioritization evaluations discovered four candidate watersheds (Zuma, Trancas, Big Sycamore, and Las Flores) where little prior or current steelhead restoration activity exists. Zuma and Trancas have significant restoration potential and many opportunities exist in these two watersheds.

3. Lowest Priority: Escondido, Lechuza, Corral, Encinal, and Little Sycamore were identified as the lowest priority watersheds. These streams, based on the amount and quality their habitat, small size of their watersheds, limited hydrologic capabilities, and apparent absence of steelhead lead this report to conclude higher priorities and better opportunities exist elsewhere.

Restoration Recommendations In addition to identifying Keystone barrier restoration activities, the assessment found a variety of opportunities to aid and possibly accelerate steelhead recovery in the region. The report recommends that the following actions be pursued:

- Existing steelhead restoration activity at Malibu and Topanga should be continued and strengthened.
- While concerted efforts are underway at Malibu and Topanga creeks, Arroyo Sequit also is being utilized by steelhead but no comprehensive watershed-based plan is in place. A comprehensive watershed plan should be developed and implemented.
- Existing steelhead restoration actions, albeit noteworthy, are fragmented and without a single entity to maximize effectiveness or public outreach opportunities. Support to enhance/coordinate the capacity of existing organizations is needed.
- A comprehensive steelhead monitoring program for the Santa Monica Mountains is essential to fill voids in steelhead biology. Life history and discernable population trends, as the result of current and future restoration actions, is needed.
- The agencies funding this report should sponsor and host within one year a conference gathering all interested parties, agencies, and municipalities to identify and select a firm set of projects from this report in a prioritized fashion so that efforts to restore steelhead and streams of the Santa Monica Mountains are done with the greatest biological and cost effectiveness possible.

Fish Passage Recommendations Restoring steelhead access to upstream habitat requires a bottom to top approach. Keystone barriers, which are the most downstream barrier blocking or significantly impeding upstream adult steelhead passage, were identified in focal watersheds. Providing effective upstream steelhead passage at Keystone barriers is an essential step to steelhead recovery within each watershed and the region.

Of the 110 steelhead migration barriers, 43% are natural. The majority (62%) of the 110 barriers are severe, 33% modest, and 3% of minor severity to steelhead upstream migration. Each of the 13 focal watersheds in the Santa Monica Mountains contained a least one Keystone barrier to adult steelhead spawning migration. If all barriers were remedied, over 29 miles of suitable steelhead stream habitat would become available. The cost estimates to take corrective actions at the individual Keystone barriers ranged from as little as $70,000 to as high as $40 million. In total the cumulative cost exceeds $70 million.

The full document may be downloaded at http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=10485.

Steelhead/Rainbow Trout Resources South of the Golden Gate, California - Center for Ecosystem Management and Restoration

This report, with accompanying database, was released in 2008 and presents a distillation of the large amount of available information regarding steelhead/rainbow trout habitat. It includes information concerning presence/absence and other natural history and habitat features in specific streams necessary for an understanding of how steelhead resources may have changed over time. Information on both historical and current presence/absence of steelhead/rainbow trout is described in a narrative fashion and also presented in both tabular form and on maps which are available for download at http://www.cemar.org (CEMAR, 2008).

Integrated Resources Plan – City of Los Angeles

The Integrated Resources Plan (IRP) is a 2020 strategic facilities plan for the City of Los Angeles' wastewater, runoff, and recycled water programs. There are a number of features relevant to this WMA including onsite percolation of wet weather runoff at schools and government properties, and neighborhood-scale percolation at vacant lots. It also calls for continued implementation of water conservation programs, such as smart irrigation devices to reduce outdoor water use and urban runoff.

The implementation strategy for the IRP will be directed by certain "triggers" that include policy decisions regarding recycled water and groundwater replenishment, and regulatory decisions regarding POTW discharges to inland waters such as the Los Angeles River (no POTWs discharge to inland waters in this WMA within the City of Los Angeles).

Specific directions were given to City staff on the next studies and evaluations required for progress. The following provide direction to staff on immediate activities and actions for recycled water, water conservation, and runoff management, dependent on staff and funding availability.

Water Conservation

- Direct the City of Los Angeles Department of Water and Power (DWP) to continue conservation efforts, including programs to reduce outdoor usage, including using smart irrigation devices on City properties, schools and large developments (those with 50 dwelling units or 50,000 gross square feet or larger), and to increase incentives to residential properties.
- Direct DWP to work with Building and Safety in continued conservation efforts, including evaluating and considering new water conservation technologies, including no-flush urinal technology.
- Direct DWP to continue conservation efforts, including working with Building and Safety to evaluate and develop policy that requires developers to implement individual water meters for all new apartment buildings
- Direct DWP to continue conservation awareness efforts, including increasing education programs on the benefits of using climate-appropriate plants with an emphasis on California friendly plants for landscaping or landscaped areas and to develop a program of incentives for implementation.
- Direct Planning to consider the development of City Directive to require the use of California friendly plants in all City projects where feasible and not in conflict with other facilities usage.

Runoff Management – Wet Weather Runoff

- Direct Public Works to review SUSMP (Standard Urban Stormwater Management Plan) requirements to determine ways to require where feasible on-site infiltration and/or treat/reuse, rather than treat and discharge, including in-lieu fees for projects where infiltration is infeasible.
- Direct Building and Safety to evaluate and modify applicable codes to encourage all feasible Best Management Practices (BMPs) for maximizing on-site capture and retention and/or infiltration of stormwater instead of discharge to the street and storm drain, including porous pavement. (This is currently handled through variances). Direct Public Works and Department of Planning to evaluate the possibility of requiring porous pavements in all new public facilities larger greater than 1 acre. Program feasibility should consider slope and soil conditions.

- Direct Department of Planning to evaluate ordinances that would need to be changed to reduce the area on private properties that can be paved with non-permeable pavement.
- Direct Public Works to evaluate and implement integration of porous pavements into the sidewalks and street programs where feasible.
- Direct Public Works and DWP and Department of Recreation and Parks to prepare a concept report and determine the feasibility of developing a powerline easement demonstration project (for greening, public access, stormwater management, and groundwater replenishment).
- Direct Public Works and DWP to work with the Los Angeles Unified School District (LAUSD) to determine the feasibility of developing projects for both new schools and for retrofitted schools, as well as government/city-owned facilities with stormwater management BMPs. [Provide wet weather runoff storage (cisterns) to beneficially use wet weather runoff for irrigation. Also, schools and government properties to reduce paving and hardscape and add infiltration basins to allow percolation of wet weather runoff into the ground where feasible.]
- Direct Public Works and General Services and the Department of Transportation (DOT) to maximize unpaved open space in City-owned properties and parking medians through using all feasible BMPs and by removing all unnecessary pavement.
- Direct Public Works to include all feasible BMPs in the construction or reconstruction of highway medians under its jurisdiction.
- Direct Public Works to coordinate with the Million Trees LA team on identifying potential locations of tree plantings that would provide stormwater benefit, with consideration of slope and soil conditions .

Runoff Management - Dry Weather Runoff

- In the context of developing TMDL implementation plans, direct Public Works to consider diversion of dry weather runoff from Ballona Creek to constructed wetlands, wastewater system, or urban runoff plant for treatment and/or beneficial use. Coordinate with the Department of Recreation and Parks.
- In the context of developing TMDL implementation plans, direct Public Works to consider diversion of dry weather runoff from inland creeks and storm drains to wastewater system or constructed wetlands or treatment/retention/infiltration basins with consideration for slope and topography.

General

- Direct the Department of Planning to consider opportunities to incorporate IRP policy decisions in the General Plan, Community Plan, and Specific Plan updates or revisions.
- Direct Department of Recreation and Parks to coordinate with Public Works on including stormwater management BMPs in all new parks.
- Direct General Services in coordination with Planning and Public Works to evaluate feasibility of all City properties identified as surplus for potential development of multiple-benefit projects to improve stormwater management, water quality and groundwater recharge.

The IRP can be downloaded at http://www.lacitysan.org/irp/

TMDLs – Regional Board

Information is available at http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml for

- Ballona Creek Trash TMDL, 2002 (and 2005 revision)
- Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003
- Ballona Creek Metals TMDL, 2005
- Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
- Ballona Creek Estuary Toxic Pollutants, 2005
- Malibu Creek Bacteria TMDL, 2006
- Malibu Creek Watershed Nutrients TMDL, established by USEPA in 2003
- Marina del Rey Harbor Toxics TMDL, 2006
- Marina del Rey Back Basins Bacteria TMDL, 2004
- Santa Monica Bay Nearshore and Offshore Debris TMDL, 2010

Ocean Protection Council – State

The Ocean Protection Council (OPC) was created pursuant to the California Ocean Protection Act which was signed into law in 2004 by Governor Arnold Schwarzenegger.

The OPC is guided by principles included in Act:

- Recognizing the interconnectedness of the land and the sea, supporting sustainable uses of the coast, and ensuring the health of ecosystems
- Improving the protection, conservation, restoration, and management of coastal and ocean ecosystems through enhanced scientific understanding, including monitoring and data gathering
- Recognizing the "precautionary principle": where the possibility of serious harm exists, lack of scientific certainty should not preclude action to prevent the harm
- Identifying the most effective and efficient use of public funds by identifying funding gaps and creating new and innovative processes for achieving success
- Making aesthetic, educational, and recreational uses of the coast and ocean a priority
- Involving the public in all aspects of OPC process through public meetings, workshops, public conferences, and other symposia

The OPC is tasked with the following responsibilities:

- Coordinate activities of ocean-related state agencies to improve the effectiveness of state efforts to protect ocean resources within existing fiscal limitations
- Establish policies to coordinate the collection and sharing of scientific data related to coast and ocean resources between agencies
- Identify and recommend to the Legislature changes in law
- Identify and recommend changes in federal law and policy to the Governor and Legislature

The 2009-2011 priorities of the OPC are outlined in A Vision for Our Ocean and Coast: Five-Year Strategic Plan. For the upcoming years, more specific guidance is given in the 2009-2011 OPC priorities document. The priorities are focused around six areas of interest, including: governance, research and mapping, ocean and coastal water quality, physical processes and habitat structure, ocean and coastal ecosystems, and education and outreach. The OPC's website is http://www.opc.ca.gov/

Marine Life Protection Act – State

The Marine Life Protection Act (MLPA) Initiative is a public-private partnership designed to help the State of California implement the MLPA using the best readily available science, as well as the advice and assistance of scientists, resource managers, experts, stakeholders and members of the public. The MLPA requires the state to redesign existing state marine protected areas (MPAs), and to establish a cohesive network of MPAs to protect, among other things, marine life, habitats, ecosystems and natural heritage, as well as to improve recreational, educational and study opportunities provided by marine ecosystems.

Marine protected areas within the MLPA South Coast Study Region (Point Conception south to the California/Mexico border) will be evaluated and redesigned with input from a regional stakeholder group, a science advisory team, a blue ribbon task force, the California Department of Fish and Game (DFG), the California Department of Parks and Recreation, and other interested parties. An available document, the "Regional Profile of the MLPA South Coast Study Region", is intended to support the MPA planning process by providing background information and data on the biological, oceanographic, socioeconomic, and governance characteristics of the south coast study region. The regional profile has been reviewed and revised based on input from regional stakeholders. This profile will assist stakeholders and decision-makers in evaluating existing MPAs in the study region and developing alternative proposals for a network of MPAs which meet the goals of the MLPA and which form a component of the statewide MPA network. More information may be found at http://www.dfg.ca.gov/mlpa.

Integrated Regional Water Management Plan – Greater Los Angeles County

The Santa Monica Bay WMA falls within the Greater Los Angeles County Integrated Regional Water Management Plan (IRWMP) Region as well as within two of its subregions, North Santa Monica Bay and South Bay. Although originally envisioned as a mechanism to secure bond funds in the short-term, the Greater Los Angeles County IRWMP, as well as the many others around the State, are envisioned as providing the roadmap to improve water supplies, enhance water supply reliability, improve surface water quality, preserve flood protection, conserve habitat, and expand recreational access in the Region. The Plan is also intended to define a comprehensive vision for the Region which will generate local funding, position the Region for future state bonds, and create opportunities for federal funding. Details on the Plan and opportunities for stakeholder involvement can be found at http://www.lawaterplan.org

Green Solution Project, Phase II

Green Solution Project, Phase I, provided quantification and identification of urban lands within LA County that would be needed for conversion to pervious, multi-benefit projects (park, recreation, wetlands and natural lands) to help meet water quality improvement goals and regulatory requirements through the infiltration or treatment of stormwater before it reaches Santa Monica Bay. The study also identified publicly owned lands within the County to assess the extent to which these lands could be used for these projects. The products of Phase I include a series of GIS-based maps depicting publicly-owned parcels within the Santa Monica Bay watershed, along with their size and general land uses.

The Coastal Conservancy, through Community Conservancy International, is funding Phase II which is needed to refine parcel data for selected land use categories; analyze hydrology and other parcel attributes related to suitability for stormwater infiltration/treatment; develop a ranking matrix to screen and prioritize candidate parcels for water quality project implementation; and develop concept designs for five high-ranking priority parcels. More information can be found at http://www.ccint.org/greensolution.html.

Low Impact Development Ordinance – County of Los Angeles

Los Angeles County adopted Ordinance No. 2008-0063 in November 2008 which established low impact development standards for developments constructed after January 1, 2009. The standards are intended to mimic undeveloped stormwater and urban runoff rates and volumes in any storm event up to and including a 50-year storm, prevent pollutants of concern from leaving a development site as the result of storms, and minimize hydromodification impacts to natural drainage systems. To aid implementation of this ordinance, the County prepared a Low Impact Development Standards Manual. The ordinance is available at http://planning.lacounty.gov/view/green_building_program while the Development Standards Manual can be downloaded at http://planning.lacounty.gov/green.

Low Impact Development Ordinance – City of Los Angeles

In January 2010, he City of Los Angeles Board of Public Works approved a low impact development (LID) ordinance which will require 100% of runoff from a storm of ¾ inch magnitude be captured or reused at new homes, larger commercial developments, and some redevelopments. If these requirements are not met, developers will be required to pay a stormwater pollution fee that will be allocated to other public LID projects. To aid implementation of this ordinance, the City prepared a Development Best Management Practices Handbook. Information on the LID program can be found at http://www.lastormwater.org/Siteorg/program/LID/lidintro.htm.

Low Impact Development Ordinance – City of Santa Monica

The City of Santa Monica’s Urban Runoff Pollution Cotnrol Control Ordinance requires that all new developments and substantial remodels prepare an Urban Runoff Mitigation Plan to ensure the site maximizes permeable surface area and minimizes the amount of runoff directed to impermeable areas. Runoff from a ¾ inch rain event must be treated or infiltrated. More information may be found at http://santamonica.org/Departments/OSE/Categories/Green_Building/Guidelines/Siting_and_Form/Runoff_Mitigation_Plan.aspx

Water Quality Compliance Master Plan for Urban Runoff - City of Los Angeles

This 2009 plan utilizes a strategy to build on ongoing successful initiatives and programs, identify common grounds (for benefits and funding), and seek new initiatives that will address complex problems. This approach will also promote water conservation and factor in objectives identified by other plans, including increased recreation opportunities and support for the greening of Los Angeles. It may be downloaded at http://www.lastormwater.org/Siteorg/program/masterplan.htm.

Summaries of Key Monitoring Programs and Large-scale Studies

Historic Statewide Monitoring Programs (CRWQCB, 1997)

The first edition of this State of the Watershed Report noted that there had been a considerable number of short- and long-term monitoring programs implemented in the WMA, particularly over the previous twenty years, that focused on urban runoff effects in general along the coastline and the fate of PCBs- and DDT-contaminated sediment on the Palos Verdes Shelf. The results of three statewide monitoring programs, State Mussel Watch (SMW), Toxic Substances Monitoring (TSM), and Bay Protection and Toxic Cleanup (BPTC), which included biological measurements, were summarized in an appendix of the first edition report. The TSM sampled fish for bioaccumulation of toxic pollutants, generally but not exclusively in fresh waters; the SMW Program sampled shellfish, generally in marine waters, for bioaccumulation; and the BPTC Program sampled sediments, generally in harbors and estuaries, for pollutants, toxicity, and the health of the benthic community. While the former two programs sampled from the early 1980s until the late 1990s, the BPTC Program operated from the early 1990s until the late 1990s.

The first edition report stated that the SMW Program had found that the open coastline of the Santa Monica Bay WMA was much cleaner than its enclosed waters (harbors and marinas, generally), at least for most substances that are both bioaccumulative and bioavailable to mussels either placed in a location or that naturally occur at a site. The pattern of accumulation for DDT and PCBs was different, however, and this may have represented the residual effects of past coastal discharges and historic sediment contamination reflected by the BPTC Program data. Fish bioaccumulation problems which might have human health implications were relatively minor in those fresh and estuarine waters sampled (except for concerns over mercury in Lake Sherwood fish which continue today) while the potential for aquatic life impacts existed in Marina del Rey Harbor and Ballona Creek (also concerns which continue today).

With regards to sediment contamination found through the BPTC Program, one group of chemicals sampled was polynuclear aromatic hydrocarbons (PAHs) which are found in oil products. The PAHs that are categorized as low molecular weight PAHs (LPAHs) are considered indicative of spills or recent releases of oil from natural seeps. High molecular weight PAHs (HPAHs) are indicative of hydrocarbon combustion such as would be found in runoff from streets or in marinas from boating activities. Grouped in that fashion, LPAHs and HPAHs can be roughly indicative of sources.

Sediments in the Ballona Creek estuary were more contaminated with PAHs than the other sites sampled in the WMA. Approximately 80-90% of the PAHs found at all of the sampled sites were HPAHs which are indicative of combustion.

Polychlorinated biphenyls (PCBs) may also be evaluated in a similar manner. PCBs are composed of mixtures of various congeners which differ mostly in the number of chlorine atoms they contain. The number of chlorine atoms determines the chemical and physical characteristics of the final PCB mixture. A higher number of chlorine atoms is associated with thicker, heavier PCBs while less chlorine atoms are associated with lighter PCBs. Heavier PCBs are also more injurious to animals and humans. The results of sediment analyses by the number of chlorine atoms gives a characteristic "fingerprint" which may reveal a common source. PCB congener data for Palos Verdes, Marina del Rey, and Ballona Creek were assessed and showed no clear indication of a common fingerprint among the three areas which could mean there is either no common source or no recent common source since PCBs do degrade over time.

With regards to concentrations of other organic chemicals in the sediments of the WMA, it was clear DDT was still being found at highly elevated levels in sediments off of the Palos Verdes Peninsula, almost certainly due to past discharges and dumping practices. Chlordane is a banned insecticide that was used to control ants and termites. It is highly persistent and was likely still being used in residential areas where individuals may have remaining stocks. This was reflected in the higher levels found in Ballona Creek.

Marina del Rey sediments contained the highest levels of metals overall with copper levels especially high compared to other embayments in the WMA. Ballona Creek contained very high levels of zinc and lead but not copper. These numbers were considered expected since copper was and continues to be used extensively in antifouling bottom paints which is likely used on the majority of boats moored in the marina. On the other hand, copper is not as large a component in urban or storm water runoff and thus should not be as high in Ballona Creek. However, at that time, lead and zinc were still commonly found in urban runoff although lead occurred in much lower concentrations since the advent of unleaded gasoline.

Sediments were also evaluated for toxicity. Survival of test organisms in Malibu Lagoon sediments was quite good. The average survival of organisms tested during four sampling runs spanning three years in the Palos Verdes area was also good. On the other hand, survival of test organisms in sediments from Marina del Rey and Ballona Creek was relatively poor.

Palos Verdes Shelf Studies and Planning for Cleanup - USEPA

Coastal Marine Fish Contaminants Survey

In 2007, the National Oceanographic and Atmospheric Administration (NOAA) and the USEPA released a report on the results of a 2002-2004 coastal marine fish contaminants survey. NOAA participated on behalf of the natural resources trustees which include NOAA, US Fish and Wildlife Service, National Park Service, California Department of Fish and Game, California State Lands Commission, and California Department of Parks and Recreation. The highest concentration of total DDT found in white croaker (a bottom-feeding fish with a high lipid content) in 2002 was almost 33,700 ppb at a sampling location near the west side of the JWPCP outfall. Total PCBs were found at 2,950 ppb at that location. Samples collected by the County Sanitation Districts of Los Angeles County in both 2002 and 2005 near the east side of outfall were an order of magnitude lower (NOAA and USEPA, 2007).

Palos Verdes Shelf Superfund Site Operable Unit 5 of the Montrose Chemical Corp. Final Feasibility Study

In 2009, USEPA released a feasibility study which describes the development, evaluation, and comparison of remedial action alternatives to manage the contaminated sediment at the Palos Verdes Shelf site (USEPA and CH2M Hill, 2009).

The report describes the results of the aforementioned 2002 – 2004 coastal marine fish contaminant survey and summarizes the results of sampling for DDT and PCBs in white croaker off the Palos Verdes Peninsula (including near the outfall) from 1999 through 2006. The data show a general decline in PCBs concentration and a more dramatic decline in DDT concentrations, particularly near the outfall. The report also compares total DDT and total PCBs concentration in pelagic fish (anchovy, mackerel, and sardine) and squid in the Southern California Bight in the early 1980s during various studies and during a 2003-2004 study conducted by SCCWRP. While there are differences in species and sampling locations, these studies show a general decline in both DDT and PCBs concentrations in the Bight over the twenty-year time period (USEPA and CH2M Hill, 2009).

Using recreational angler consumption rates developed during the1994 SMBRP Seafood Consumption Study, fish tissue concentrations found to be protective of human health were, for DDTs in fish fillet, 490 ppb and for PCBs in fish fillet, 80 ppb, based on 21.4 g/day consumption. This would result in an excess lifetime cancer risk of 1×10^{-5}. When consumption was based on 116 g/day, protective levels were at 400 ppb for DDTs and 70 ppb for PCBs with an excess lifetime cancer risk of 1×10^{-4}. Pelagic fish concentrations of PCBs and DDTs are generally below those levels while higher concentrations are associated with bottom-feeding fish, particularly, white croaker (USEPA and CH2M Hill, 2009).

The document reported on ecological risk to the fauna of the Palos Verdes Shelf area including effects on the benthic community, fish, and predators of fish through contaminated sediment. The evaluation found that the highest risks are in the vicinity of the JWPCP outfalls. Intermediate-risk areas are generally to the north and northwest of the outfalls. Low-risk areas occur south of the outfalls, in waters less than 30 m in depth, at the far northern areas of the Palos Verdes Shelf, and throughout the remainder of the Bight. Benthic invertebrates and local fish would be directly affected by contaminated sediment whereas predators of fish, such as birds, would be affected through food-chain transfer of the pollutants. Sediment concentrations of PCBs in the Palos Verdes Shelf area are below levels considered to be protective of benthic infauna and concentrations of DDTs are of concern only in the immediate area around the outfalls. Regarding risk to fish-eating birds and mammals, concentrations of DDTs continue to pose a risk while PCBs pose a much lower risk (USEPA and CH2M Hill, 2009).

The report also presents potential remediation goals for the protection of human and ecological health and presents remedial alternatives including dredging and capping of various amounts of contaminated sediment (USEPA and CH2M Hill, 2009).

USEPA announced their preferred alternative for remediating the Palos Verdes Shelf Superfund site in June 2009. Public meetings were held in June and comments were accepted into July. A news release on June 11, 2009, stated “The EPA's Preferred Alternative Plan is an interim remedy that proposes institutional controls, monitored natural recovery and a containment cap. On October 5, 2009, a news release issued by USEPA announced, in part "The U.S. Environmental Protection Agency has selected a cleanup strategy for the Palos Verdes Shelf Superfund Site, where a large area on the ocean floor off the Palos Verdes peninsula is contaminated with DDT and PCBs. The EPA will spend more than $50 million to cap the most contaminated sediment on the shelf, as well as continue the highly effective public outreach program to protect at-risk populations from consuming contaminated fish." More information on the Palos Verdes Shelf contamination issues and potential federal remediation actions can be found at http://www.epa.gov/region09/superfund/pvshelf.

Municipal Separate Storm Sewer System (MS4) Monitoring (Municipal Stormwater NPDES Permit) – MS4 permittees

The major objectives of the Monitoring Program outlined in the Municipal Stormwater Permit are to:

- Assess permit compliance,
- Measure and improve the effectiveness of the Stormwater Quality Management Plans,
- Assess the chemical, physical, and biological impacts of receiving waters resulting from urban runoff,
- Characterize stormwater discharges,
- Identify sources of pollutants,
- Assess the overall health and evaluate long-term trends in receiving water quality.

The required monitoring includes the following components:

- Core Monitoring Program: mass emission, water column toxicity, tributary, shoreline, and trash monitoring. Mass emission and toxicity monitoring conducted in the Santa Monica Bay WMA were located in Malibu and Ballona Creeks. The most recent tributary monitoring took place outside of the WMA. Trash monitoring occurred on Ballona Creek.
- Regional Monitoring Program: estuary sampling and bioassessment and the results of three special studies. Estuary sampling was completed in conjunction with Bight '03 work. Bioassessment sampling occurred at one site on Ballona Creek and at four sites tributary to the mainstem of Malibu Creek.

An Integrated Receiving Water Impacts Report was created in 2004-2005 that incorporates results, analysis, and progress of the Core and Regional Monitoring Programs. That report also looked at trends for the period 1994-2005. Annual Stormwater Monitoring Reports can be found on the Los Angeles County Department of Public Works website at http://dpw.lacounty.gov/wmd/NPDES/report_directory.cfm. Results for Ballona and Malibu Creeks sampling are summarized in those subwatershed sections. The reporting on the most recent shoreline monitoring results for bacterial indicators is briefly summarized here (LACDPW website).

Dry-weather Approximately, 2,400 samples were collected for bacteria indicator monitoring during the most recent sampling year at eighteen sites along Santa Monica Bay. Stations located at Santa Monica Canyon Storm Drain and Santa Monica Pier were the northern Bay sites with the highest geometric means for all bacterial indicators during dry-weather. Stations at Ashland and Windward had the lowest dry-weather geometric means in the northern Bay area for all indicators. Southern Bay stations located at the mouth of Ballona Creek and at Redondo Beach Pier had the highest bacterial densities for all indicator bacteria during dry-weather with the Ballona Creek site the highest (of all sites sampled) and the Redondo Beach Pier site the next highest. The higher geometric means were recorded for northern stations when compared to stations to the south; storm drains flow more consistently in the north (LACDPW website).

Wet-weather Annual geometric means for FY 2008-2009 revealed higher bacterial densities for all three fecal indicators during wet-weather when compared to dry-weather. Water quality will deteriorate during and immediately after a rainstorm, but generally return to previous levels within two to four days. Northern Bay stations exhibited higher mean values during wet-weather than those to the south for all fecal indicators. Northern stations with the highest wet-weather bacterial densities were stations at Surfrider Beach, Santa Monica Canyon Storm Drain, and Pico-Kenter Storm Drain. Although total coliform and E. coli means were comparable among these three stations, the Enterococcus mean value at the Santa Monica Canyon Storm Drain was almost twice as high as means at the other two sites. For stations to the south, wet-weather mean values at the Ballona Creek station were highest for all fecal indicators. Comparing all stations, north and south, the total coliform wet-weather mean was highest at Ballona Creek; E. coli was highest at Surfrider Beach, Santa Monica Canyon Storm Drain; and the enterococcus mean value was highest at Santa Monica Canyon Storm Drain (LACDPW website).

Surface Water Ambient Monitoring Program (SWAMP) – State

Santa Monica Bay Streams Study California's Surface Water Ambient Monitoring Program (SWAMP) is a comprehensive monitoring program designed to assess the quality of the beneficial uses of the State's water resources. In 2003-2004, the Santa Monica Bay WMA was sampled. The main goal of the sampling in the WMA was to obtain an overall view of the health of the watershed. Additionally, the monitoring plan was designed to provide information on potential reference sites in the watershed, and beneficial use attainment or non-attainment. Sixty-one sites distributed among the approximately 30 coastal sub-watersheds of the WMA were selected for sampling. In most cases, two stations were sampled in each sub-watershed. Sampling was completed at 59 sites; two sites were dry during sampling events. Sampling was conducted during the spring seasons of 2003 and 2004. Sampling at all stations included field measurements (conductivity, DO, pH, salinity, temperature, turbidity, and current speed), conventional water column chemistry (alkalinity, ammonia-N, boron, chloride, chlorophyll a, conductivity, dissolved oxygen, fluoride, hardness, nitrate-N, nitrite-N, orthophosphate, sulfate, total dissolved solids (TDS), temperature, total Kjeldahl nitrogen (TKN), total phosphorous (P), and turbidity) and bacteriology. Bioassessment was conducted at 39 sites and enzyme-linked immunosorbent assay (ELISA) analyses for chlorpyrifos and diazinon were conducted at 37 sites. During spring 2003, a subset of twenty stations was sampled for water column toxicity, dissolved metals, and organophosphate chemistry, and another subset of five stations was sampled for dissolved metals only. Additionally, two sites located near gas stations were tested for MTBE (SWRCB, 2005).

Some highlights of the findings were: DO was < 90% saturation at 34 sites during at least one sampling event while pH was > 8.5 at nine sites. Chloride exceeded USEPA criteria for protection of aquatic life at thirteen sites. Sulfate and TDS concentrations exceeded California Secondary MCLs (generally associated with taste) at most sites. E. coli and fecal coliform exceeded freshwater single sample limits at sites throughout the WMA. Metals were generally below criteria, objectives or action levels. With the exception of chorpyrifos and diazinon, no other organic compounds were detected. Acute and chronic water column toxicity were detected at six sites in the WMA. Five of these sites were each in the lower portion of their respective sub-watersheds (Lower Trancas Canyon, Lower Puerco Canyon, Lower Marie Canyon, Lower Ramirez Canyon, and Ballona Creek at Centinela) with one in the upper portion (Upper Escondido Canyon). Benthic IBI scores ranged from 4 to 78 and represented four condition categories ranging from Very Poor to Good. No scores were in the Very Good category. Very Poor scores were found at Lower Marie Canyon, Malibu Lagoon, Middle Santa Ynez Canyon, Lower Santa Monica Canyon, Lower Rustic Canyon, Ballona Creek at Centinela, and unnamed drainages into Upper and Lower Malaga Cove. The majority of Very Poor and Poor sites were located toward the southern end of Santa Monica Bay. On the other hand, sites rated as Good were mostly found more toward the northern end of Santa Monica Bay. Inconsistent patterns in physical habitat, water chemistry, and toxicity data prevent the conclusion of which factors contribute to degraded biotic condition. There were differences between upper and lower sites within individual watersheds. However, differences were not consistent among watersheds. In several watersheds, more water quality problems were indicated in the lower portions, while in other watersheds conditions were similar among sites. However, in some cases the upper and lower sites were located very close together and may not truly represent the upper and lower portions of the watershed (SWRCB, 2005).

The deterministic sampling design used in the study did not have the statistical power necessary for making conclusions with regard to the watershed as a whole (percentage of streams in the watershed or region that support beneficial uses, and how that percentage is changing over time). Additionally, the original study design called for locating two sites in a sub-watershed, one site in the upper watershed and the other in the lower watershed near its intersection with Pacific Coast Highway. However, due to the inability to find sites with running water and access, sites designated “Upper” were not always in the true upper portion of the watershed, and in some cases were located in close proximity to the “Lower” sites. Thus, not all paired Upper and Lower sites in this study represented a true comparison of the characteristics of the upper and lower portions of the watersheds. However, this may be virtually impossible due to the ephemeral nature of southern California streams (SWRCB, 2005).

<u>California Lakes Fish Contamination Study</u> The State Water Resources Control Board released a report entitled *Contaminants in Fish from California Lakes and Reservoirs*, that presents initial results from a statewide survey. The monitoring indicates that concentrations of mercury in indicator species are above human health thresholds across much of the state. PCBs were second to mercury in exceeding thresholds, although far fewer lakes reached concentrations that pose potential health concerns to consumers of fish from California lakes. Concentrations of other pollutants were generally low and infrequently exceeded thresholds (Davis, et al., 2009).

The report was a product of the Surface Water Ambient Monitoring Program and presented findings from the first year (2007) of a two-year study. The study marks the beginning of a new program that will track sport fish contamination in California lakes, rivers, streams, and coastal waters (Davis, et al., 2009).

The study sampled more than 200 of the most popular fishing lakes in the state and also conducted a random sampling of 50 of California's other 9,000 lakes to provide a statistical statewide assessment. The species selected for sampling are known to accumulate high concentrations and be good indicators of contamination problems, however, the study was not design to provide consumption advice which would require more detailed monitoring and a much higher level of funding (Davis, et al., 2009).

Fish tissue concentrations were evaluated using thresholds developed by the California Office of Environmental Health Hazard Assessment (OEHHA) for methylmercury, PCBs, dieldrin, DDTs, chlordanes, and selenium. Fish Contaminant Goals (FCGs) were developed; these are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week, prior to cooking. FCGs prevent consumers from being exposed to more than the daily reference dose for non-carcinogens or to a risk level greater than one additional cancer case in a population of 1,000,000 people consuming fish at the given consumption rate over a lifetime. FCGs are based solely on public health considerations relating to exposure to each individual contaminant, without regard to economic considerations, technical feasibility, or the counterbalancing benefits of fish consumption (Davis, et al., 2009).

OEHHA determined that there is a compelling body of evidence and general scientific consensus that eating fish at dietary levels that are easily achievable, but well above national average consumption rates, appears to promote significant health benefits, including decreased mortality, i.e., there are unique health benefits associated with fish consumption. Advisory tissue levels (ATLs) were developed as a result. ATLs were calculated using the same general formulas as those used to calculate FCGs, with some adjustments in order to incorporate the benefits of fish consumption. ATLs provide a number of recommended fish servings that correspond to the range of contaminant concentrations found in fish and are designed to prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. The use of ATLs still confers no significant health risk to individuals consuming sport fish in the quantities shown over a lifetime, while encouraging consumption of fish that can be eaten in quantities likely to provide significant health benefits and discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be recommended in amounts suggested for improving overall health (Davis, et al., 2009).

While the Lake Study report said that lakes were considered "clean" if all average pollutant concentrations in all species were below all OEHHA thresholds, for the purposes of this State of the Watershed Report, the data were assessed for the worst case scenario, i.e., the highest values found rather than average values for each of the chemicals of concern (mercury and PCBs, for the most part) (Davis, et al., 2009).

High mercury levels were found at two of the WMA's lakes, Ken Hahn Park Lake and Lake Sherwood. Atmospheric deposition is a possibility; the size of the lakes, how often maintenance dredging occurs, and the potential for fish to survive and be long-lived (thus bioaccumulating more pollutants) are all factors to be considered. The other chemical of concern in fish is total PCBs in a few lakes; however, PCBs levels in fish tissue in the WMA's lakes are much lower relative to mercury levels in fish when compared to the OEHHA thresholds (Davis, et al., 2009).

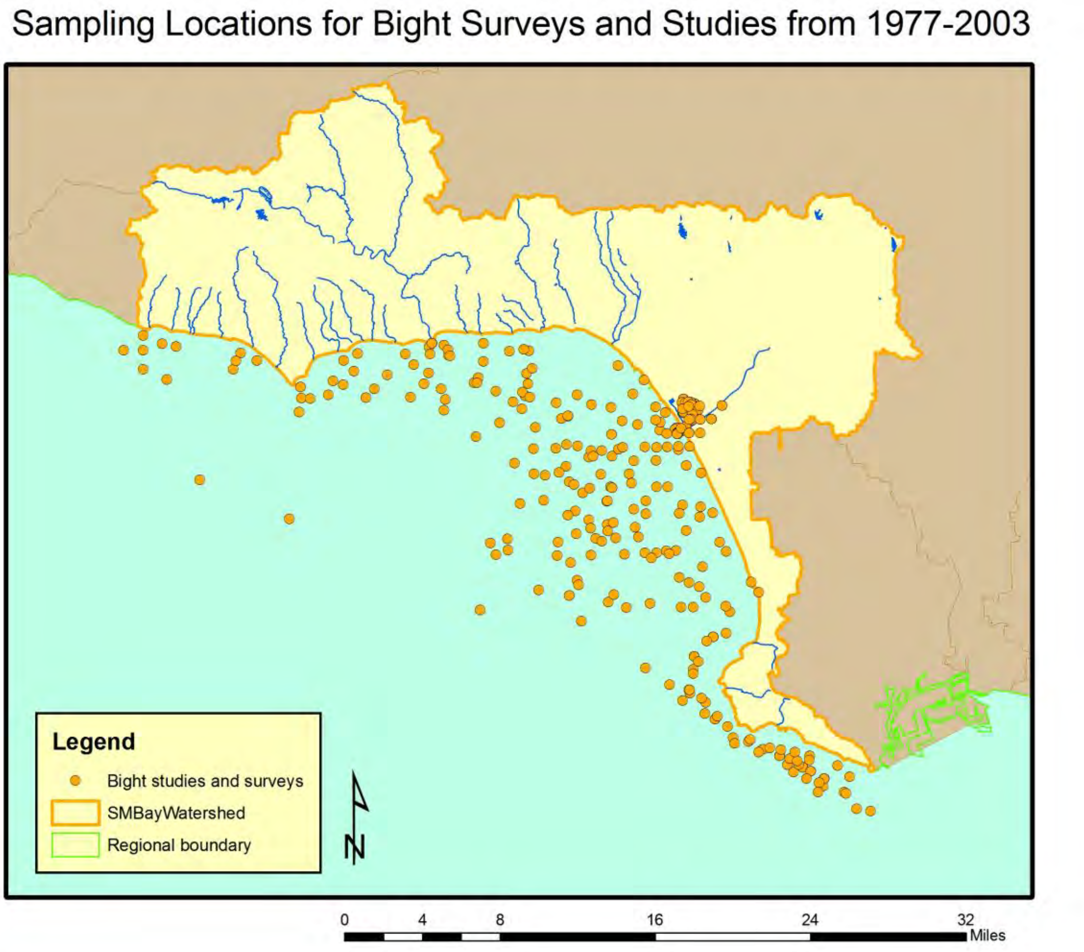
Southern California Bight-wide Monitoring (and Related Coordinated Monitoring) – multiple partners

A massive amount of data has been collected in the Southern California Bight and its adjacent coastal water bodies through large-scale monitoring programs which began in 1977 with a Bight-wide reference survey, coordinated by SCCWRP, which included sampling sediment chemistry and fish abundance and was followed by multiple additional surveys and studies which added to the large dataset of chemistry and biology. The 1977 survey was followed by more limited reference surveys in 1985 and 1990. In 1994, the Southern California Bight Pilot Project was undertaken. Additional biological and chemical measures were added with the Pilot Project and coordination of ocean monitoring required of major NPDES dischargers occurred in order to maximize use of resources among all the agencies already conducting monitoring. Bight-wide monitoring conducted in such a fashion became a regular occurrence beginning in 1998 and has followed every five years since. In 2003, additional focus was put on harbors while in 2008 estuaries were given additional attention. The effort continues to be led by SCCWRP in coordination with the other funding agencies and interested stakeholders. Datasets from these surveys and Bight projects are available for download from the SCCWRP website at http://www.sccwrp.org.

Much of the sediment data collected through the survey and Bight monitoring programs were subsequently collected and combined into a single Microsoft Access database along with sediment data from various special studies of Santa Monica Bay and the Palos Verdes Shelf. The consolidated sediment database can also be downloaded off the SCCWRP website.

The figure below shows the sampling locations from 1977-2003 associated with the many surveys and studies conducted in the Bight and its adjacent harbors with a sediment component.

Figure 22



The southern California Stormwater Monitoring Coalition (SMC) is also conducting large-scale, coordinated monitoring. The SMC was formed in 2000 by the Phase I municipal stormwater NPDES lead permittees and the NPDES regulatory agencies in southern California. Their research agenda, published in 2001, consisted of fifteen projects focusing on three major areas: 1) developing a regional monitoring infrastructure; 2) understanding stormwater runoff mechanisms and processes; and 3) assessing receiving water impacts. As an example, the SMC developed a regional coordinated freshwater stream bioassessment monitoring program which began in 2009. The invertebrates which are collected during bioassessment sampling integrate the effects of multiple stressors, including chemical pollutants and physical alterations in receiving waters and thus are of great use in assessment impacts to sensitive beneficial uses. This work has been closely coordinated with bioassessments being conducted in southern California by the state's Surface Water Ambient Monitoring Program (SMC website).

Summary/Conclusions

The years since the first edition report was published in 1997 have seen incredible changes in the ability to share information. Virtually no reference materials were available electronically at that time and data were maintained in completely separate locations, often in very different formats. Maps were often hand-drawn or copied from USGS quad sheets. Digitized geographic information was relatively rare and the programming to utilize such information required considerable training. The ability to access the Internet was in its infancy and the use of Email was just beginning. Although there is an enormous amount of electronic information available today, much remains in paper form that is of considerable value. This report focuses almost exclusively on electronically-available information. Considering the great interest by the public and elected officials that continues in Santa Monica Bay and its adjacent land areas, there was no shortage of useful, readily available electronic information.

These reference materials speak to a concerted and quite collaborative effort to repair the damaged resources of the WMA. While much voluntary work is occurring at a neighborhood/citizen group scale, agency-driven actions, often regulatory in nature, are setting the stage for most of the work through mandated results with strict timelines and requirements. The references also highlight the increasing contributions of stormwater and urban runoff, relative to more traditional point sources, to impairments of beneficial uses. It is clear urbanized areas produce more pollutants than areas that are mostly open space. It is also clear that runoff from large areas of impervious surfaces are detrimental to aquatic life.

Increasingly, agencies are turning to integrated approaches to resolve seemingly disparate problems such as lack of open space, degraded wetlands and riparian habitats, impaired water quality, contaminated sediments and marine life, and flooding. These integrated approaches often promote increased open space through policies such as low impact development, which in turn, reduce impervious surfaces, increase infiltration, reduce flooding, improve the water quality of runoff, and put less stress on the riparian areas and wetlands that remain. The Regional Board encourages these types of integrated water resources approaches to addressing the water quality issues in the Santa Monica Bay WMA. Targeted use of structural and non-structural BMPs along with public education and outreach in the short-term also continues to be an important part of the overall solution.

The ability to access data (as opposed to "information") electronically continues to be a problem. While the Water Boards are moving toward use of "regional data centers" with the assistance of the California Water Quality Monitoring Council (see http://www.waterboards.ca.gov/water_issues/programs/monitoring_council/index.shtml), in the meantime, obtaining raw data (particularly, historic data) is a sometimes tortuous process. Virtually every entity that conducts monitoring or special studies stores their data electronically yet formats are quite different and are at times completely incompatible. This will no doubt continue to be a problem until regional data centers are in full operation.

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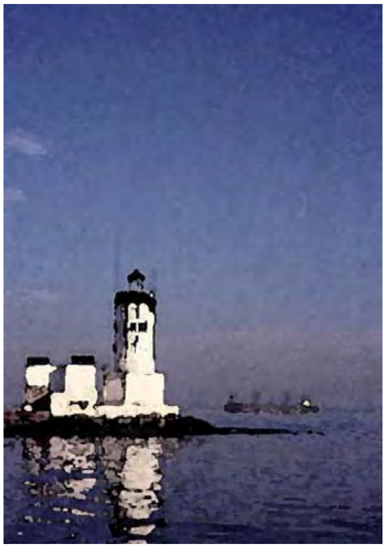
STATE OF THE WATERSHED – Report on Surface Water and Sediment Quality

The Dominguez Channel and Los Angeles/ Long Beach Harbors Watershed Management Area



October 2008

California Regional Water Quality Control Board – Los Angeles Region
Shirley Birosik, Watershed Coordinator

PREFACE

This report is a descriptive document and no policy or regulation is either expressed or intended. It is one in a series written by the Regional Board's watershed coordinator which summarizes and characterizes surface water or sediment quality data for the Region's watersheds. The Regional Board is often asked very basic questions about water quality and in many instances State of Watershed reports answer these questions. The reports are also helpful in showing how effectively or ineffectively we are all collectively doing monitoring and sharing data by going through the process of acquiring and merging data from different sources and making these data accessible.

In an highly industrialized area where sediment deposition occurs on an ongoing basis and water circulation may be limited, the ability for unlined channel and harbor waters to support biota is as dependent (or often more dependent) on sediment quality as it is on surface water quality. Sediment concentrations of pollutants are also less variable than water column concentrations. And, much of the previously hard-to-obtain sediment data are now in a consolidated database or otherwise available via the Internet. Thus, this document puts great emphasis on evaluating sediment data and less attention is given to evaluating water column information except for general water quality trends. Additionally, various reports, including the Dominguez Watershed Management Master Plan, have provided a comprehensive summary of water column information within the watershed. And, while there are certainly interactions between groundwater and surface water in the WMA, with groundwater contamination a possible contributor to some surface water or sediment impairments, this report is focused on evaluating surface conditions.

There is some discussion of the watershed's biological resources due to their widespread occurrence and since there are many aquatic life-related beneficial uses sensitive to water and sediment quality problems; however, this report is not meant to be a complete documentation of these resources.

Prior to release of the public draft, in-house comments were provided by Regional Board staff. An announcement of the public draft report's availability for review and comment was made to the Email list for the Dominguez Watershed Advisory Council. Comments were received from the cities of Carson and Los Angeles, the Ports of Long Beach and Los Angeles, and a consultant to the ports, Weston Solutions, Inc.

October 2008

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California Regional Water Quality Control Board, Los Angeles Region

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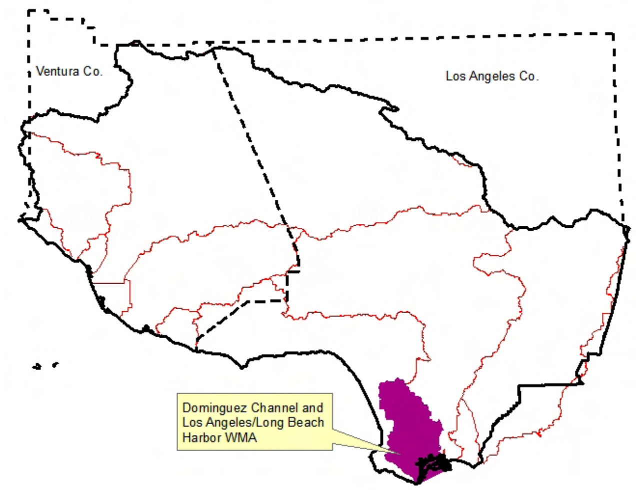


The Dominguez Channel and Los Angeles/Long Beach Harbors Watershed Management Area (Dominguez WMA) is located in the southern portion of the Los Angeles Basin. Along the northern portion of San Pedro Bay is a natural embayment formed by a westerly extension of the coastline which contains both harbors, with the Palos Verdes Hills the dominant onshore feature. Historically, the area consisted of marshes and mudflats. Near the end of the19th century and during the beginning of the next century, channels were dredged, marshes were filled, wharves were constructed, the Los Angeles River was diverted, and a breakwater was constructed in order to allow deep draft ships to be directly offloaded and products be swiftly moved. Eventually, the greater San Pedro Bay was enclosed by two more breakwaters and deep entrance channels were dredged to allow for entry of ships with need of 70 feet of clearance. The Los Angeles/Long Beach (LA/LB) Harbor complex is now one of the largest ports in the country (CRWQCB, 2007b).

Permitted discharges:

- Eight major NPDES discharges: one POTW, two generating stations, and five refineries; 38 minor NPDES discharges; 54 discharges covered by general NPDES permits
- 440 dischargers covered under an industrial storm water permit
- 214 dischargers covered under the construction storm water permit

Despite its industrial nature, contaminant sources, and low flushing ability, the inner harbor area supports fairly diverse fish and benthic populations and provides a protected nursery area for juvenile fish. The California least tern, an endangered species, nests in one part of the harbor complex. The outer part of both harbors (the greater San Pedro Bay within the breakwaters) has been less disrupted and supports a great diversity of marine life and a large population of fish. It is also open to the ocean at its eastern end and receives much greater flushing than the inner harbors. Small freshwater wetlands continue to persist elsewhere in the WMA, as well (CRWQCB, 2007b).

Various parts of the WMA are currently 303(d)-listed (2006 list) as impaired for metals, PCBs, PAHs, historic pesticides, coliform, trash, and nitrogen (CRWQCB, 2007b).

Potential sources of pollution:

- Historical deposits of DDT and PCBs in sediment
- Discharges from POTW & refineries
- Spills from ships and industrial facilities
- Leaching of contaminated groundwater
- Stormwater runoff

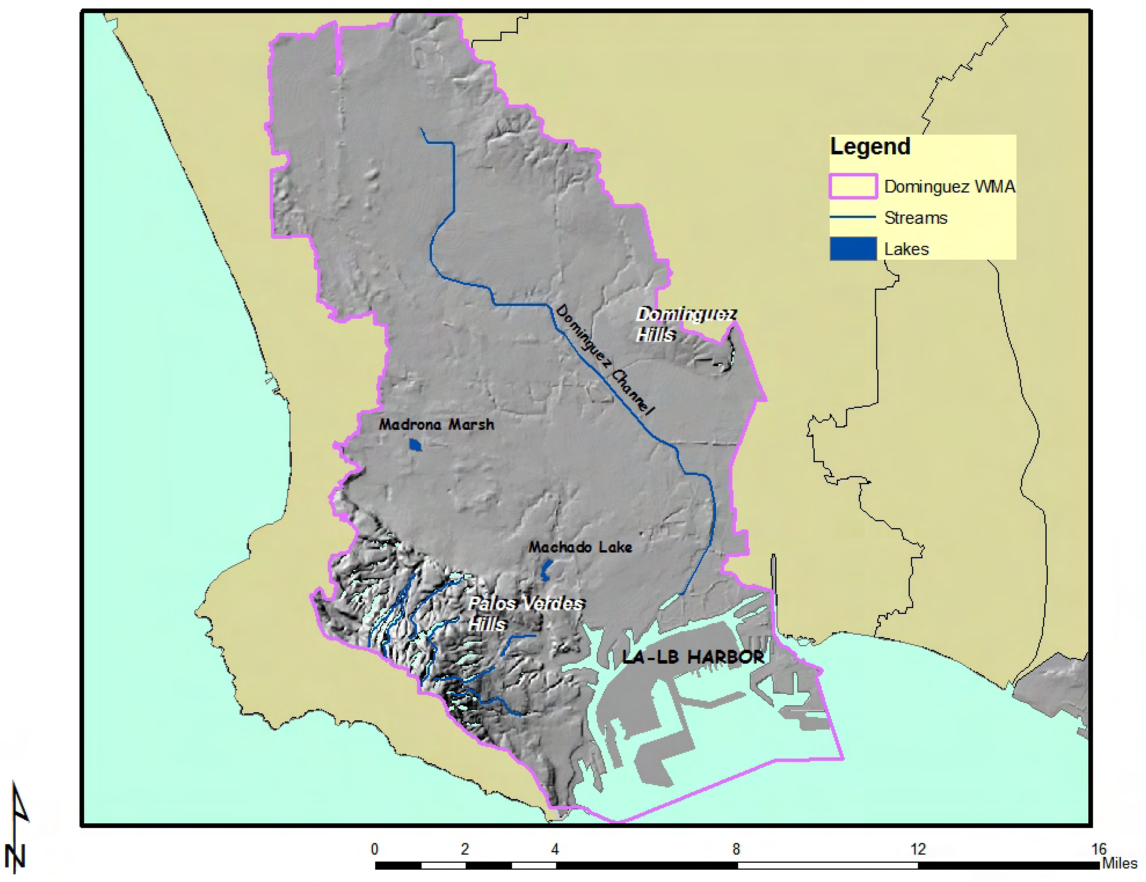
STATE OF THE WATERSHED

Physical Description of Watershed

The Dominguez WMA is located in the southern portion of the Los Angeles Basin. A natural embayment occurs along the northern portion of San Pedro Bay, formed by a westerly extension of the coastline which contains LA/LB Harbors; the Palos Verdes Hills is the dominant onshore feature as can be seen below. Unlike more "traditional" watersheds containing a river flowing toward the ocean and draining upland and mountainous areas to the ridgeline, the watershed has a generally low gradient. Its boundaries are not visually apparent in many locations and are defined by the directions that underground storm drains flow.

Figure 1

Topographic Features of the Dominguez WMA



Los Angeles Harbor is 7,500 acres in size while Long Beach Harbor is 7,600 acres; together they have an open water area of approximately 8,128 acres. The 15 miles-long Dominguez Channel drains a densely urbanized area to inner Los Angeles Harbor (LACDPW, 2004).

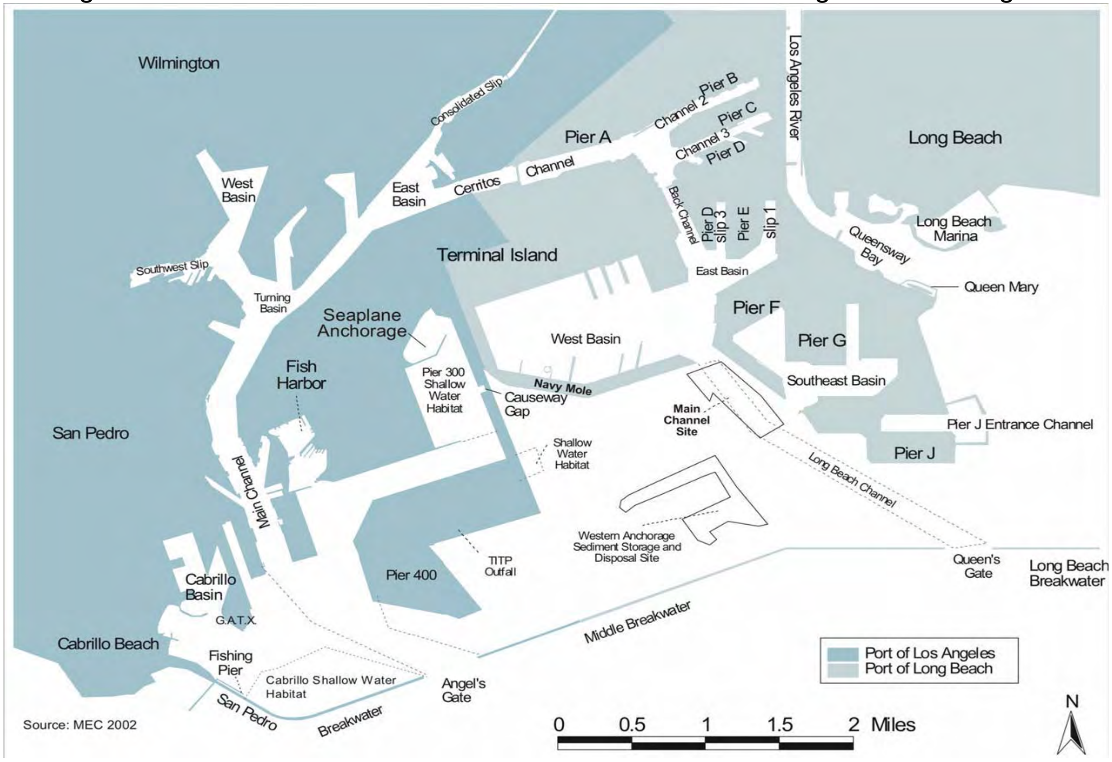
Historically, the area consisted of marshes and mudflats with large marshy areas, including Dominguez and Bixby Sloughs, to the north. Flow from the Los Angeles River drained to different locations over the years, including to Santa Monica Bay, but for a time it entered where Dominguez Channel now drains. The map below from 1903 depicts the extensive wetlands that were in the area (LACDPW, 2004 [labels added]).

Figure 2. Map of the Dominguez WMA from 1903

Near the end of the19th century and during the beginning of the next century, channels were dredged, marshes were filled, wharves were constructed, the Los Angeles River was diverted, and breakwaters were constructed in order to allow deep draft ships to be directly offloaded at docks and products be swiftly moved. The Dominguez Slough was completely channelized and became the drainage endpoint for runoff from a highly industrialized area. Eventually, the greater San Pedro Bay was enclosed by two more breakwaters and deep entrance channels were dredged to allow for entry of ships with need of 70 feet of clearance. The LA/LB Harbor complex together is now one of the largest ports in the country (CRWQCB, 2007b).

The following figure shows the various features of the area in and around the ports (LACDPW, 2004).

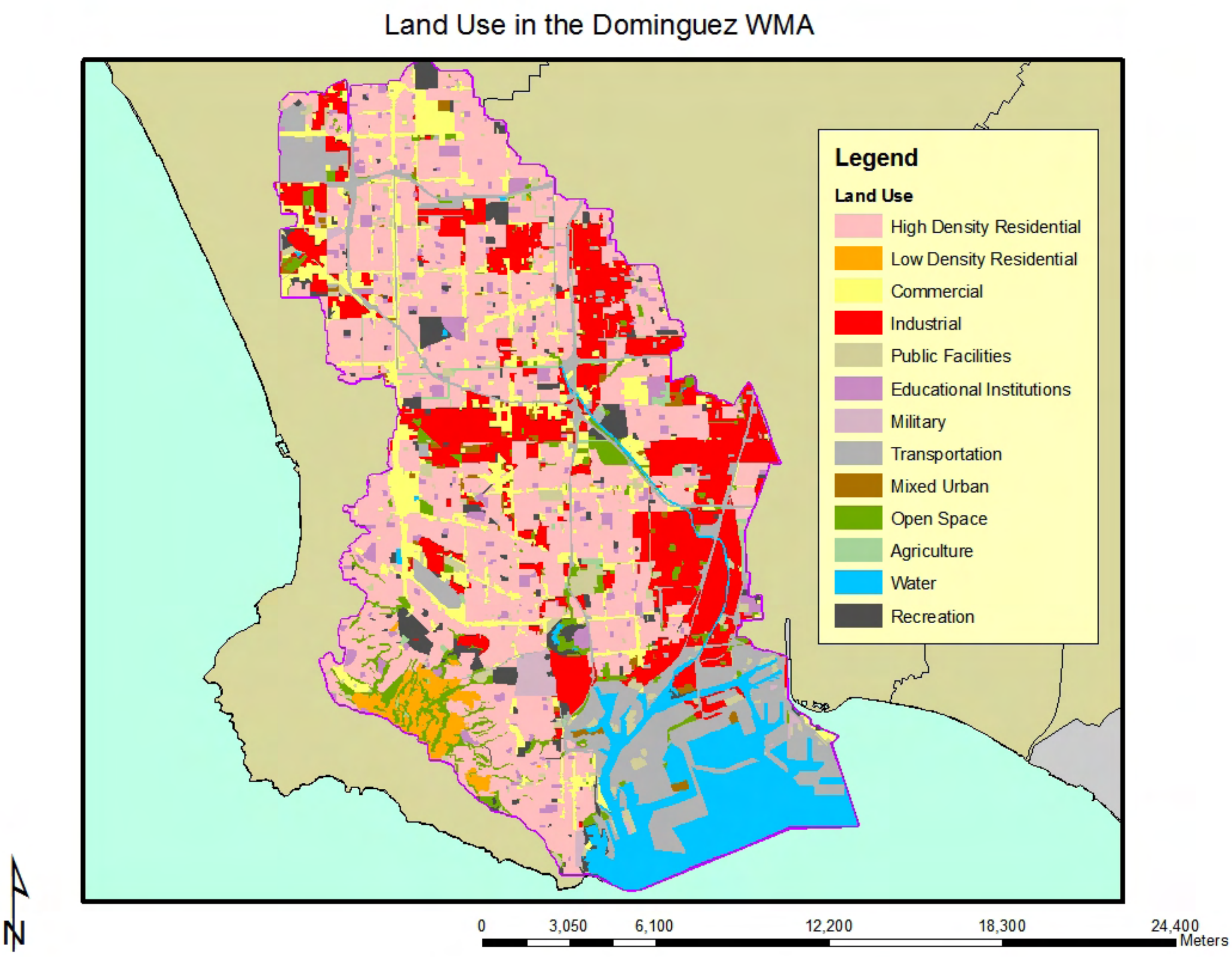
Figure 3. Features of the Area Around the Ports of Los Angeles and Long Beach



Source: MEC 2002

The highly industrialized nature (and resultant large amount of impervious surface) of the Dominguez WMA can be seen in the figure below based on Southern California Association of Governments 2005 GIS layers.

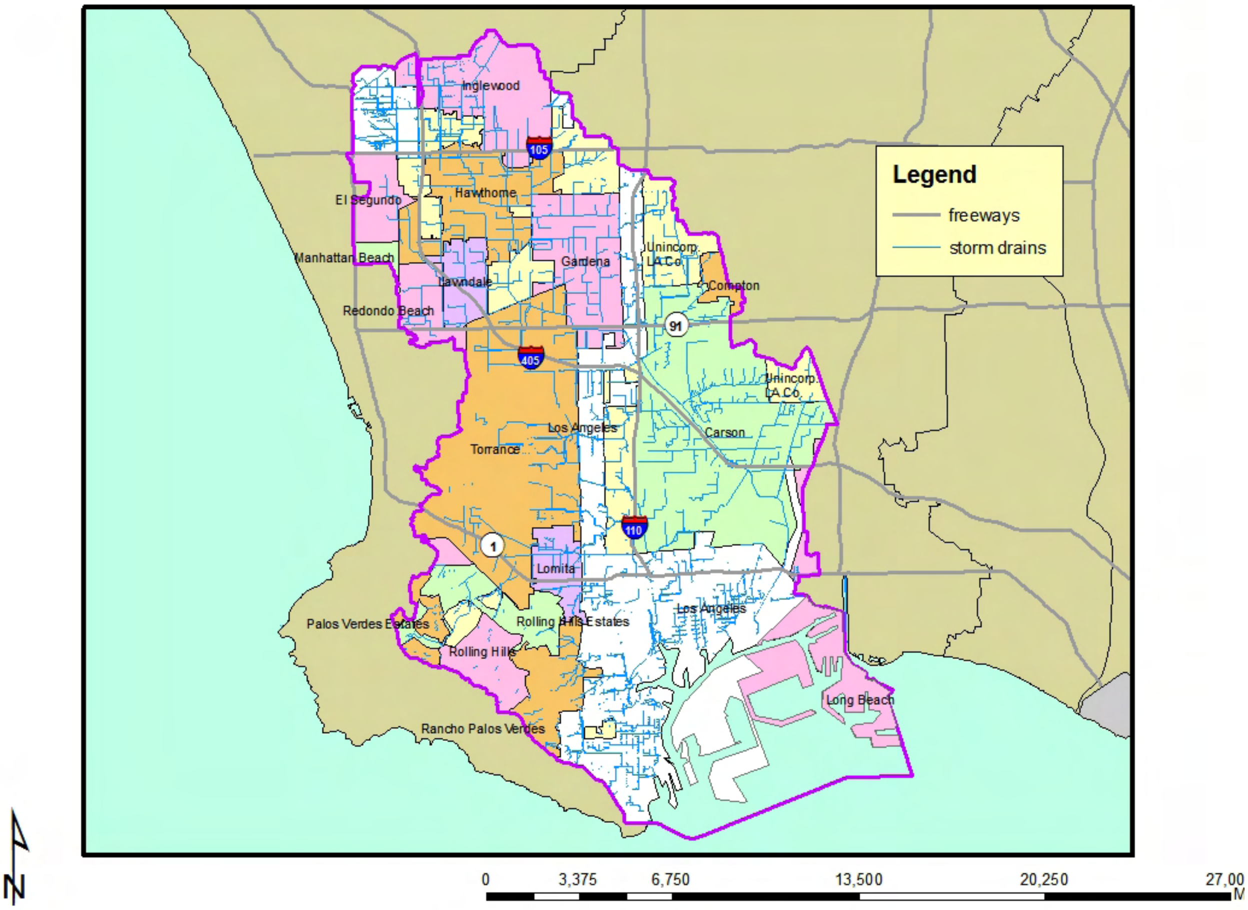
Figure 4



Other urban features of the WMA can be seen in the figure below.

Figure 5

Urban Features of the Dominguez WMA



Major Historical Events in Watershed

- 1542 – San Pedro Bay is discovered by Juan Rodriguez Cabrillo (Port of Los Angeles website)
- 1869 - Los Angeles and San Pedro Railroad begins service between San Pedro Bay and City of Los Angeles (Port of Los Angeles website)
- 1871 - Main Channel dredged to -10 feet; breakwater built between Rattlesnake Island (now Terminal Island) and Deadman's Island (formerly located near Terminal Island) (Port of Los Angeles website)
- 1899 – Construction of the San Pedro breakwater begins (Port of Long Beach website)
- 1901 – Brighton Beach, on the southern end of the former Rattlesnake Island, becomes fashionable resort (LA Times, 7/20/1992)
- 1907 – Port of Los Angeles officially founded with creation of Los Angeles Board of Harbor Commissioners (Port of Los Angeles website)
- 1909 – The towns of Wilmington and San Pedro become part of the City of Los Angeles (Port of Los Angeles website)
- 1911 – Port of Long Beach officially founded (Port of Long Beach website)

- 1911–1912 - First 8500-foot section of the San Pedro breakwater completed; Main Channel widened to 800 feet and dredged to -30 feet; Southern Pacific Railroad completed its first major wharf in San Pedro (Port of Los Angeles website)
- 1916 – Brighton Beach resort closes down as major dredging begins (LA Times, 7/20/1992)
- 1916 – Dredging of channels and a turning basin completed (Port of Long Beach website)
- 1917 - Todd Shipyard began operation (as Los Angeles Shipbuilding & Dry Dock Corporation) (LA Times, 7/8/1989)
- 1917 – First Port of Long Beach Board of Harbor Commissioners formed (Port of Long Beach website)
- 1926 – Long Beach attains deepwater port status (Port of Long Beach website)
- 1932 – Construction begins on the middle breakwater (Port of Long Beach website)
- 1936 – Oil is discovered in the harbor (Port of Long Beach website)
- 1937 - Construction of the 18,500-foot-long extension of the middle breakwater completed (Port of Los Angeles website)
- 1940 – A U.S. naval station is established on Terminal Island (Port of Long Beach website)
- World War II - Shipbuilding becomes the Port's prime economic activity with shipyards collectively employing more than 90,000 workers (Port of Los Angeles website)
- 1949 – Construction completed on Long Beach breakwater (Port of Long Beach website)
- 1959 – Beginning of containerized shipping (Port of Los Angeles website)
- 1962 – Beginning of containerized shipping (Port of Long Beach website)
- 1963 – Vincent Thomas Bridge opens to traffic (Port of Los Angeles website)
- 1965 – Construction of Piers F and J completed (Port of Long Beach website)
- 1983 – Dredging of Main Channel to -45 feet completed (Port of Los Angeles website)
- 1989 - Todd Shipyard ceases operation (LA Times, 7/8/1989)
- 1993 – Pier J expansion completed (Port of Long Beach website)
- 1997 - The Terminal Island Container Transfer Facility is completed, allowing for the direct transfer of containers to and from ships and railcars (Port of Los Angeles website)
- 2000 – Completion of dredging and landfills for Pier 400 (Port of Los Angeles website)
- 2002 – Alameda Corridor opens; the 20-mile rail expressway directly connects the Port to downtown Los Angeles (Port of Los Angeles website)

Biological Setting

Despite its industrial nature, contaminant sources, and low flushing ability, the inner harbor area supports fairly diverse fish and benthic populations and provides a protected nursery area for juvenile fish. The California least tern, an endangered species, nests in one part of the harbor complex. The outer part of both harbors (the greater San Pedro Bay within the breakwaters) has been less disrupted and supports a great diversity of marine life and a large population of fish. It is also open to the ocean at its eastern end and receives much greater flushing than the inner harbors (CRWQCB, 2007b).

The Ports contracted with a consultant team to conduct a biological baseline study in 2000 which was the first study of its kind since the 1970s (the Ports have plans to repeat the biological studies in 2008). A number of surveys were conducted including those quantifying the benthic community; larval, juvenile, and adult fish populations; bird use patterns; and biological communities attached to rocky riprap habitats; as well as, mapping of kelp and eelgrass distributions. Collectively, the fish population of both inner and outer harbors was estimated at 44 million in 2000 which makes a large portion of this WMA a valuable marine resource. A total of 74 species of fish were collected in the harbors in the 2000 study. Pelagic schooling fish ranged in high abundances throughout the harbor complex, while demersal fish were more common in the deepwater habitats of the outer and middle harbor areas. The shallow waters of the harbors provide an important nursery habitat for a variety of species including California halibut and queenfish. The most abundant species in the harbor included northern anchovy, white croaker, queenfish, topsmelt, Pacific sardine, salema, white surfperch, and shiner surfperch. Other relatively abundant commercially and recreationally important species included California halibut, barred sand bass, and California corbina (POLB and POLA, 2002).

Over 400 species of benthic infauna and larger macroinvertebrates were reported in Long Beach and Los Angeles Harbors in 2000. Over the past half century a steady improvement in benthic habitat quality of the harbors has been demonstrated by increased diversity and less dominance by pollution-tolerant benthic infauna species. The harbor areas exhibiting the highest quality for benthic communities are in the created shallow water habitats and in the deep open waters of both harbors. While much improvement has occurred in the harbors, polluted and “semi-healthy” areas still exist. The Consolidated Slip of Los Angeles Harbor remains the most polluted while “semi-healthy” areas exist in Cerritos Channel of the inner harbor, and in confined basins and slips in both harbors. The spatial extent of these poorer habitat areas are not as widespread today as they were in the 1950s (POLB and POLA, 2002).

A total of 265 species of invertebrates and algae was identified within the riprap community and spatial patterns were similar to those found during the 1980s. More species occurred on riprap in the outer than inner harbor areas (POLB and POLA, 2002).

A total of 99 species of birds, representing 31 families, were observed within the Ports during the 2000-2001 monitoring year for the 2000 baseline study. Of those, 69 species are considered to be dependent on marine habitats. The most abundant birds were western gulls. Diving birds that feed on fish were second in abundance and were dominated by elegant terns and brown pelicans. The third most abundant bird guild was waterfowl, represented largely by western grebe, Brant's cormorant, and surf scoter. Upland birds, dominated by large numbers of rock doves roosting under docks and pilings, were the next most dominant followed by small shorebirds, large shorebirds, and wading/marshbirds. Survey zones along the breakwaters supported the highest densities of birds. Several sensitive species were observed including the California brown pelican, total observations of which had increased substantially from studies during 1973-1974, and peregrine falcons, several pairs of which are known to nest within the Ports and vicinity. California least terns also nest in the Port of Los Angeles. There were over 500 nesting pairs in 2000, which was substantially higher than the approximately 100 nesting pairs during the 1986-1987 study. Other sensitive species nesting within the Port of Los Angeles and observed in high numbers during the 2000 summer surveys were caspian tern, elegant tern, and black skimmer. Other sensitive species observed during surveys included black-crowned night herons, black oystercatcher, burrowing owl, and loggerhead shrike (POLB and POLA, 2002).

The 2000 study found that kelp and macroalgal communities are for the most part restricted to the shallow hard bottom environments associated with riprap shorelines, breakwaters, and pier structures, as well as harbor debris. The true kelp communities were restricted to the outermost portions of the harbor where giant kelp forms a principal component of the assemblages. There is a general trend of lessening algal diversity from the outermost portions of the Ports to the innermost channel environments. Giant kelp communities within harbors totaled about 25 acres in the spring of 2000 and declined to about 14 acres in the fall of 2000. Giant kelp was established within the Ports as transplants to the San Pedro Breakwater in 1977 and distribution of kelp has expanded within outer Los Angeles Harbor since that time. During the 2000 study, giant kelp also was found along the Middle Breakwater, on a submerged dike at the Cabrillo Shallow Water Habitat, on riprap edges of Pier 400, at other localized riprap shorelines, and on cobbles offshore Cabrillo Beach (POLB and POLA, 2002).

Eelgrass habitat occurs in shallow waters offshore Cabrillo Beach and within the Pier 300 Shallow Water Habitat in Los Angeles Harbor. The beds vary seasonally in overall area; beds within the Port of Los Angeles ranged from approximately 50 acres in the spring of 2000 to approximately 100 acres at their peak in the fall (POLB and POLA, 2002).

Dominguez Channel drains into Consolidated Slip within Los Angeles Inner Harbor. Most of the WMA's runoff to the harbors enters through the Channel which is approximately 15 miles long and is fed by several tributary channels, most notably the Torrance Lateral, Del Amo Lateral, Victoria Creek, and 132nd and 135th Street Drains. Dominguez Channel is concrete-lined from its origin in Hawthorne to approximately Vermont Street in the City of Gardena. Few biological resources occur within the upper Dominguez Channel or its tributary channels, which are concrete-lined. From Vermont Street downstream to Los Angeles Harbor, Dominguez Channel has a soft-bottom with riprap banks, and is tidally-influenced; however, during the highest high tides in Dominguez Channel, the upper limit of tidal influence extends to near Artesia Street (within the concrete-lined portion). In Torrance Lateral, the highest high tides can extend upstream about 0.75 miles (Port of LA comment letter, 8/29/08). Mussels grow on bridge pilings and fish are seen in the channel. The channel banks are mostly unvegetated. A total of 43 species of birds were observed by private citizens during lunch breaks at the park and ride near Vermont and Artesia Boulevard during 2001 and 2002. The most abundant species included western grebe, double-crested cormorant, snowy egret, mallard, cinnamon teal, American coot, black-necked stilt, least sandpiper, western sandpiper, western gull, ring-billed gull, and European starling (LACDPW, 2004).

Other habitat areas within the harbor include the Cabrillo Salt Marsh and the 22nd Street Wetland. The Cabrillo Salt Marsh (3 acres) was created in the late 1980s and consists of lagoon and salt marsh habitats. Topsmelt and goby fish occur in the lagoon. The 22nd Street Wetland is supported by water seepage from an underground source. Red-winged blackbirds and other birds use the site, and mosquitofish have been observed within waters at the site (LACDPW, 2004).

Canyons on the Palos Verdes Peninsula, interspersed among low-density residential lots, provide wildlife habitat and riparian areas. The canyons are mostly privately-owned canyons and include Dodson, Colt, and Miraleste Canyons on the east facing slopes, and Sepulveda, Agua Manga, Chadwick and George F. Canyons on the north facing slopes of the peninsula. These canyons support relatively undisturbed coastal sage scrub, chaparral, and riparian communities in which numerous wildlife species occur. Several sensitive species of birds, reptiles, and mammals exist, or have the potential to exist, in these areas (LACDPW, 2004).

Wetlands persist in the Ken Malloy Harbor Regional Park area (Machado Lake Wetlands and the unlined portion of Wilmington Drain), in Gardena (Telco Wetlands and Gardena Willows), in Carson (Albertoni Farms Wetlands), and in Torrance (Madrona Marsh) (LACDPW, 2004).

Harbor Regional Park, located in Wilmington and Harbor City, is operated by the City of Los Angeles Department of Recreation and Parks. The park is 231 acres in size, and contains a large perennial freshwater lake (Machado Lake) with extensive freshwater marsh habitats. Willow woodland and scrub habitat borders much of the east side of the lake. Approximately, 200 species of birds occur at the park annually. The California least tern, a federal- and state-listed endangered bird, uses the park for foraging, and the endangered Least Bell's vireo was present there in. Many raptor species have been observed in the area including the osprey, white-tailed kite and Cooper's hawk. Only exotic fish species live in the lake including carp, goldfish, green sunfish, bluegill, large-mouthed bass, channel catfish, black bullhead and mosquitofish (LACDPW, 2004).

Wilmington Drain discharges into Machado Lake from the north; the channel is concrete-lined from its origin south of Sepulveda Boulevard (between Normandie and Vermont Avenues) to where it crosses under the Harbor Freeway north of Lomita Boulevard. South of this point it changes to a soft bottom with natural side banks to where it empties into Machado Lake. Habitat in this part of the drain includes mature riparian woodland, riparian scrub, freshwater marsh, and weedy vegetation. The biological value of the habitat is not considered great due to the lack of adjacent natural open space; however, the area is well-utilized by birds (LACDPW, 2004).

The Gardena Willow Wetlands is approximately nine acres in size and contains water much of the year; it is characterized by dense stands of large willows. A number of bird species utilize the wetlands which is surrounded by a highly urbanized area. The Telco Wetlands is partially supported by drainage from the Gardena Willows Wetlands as well as water from a second drainage; it drains to Dominguez Channel. Habitat is rather limited but includes some willows and sycamores. Albertoni Farms Wetlands is along a drainage which runs through a mobile home park. The wetlands are heavily infested with nonnative vegetation but may support some use by native wildlife (LACDPW, 2004).

Madrona Marsh is a vernal freshwater marsh preserve located in the City of Torrance which encompasses approximately 43.5 acres. It includes willow riparian habitats, vernal marsh and pool habitats, and upland areas. Over 90 species of plants, 232 species of birds, 58 taxa of aquatic insects, and 30 species of butterflies have been reported there (LACDPW, 2004).

Watershed Stakeholders

The Dominguez Watershed Advisory Council was formed in February 2001 and met on a monthly basis for three years to conduct a variety of tasks including development of a Watershed Management Master Plan (funded by Proposition 13) aimed at protecting and improving the environment and beneficial uses of the watershed. The watershed plan was finalized and a list of potential implementation projects/programs was included in the Plan. Meetings are now held less frequently. The group's website is at http://ladpw.org/wmd/watershed/dc/ where a copy of the Watershed Plan may be downloaded. The Council consists of a diverse group of stakeholders including municipalities, refineries, environmental groups, and neighborhood representatives.

The WMA's Designated Beneficial Uses

The Regional Board designates beneficial uses of all waterbodies in the Water Quality Control Plan for the Ventura and Los Angeles Coastal Watersheds (usually referred to as Basin Plan). These beneficial uses are the cornerstone of the State and Regional Board's efforts to protect water quality, as water quality objectives are set at levels that will protect the most sensitive beneficial use of a waterbody. Together, beneficial uses and water quality objectives form water quality standards (CRWQCB, 1994).

Fourteen beneficial uses for waters in the Dominguez WMA are designated in the Regional Board's Basin Plan. These beneficial uses are listed by waterbody and hydrologic unit in the table below. Certain site specific water quality objectives, namely TDS, sulfate, chloride, boron, and--for surface waters--nitrogen, reflect background levels of constituents in the mid-1970s, in accordance with the State Board's Antidegradation Policy. Water quality objectives for these and for other constituents and parameters can be found in the Basin Plan (CRWQCB, 1994).

Table 1. Beneficial Uses of waters within the Dominguez WMA (CRWQCB, 1994)

Watershed[a]	**Hydro Unit #**	**MUN**	**IND**	**PROC**	**AGR**	**GWR**	**FRSH**	**NAV**	**POW**	**REC1**	**REC2**	**COMM**	**AQUA**
DOMINGUEZ CHANNEL WATERSHED													
Dominguez Channel to Estuary	405.12	P*								Ps	E		
Dominguez Channel Estuary [w]	405.12							P		Es	E	E	
Los Angeles – Long Beach Harbor													
Outer Harbor	405.12							E		E	E	E	
Marinas	405.12		E					E		E	E	E	
Public Beach Areas	405.12							E		E	E	E	
All Other Inner Areas	405.12		E					E		P	E	E	

Watershed[a]	**Hydro Unit #**	**WARM**	**COLD**	**SAL**	**EST**	**MAR**	**WILD**	**BIOL**	**RARE**	**MIGR**	**SPWN**	**SHELL**	**WET[b]**
DOMINGUEZ CHANNEL WATERSHED													
Dominguez Channel to Estuary	405.12	P					P		E				
Dominguez Channel Estuary [w]	405.12				E	E	E		Ee	Ef	Ef		
Los Angeles – Long Beach Harbor													
Outer Harbor	405.12					E			E			P	
Marinas	405.12					E			E			P	
Public Beach Areas	405.12					E	E		E		P	E	
All Other Inner Areas	405.12					E			Ee			P	

E: Existing beneficial use
I: Intermittent beneficial use
P: Potential beneficial use
E, P, and I shall be protected as required.
*: Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemption at a later date (See pages 2-3, 4 of Basin Plan for more details).

(a) Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial designations apply to all tributaries to the indicated waterbody, if not listed separately.
(b) Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory section would require a detailed analysis of the area.
(e) One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting.
(f) Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs.
(s) Access prohibited by Los Angeles County Department of Public Works.
(w) These areas are engineered channels. All reference to Tidal Prisms in Regional Board documents are functionally equivalent to estuaries.

Beneficial Use Definitions

Beneficial uses in the Regional Board's Basin Plan are defined below. The uses are listed in no preferential order.

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH)
Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW)
Uses of water for hydropower generation.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA)
Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Inland Saline Water Habitat (SAL)
Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as **Areas of Special Biological Significance (ASBS),** established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

Discharges into the Watershed

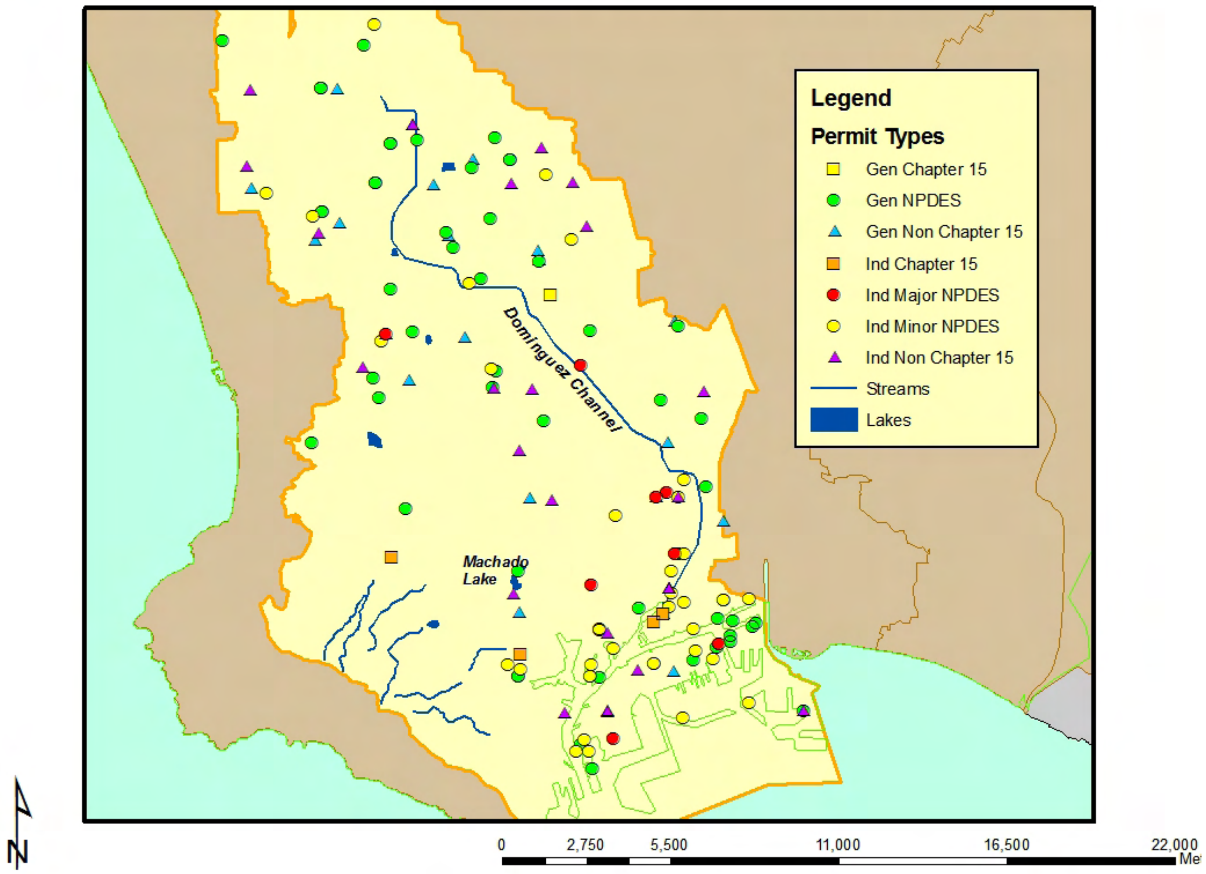
A Publicly-Owned Treatment Works (POTW), the City of Los Angeles' Terminal Island Treatment Plant, discharges tertiary-treated effluent to the outer LA/LB Harbor and is under a time schedule order to remove the discharge. The discharger's plan consists of achieving full reclamation (mostly for industrial reuse purposes) by 2020 which would eliminate the discharge completely. Two generating stations have permits to discharge to the inner harbor areas. Many smaller, non-process waste discharges to both Dominguez Channel and harbor waters also occur. Another POTW, the Joint Water Pollution Control Plant, is physically located in the watershed but discharges off of the Palos Verdes Peninsula to the Santa Monica Bay WMA (CRWQCB, 2007b).

There are eight major National Pollutant Discharge Elimination System (NPDES) discharges: the previously mentioned POTW, two generating stations, and five refineries (five Channel discharges, three Harbor discharges). In addition, there are 38 minor individual permits (15 Channel, 23 Harbor) and 54 discharges covered by general NPDES permits (32 Channel, 22 Harbor). About one-half of the 100 NPDES permitted facilities discharge to Dominguez Channel; the rest discharge to the LA/LB Harbor complex (CRWQCB, 2007b).

Major NPDES discharges are those from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity. The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure (CRWQCB, 2007b). A complete list of dischargers in the watershed may be obtained electronically from the author.

Figure 6

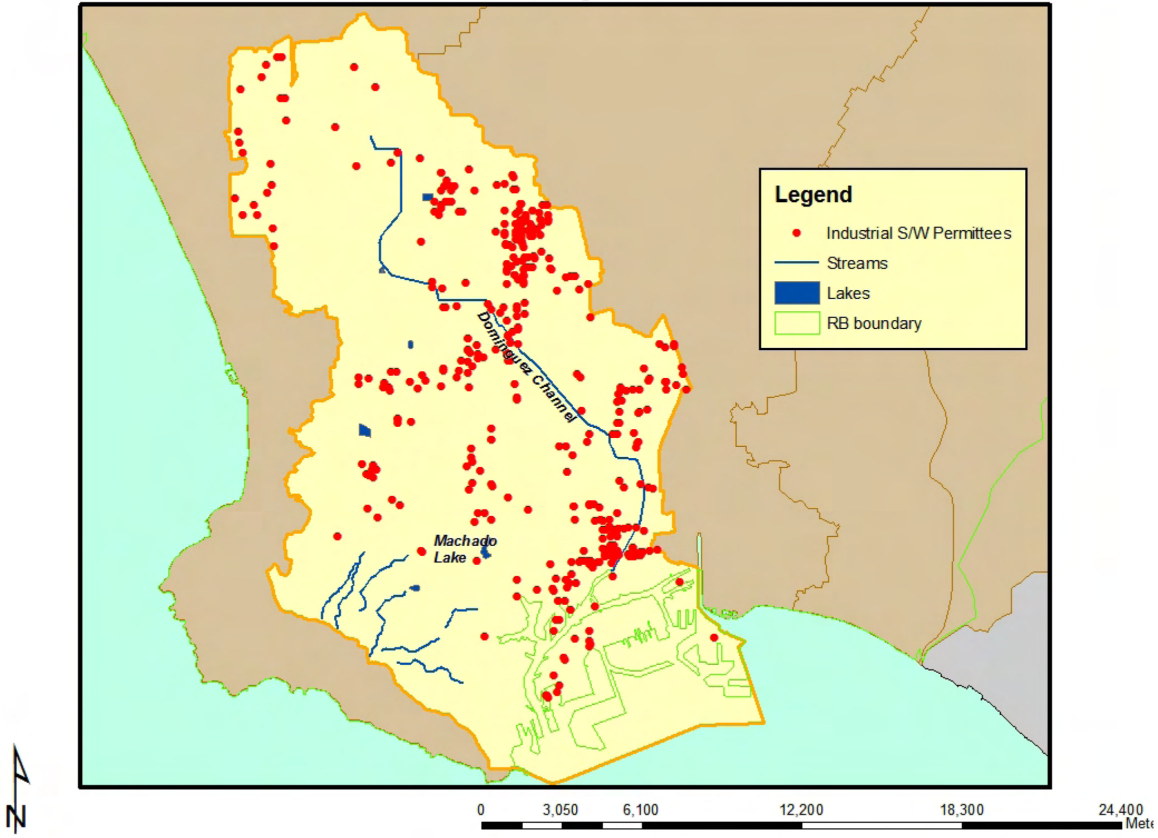
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Dominguez WMA



There are 214 sites enrolled under the general construction storm water permit (the number of enrollees varies from year to year). The sites are spread fairly evenly throughout the watershed and are a mix of residential, industrial, and commercial sites; about one-half of the sites are five acres or larger in size. The larger parcels of up to 500 acres in size are mostly located in the ports (CRWQCB, 2007b).

Of the 440 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Gardena, Wilmington, Torrance, and Carson, along Dominguez Channel. Wholesale trade-durable goods, fabricated metal products, trucking & warehousing, chemicals & allied products, transportation equipment, and rubber & miscellaneous plastics products are a large component of these businesses based on their Standard Industrial Classification (SIC) code. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure (CRWQCB, 2007b).

Figure 7
Locations of Dischargers Covered by General Industrial Stormwater Permit in the Dominguez WMA



Water/Sediment Quality Concerns and Impairments

There are a total of 96 pollutant/waterbody impairments in the WMA. The Los Angeles/Long Beach Inner Harbor is on the 2006Clean Water Act Section 303(d) list due to bacteria, impaired benthic community, sediment toxicity, DDT, copper, zinc, PAHs, and PCBs. In addition, two areas within Los Angeles Harbor are considered to be toxic hot spots under the Bay Protection and Toxic Cleanup Program (BPTCP): Dominguez Channel/Consolidated Slip, based on sediment concentrations of DDT, PCBs, cadmium, copper, lead, mercury, zinc, dieldrin, chlordane, sediment toxicity, and degraded benthic infaunal community; and Cabrillo Pier area, based on sediment concentrations of DDT, PCBs and copper, sediment toxicity and issuance of a human health (fishing) advisory for DDT and PCBs in white croaker and exceedances of National Academy of Science guidelines for DDT in fish and shellfish (CRWQCB, 2007b).

Also, several locations are listed as sites of concern under the BPTCP: Inner Fish Harbor, due to sediment concentrations of DDT, PCBs, copper, mercury and zinc and sediment toxicity (not recurrent); Kaiser International, due to sediment concentrations of DDT, PCBs, PAHs, copper and endosulfan; Hugo Neu-Proler, due to PCBs sediment concentrations; Southwest Slip, due to sediment concentrations of DDT, PCBs, PAHs, mercury, and chromium, and sediment toxicity; Cerritos Channel, due to sediment concentrations of DDT, PCBs, metal, chlordane, TBT, sediment toxicity and accumulation in mussel tissue; Long Beach Outer Harbor, due to sediment concentrations of DDT and chlordane and sediment toxicity; and West Basin, due to sediment concentrations of DDT and PCBs, sediment toxicity, and accumulation in clam tissue. Potential sources of these materials are considered to be historical deposition, discharges from the nearby POTW (especially for metals), spills from ships and industrial facilities, as well as stormwater runoff. Many areas of the harbors have experienced soil and/or groundwater contamination, which may result in possible transport of pollutants to the harbors' surface waters. Dredging and disposal, capping, and/or remediation of contaminated sediments and source control of pollutants in the harbors is a major focal point for the Contaminated Sediment Task Force described further elsewhere in this document (CRWQCB, 2007b).

The WMA is a highly industrialized area with numerous nonpoint sources of pollution for PAHs and also contains remnants of persistent legacy pesticides as well as PCBs which results in poor sediment quality both within the Dominguez Channel and in adjacent Inner Harbor areas, especially Consolidated Slip. The Channel was the recipient of runoff from the Montrose Chemical Facility which manufactured DDT for several decades until the early 1970s. Although highest in Dominguez Channel estuary and Consolidated Slip sediments, DDT is pervasive throughout the harbors. Metals, particularly copper and zinc, remain elevated at some locations in the sediments of the inner harbors. A likely major nonpoint source contributor to these concentrations is antifouling paint containing copper that leach from the many ships and boats in the harbors as well as the zinc anodes used on watercraft. Sediment toxicity occurs more frequently in parts of the Inner Harbor than elsewhere (CRWQCB, 2007b). Consolidated Slip, the part of Inner Harbor immediately downstream of Dominguez Channel, continues to exhibit a very impacted benthic invertebrate community (POLB and POLA, 2002).

Cal-EPA's Office of Environmental Health Hazard Assessment (OEHHA) advises against consumption of white croaker in the harbor and recommends no more than one meal every two weeks of black croaker, queenfish, and surfperches if caught in the harbor (CRWQCB, 2007b.

The table below shows the complete list of water quality impairments from the 2006 303(d) list.

Table 2. Water Quality Impairments in the Dominguez WMA

Water Quality Limited Segment Name	Pollutant
Dominguez Channel (lined portion above Vermont Ave)	Ammonia Copper Dieldrin (tissue) Indicator bacteria Lead (tissue) Sediment Toxicity Zinc (sediment)
Dominguez Channel Estuary (unlined portion below Vermont Ave)	Ammonia Benthic Community Effects Benzo(a)pyrene (PAHs) Benzo[a]anthracene Chlordane (tissue) Chrysene (C1-C4) Coliform Bacteria DDT (tissue & sediment) Dieldrin (tissue) Lead (tissue)

Water Quality Limited Segment Name	Pollutant
	PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Zinc (sediment)
Los Angeles Harbor - Cabrillo Marina	DDT PCBs (Polychlorinated biphenyls)
Los Angeles Harbor - Consolidated Slip	Benthic Community Effects Cadmium (sediment) Chlordane (tissue & sediment) Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory) Dieldrin Lead (sediment) Mercury (sediment) PCBs (tissue & sediment) (Fish Consumption Advisory) Sediment Toxicity Toxaphene (tissue) Zinc (sediment) Benzo[a]anthracene Benzo(a)pyrene Chrysene Pyrene Phenanthrene 2-Methyl-naphthalene
Los Angeles Harbor - Fish Harbor	Benzo[a]anthracene Benzo(a)pyrene Chlordane Chrysene (C1-C4) Copper DDT Dibenz[a,h]anthracene Lead Mercury PAHs (Polycyclic Aromatic Hydrocarbons) PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Sediment Toxicity Zinc
Los Angeles Harbor - Inner Cabrillo Beach Area	Copper DDT (Fish consumption advisory for DDT) PCBs (Fish Consumption Advisory for PCBs) Indicator bacteria*
Los Angeles/Long Beach Inner Harbor	Beach Closures Benthic Community Effects

Water Quality Limited Segment Name	Pollutant
	Copper DDT PCBs (Polychlorinated biphenyls) Sediment Toxicity Zinc
Los Angeles/Long Beach Outer Harbor (inside breakwater)	DDT PCBs (Polychlorinated biphenyls) Sediment toxicity
Machado Lake (Harbor Park Lake)	Algae Ammonia ChemA (tissue)** Chlordane (tissue) (Fish Consumption Advisory) DDT (tissue) (Fish Consumption Advisory) Dieldrin (tissue) Eutrophic Odor PCBs (Polychlorinated biphenyls) (tissue) Trash
San Pedro Bay Near/Off Shore Zones	Chlordane Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory for DDT) PAHs (Polycyclic Aromatic Hydrocarbons) (sediment) PCBs (Fish Consumption Advisory for PCBs) Sediment Toxicity Zinc (sediment)
Torrance Carson Channel	Coliform Bacteria Copper Lead
Wilmington Drain	Ammonia Coliform Bacteria Copper Lead

*Los Angeles Harbor Bacteria TMDL, 2005
** ChemA refers to the sum of the chemicals aldrin, dieldrin. chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

Summaries/Descriptions of Two Long-term Bioaccumulation Programs and Several Large-scale Studies

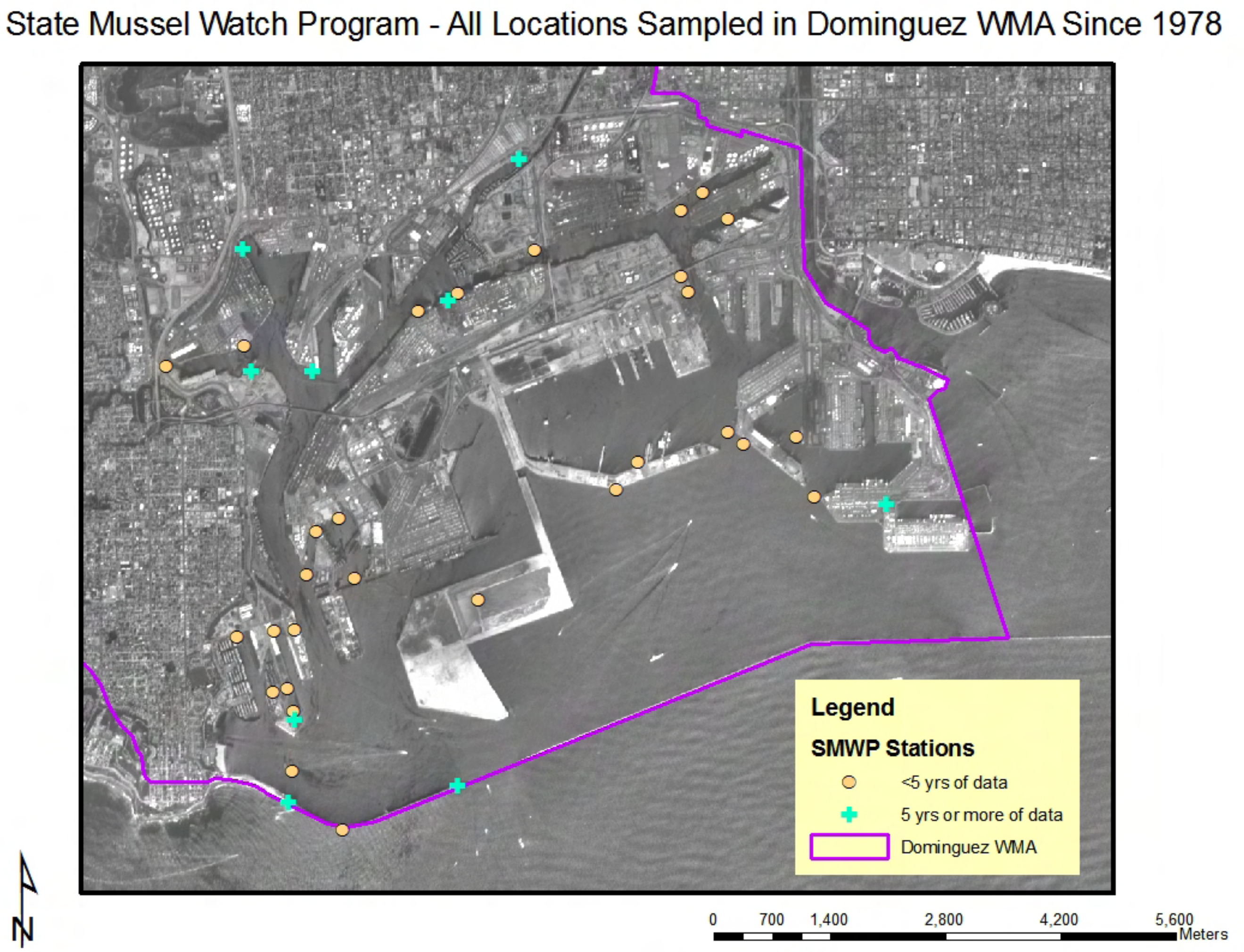
Monitoring in this watershed has taken quite a different approach from that taken in more traditionally-structured watersheds. Usually ambient monitoring will take place in a setting where tributaries flow to a mainstem river which discharges to an estuary. More often than not, water samples are collected in the tributaries and mainstem (targeted or randomly-sited) while, additionally, sediment and/or bioaccumulation samples are collected in the estuary (where deposition is to be expected). Sediment will often not be collected in the tributaries and mainstem due to periodic flushing during storms or due to a larger grain size (to which pollutants tend not to adsorb) while benthic infauna will be collected during more stable weather periods (late spring or fall). In any case, there is a clear connection between tributaries, mainstem, and estuary both visually and in monitoring design. However, in a watershed where much of the "upland" is paved over, tributaries are mostly underground storm drains, and the main visible water feature is a large deepwater port (with marine more so than estuarine waters but still subject to sediment deposition), monitoring programs must be adjusted accordingly.

Both ports have conducted water column monitoring for basic constituents at fixed locations, and at multiple depths, for many years and have additionally conducted large-scale special studies, most recently in 2006. Sediments have been frequently collected and tested in anticipation of dredge projects. Randomly-selected sites have been utilized for chemical, toxicological, and benthic community analysis of sediments in a number of regionally-scaled studies such as Bight'03. A feature of most of the sediment monitoring is the generally limited repeat sampling of sites. Since the locations of dredge sites vary and the very nature of sampling randomly-chosen sites results in little likelihood of repeat samples over time, there are limited data at any one site should site-specific trend analysis be of interest. On the other hand, one can choose a fairly arbitrary timespan and evaluate all data collected during it with the assumption that sediment concentrations change rather slowly through time unless an area is dredged. Other than water column sampling as an exception to this, the other fixed station sampling that has occurred is bioaccumulation monitoring through the State Mussel Watch (SMW) Program and Toxic Substances Monitoring (TSM) Program (both now merged into the structure of the State's Surface Water Ambient Monitoring Program – SWAMP). A summary of SMW and TSM Programs data and brief summaries of large-scale studies follow. The sediment data generated by the large-scale studies are further characterized in the section entitled "Discussion of Combined Sediment Quality Dataset."

State Mussel Watch Program

The SMW Program utilized the filter-feeding characteristics of bivalves (predominantly mussels) to detect and evaluate the occurrence of toxic substances in areas with stable higher salinity such as ports and marinas, as well as, some of the Region's estuaries which tend to stay open and thus are mostly saline. Data from the program documented high levels (relative to elsewhere in the State) of various organic compounds and metals in mussel tissue at several locations in the inner harbor area. The first map below shows the locations of the many SMW Program sites over the years. Only a few of the sites were sampled for five years or more. It is followed by three maps which show in essence a time series of contamination for one of the more significant pollutants in the watershed, DDT (total DDT is shown but is largely comprised of DDE, a degradation by-product). Only data for transplanted California mussel (*Mytilus californianus*) are shown which represent the bulk of the data. While there are additional data for resident California mussel, as well as, resident Bay mussel (*Mytilus edulis*) and transplanted Bay mussel, different species of mussels (and bivalves, in general) bioaccumulate at different rates. Additionally, resident mussels tend to depurate pollutants somewhat over time which make their tissue concentrations less appropriate to compare directly with the transplanted (from Bodega Bay) "clean" mussels deployed for a known period of time. The scaling of the concentrations is arbitrary considering there are currently no solid human health or wildlife protection goals for use with shellfish. The number of sites sampled decreased dramatically over the years due to budget constraints and, as previously mentioned, bioaccumulation monitoring is now conducted through SWAMP. In any case, it is clear that concentrations have generally decreased throughout the areas sampled over time as can be seen in a graph following the maps which shows total DDT concentrations in mussel tissue at two long-term inner harbor stations. Total PCBs (summed from Arochlors in the early years of the program and in later years summed from PCB congeners) and lead also have decreased over time whereas zinc concentrations do not clearly trend up or down (SWRCB - SMW Program website).

Figure 8



State Mussel Watch Program - All Locations Sampled in Dominguez WMA Since 1978

Figure 9
State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (1982)

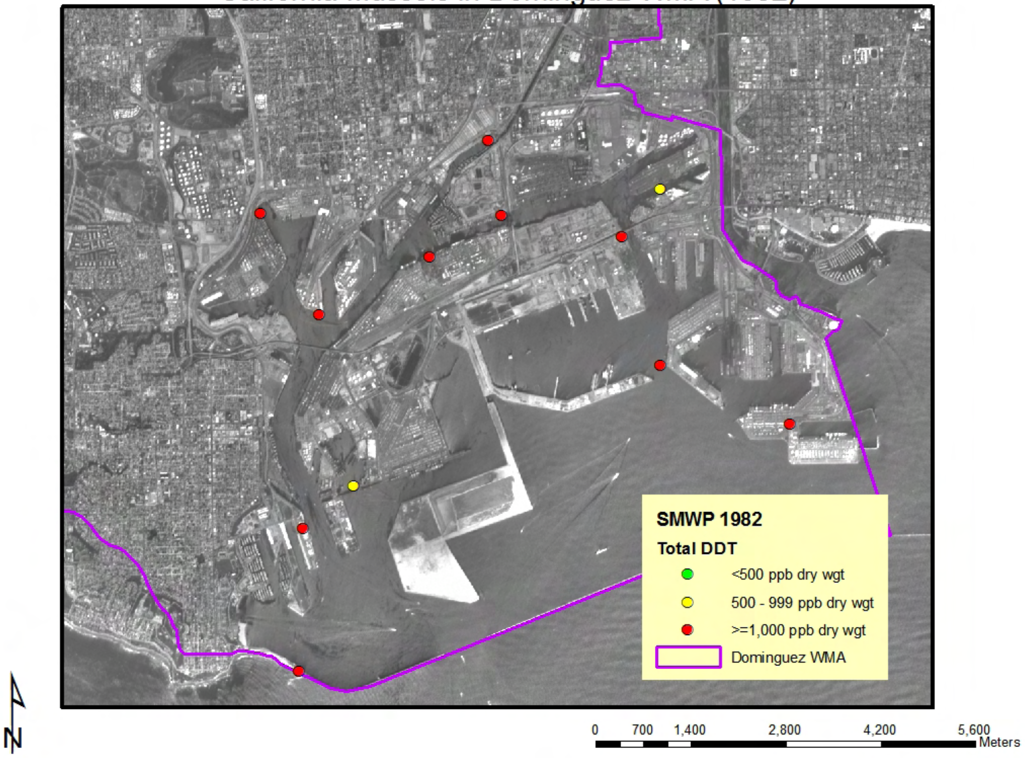


Figure 10
State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (1987)

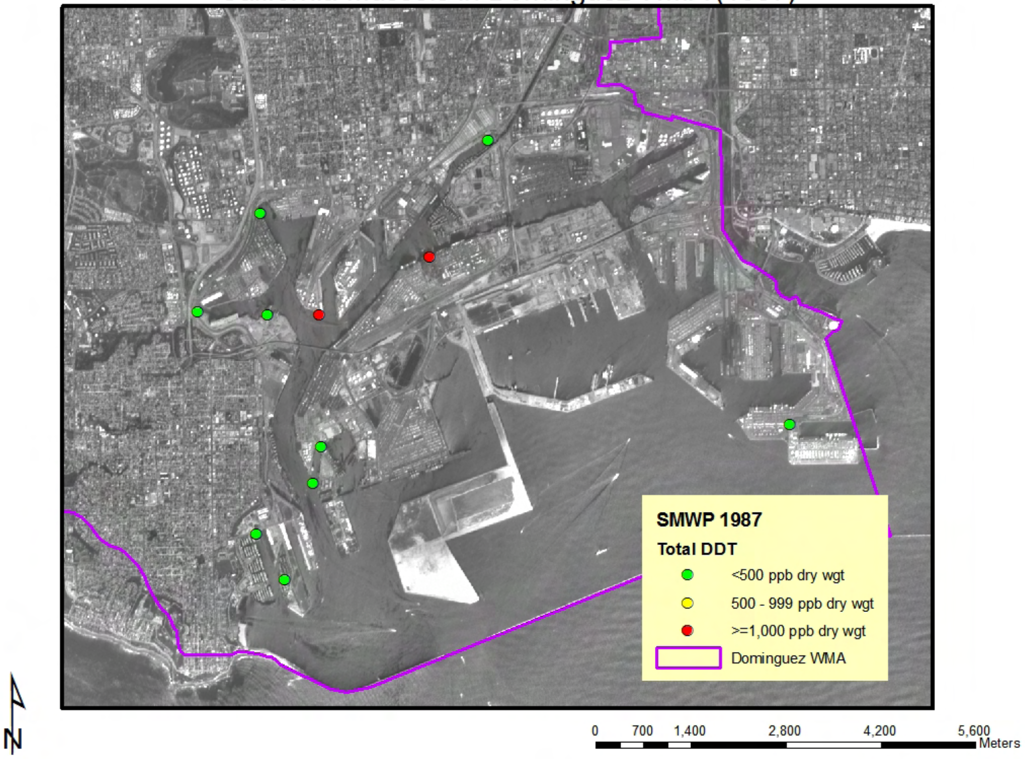


Figure 11

State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (2005)

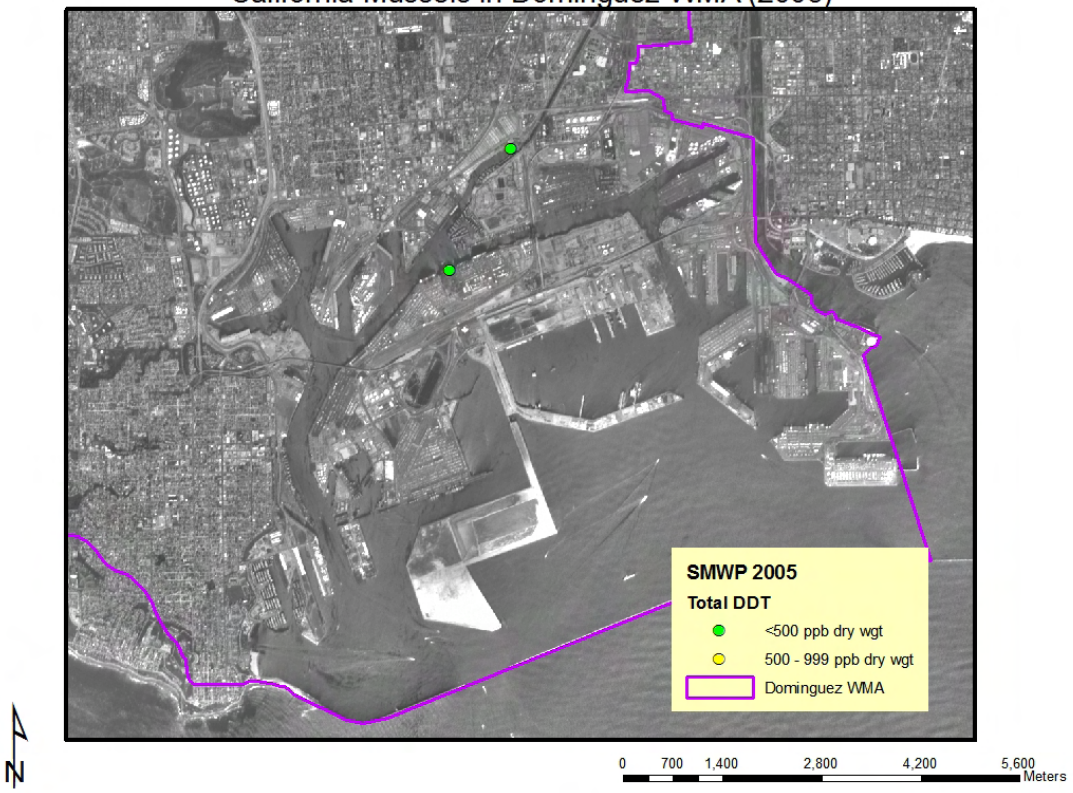
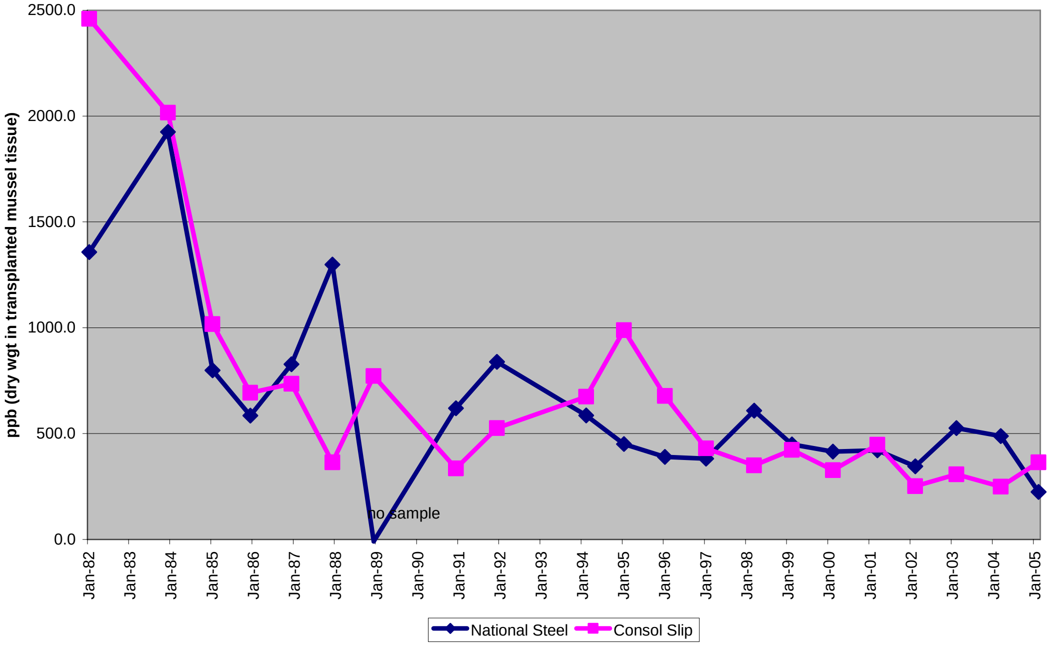


Figure 12

State Mussel Watch Program - Total DDT at Two Long-term Sites in LA Harbor, 1982 - 2005



Toxic Substances Monitoring Program

The TSM Program collected many species of fish and, at times, other aquatic life in lakes, rivers, streams, and occasionally in estuaries and fully marine waters to detect and evaluate the occurrence of toxic substances in those waters. Fish were collected from Machado Lake during 1983, 1984, 1985, 1989, 1990, 1992, 1994, and 1997. Species collected and analyzed over the years for pollutants included channel catfish, goldfish, carp, largemouth bass, and bullhead. The various species of fish represent different trophic levels and bioaccumulate pollutants at different rates so concentrations are not directly comparable. However, in goldfish, total DDT (mostly as DDE) concentrations have gradually decreased over time from a high of 4,449 ppb wet weight in 1983 to 514 ppb in 1989. Largemouth bass consistently have had the lowest concentrations of total DDT of the species collected at approximately 20 – 30 ppb wet weight. Total DDT concentrations in carp have ranged between 200-400 ppb wet weight with no clear trend over time. Total PCBs concentrations follow a similar pattern with goldfish (mostly caught in the earlier years with concentrations ranging from 200 – 1,700 ppb), exhibiting generally much higher concentrations than carp (ranging from about 200 - 600 ppb). Largemouth bass and bullhead filets were not analyzed for PCBs (SWRCB – TSM Program website).

The California Office of Environmental Health Hazard Assessment (OEHHA) Fish Contamination Goals (FCGs) are estimates of the contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week over a lifetime. FCGs prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-6}$ for carcinogens (not more than one additional cancer case in a population of 1,000,000 people consuming fish at the given consumption rate over a lifetime). The FCG for total DDT is 21 ppb wet weight (OEHHA, 2008).

The OEHHA has also generated Advisory Tissue Levels (ATLs) which are designed to encourage consumption of fish that can be eaten in quantities likely to provide significant health benefits, while discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be eaten in amounts recommended for improving overall health (eight ounces total, prior to cooking, per week). ATLs are used to provide consumption advice to prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-4}$ for carcinogens (not more than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime). The ATL for total DDT for one 8-ounce servings a week of fish is >1,000 – 2,100 ppb (OEHHA, 2008).

The OEHHA FCG for total PCBs is 3.6 ppb while the ATL for one 8-ounce serving a week of fish is >42 - 120 ppb (OEHHA, 2008). The tissue concentrations of total DDT and total PCBs in fish sampled by the TSM Program in Machado Lake are much higher than the current FCGs and ATLs; however, much of the data are now quite old. Carp were collected from the lake in 2007 as part of a statewide lake study, but those data are not yet available to the public.

Mercury concentrations in Machado Lake under the TSM Program appeared to pose only a minimal human health risk when compared to FCGs and ATLs. However, it is possible the concentrations were high enough to pose a risk to wildlife (particularly the endangered least tern) consuming fish from the lake. Concentrations under the TSM Program ranged from non-detect to 0.09 ppm wet weight in filets. A US Fish & Wildlife document presented a range of values (for whole fish) tied to the trophic levels of fish being consumed by wildlife that would be protective of endangered species in California. Depending on trophic level and calculation method, those numbers range from 0.013 ppm in trophic level 2 (herbivorous fish) to 0.66 ppm in trophic level 4 (top-level carnivorous fish) (USFWS, 2003).

Sampling by Ports of LA and LB in 2006/ Ports Baseline Study of 2000

The most recent large-scale sampling event for which data are available was conducted by the Ports in 2006 to support the TMDL development process. Bulk sediment, porewater, and overlying water samples were collected at about 60 sites within the ports and analyzed for various metals and organics.

The Ports contracted with a consultant team to conduct a biological baseline study in 2000 which was the first study of its kind since the 1970s. Water quality and sediment grain size were measured to provide physical/chemical characterization of environmental conditions during biological surveys. The surveys conducted included quantifying the benthic community; larval, juvenile, and adult fish populations; bird use patterns; and biological communities attached to rocky riprap habitats; as well as, mapping of kelp and eelgrass distributions. The study's findings also were compared with previous baseline studies.

Bight-wide Monitoring in 1998 and 2003

Southern California Bight-wide coordinated regional monitoring began with a pilot project in 1994 and has continued every five years since the full-scale program began in 1998. The goal of Bight-wide monitoring is to work cooperatively toward a regional assessment of coastal condition. In lieu of their ongoing routine monitoring, participants are asked to disperse their sites and use standardized methods throughout the region to help make Bight-wide assessments for little to no increase in cost over their existing program. The '98 and '03 surveys assessed the extent and magnitude of impacts for a number of indicators including sediment chemistry, benthic infauna, sediment toxicity, fish assemblages and bioaccumulation. Specifically for sediment contamination, both surveys found a large proportion of the Bight contaminated by anthropogenic pollutants with a disproportionate accumulation occurring near urban activities such as discharges from large POTWs and ports, harbors, and marinas.

Sixty-five organizations participated in at least one of the Bight'03 components which included Coastal Ecology, Shoreline Microbiology, and Water Quality. Twenty-three sampling sites fell within the Dominguez WMA. Marinas and LA estuaries consistently exhibited the highest mean concentrations for trace metal and organic analytes; copper was highest in marinas followed by ports/bays/harbors, and LA estuaries. Data from the Bight '03 sampling event are available on the Southern California Coastal Water Research Project website (SCCWRP – Bight '03 website). Many of the Bight stations sampled for sediment had a planned overlap with water column sampling locations utilized by SWAMP.

Sixty-two organizations participated in at least one of the Bight'98 components. Thirty-two sampling sites fell within the Dominguez WMA. Within the bays and harbors of the southern California Bight, higher levels of contamination were typically associated with industrial, port and marina areas. Data from the Bight'98 sampling event are available on the Southern California Coastal Water Research Project website (SCCWRP – Bight'98 website).

SWAMP Sampling in 2003

This watershed was the focus of SWAMP monitoring for FY02/03. The WMA was divided into six subareas based on their characteristics in order to simplify sampling design: (1) headwater streams, (2) the inner and outer harbors of LA and LB (integrated with Bight '03 monitoring), (3) Madrona Marsh (not sampled in the end due to lack of suitable collection sites), (4) Machado Lake, (5) the Dominguez Channel estuary, and (6) the upper channelized Dominguez Channel above normal tidal influence. A different sampling strategy was undertaken for the LA/LB harbor complex. Sampling there included water column toxicity and chemistry, metals chemistry, and PAHs analysis - sediment in the harbors complex was collected through the Bight '03 sampling . The focus was on a randomized probabilistic sample design as modeled after the USEPA's Environmental Monitoring and Assessment Program (EMAP), especially for the harbor area where coordination with the Bight '03 monitoring program occurred. The triad approach (toxicity, chemistry, and benthic community) was utilized where possible (CRWQCB, 2007a).

A report on the results of this sampling event prepared by Regional Board staff describes that while the SWAMP monitoring only provided a snapshot of water quality in the watershed, it indicates there may be some degradation in water quality within the northern end of Machado Lake, possibly due to inputs from Wilmington Drain. Dissolved oxygen and pH were lower there than elsewhere in the lake while nitrogen levels were higher. There was no appreciable toxicity in the water column, however. Sediment was also collected at the five sampling stations. Based on sediment quality guidelines, Machado Lake sediments would be classified as "possibly contaminated" for most of the trace metals and trace organics for which guidelines exist. Cadmium, chromium, copper, lead, nickel and zinc concentrations fell between the possible effects and probable effects thresholds at 4 or all 5 of the stations. However, only the nickel concentration at the station closest to Wilmington Drain exceeded the probable effects threshold. Total chlordane, total DDTs, total PCBs, and PAHs also fell between the two thresholds at all 5 stations. Chlordane concentrations also exceeded the probable effects threshold at 4 of the stations. Despite the widespread sediment contamination for many trace metals and trace organics, sediment toxicity testing demonstrated acute toxicity only at stations toward the middle of the lake. No chronic toxicity was observed (CRWQCB, 2007a; SWRCB – SWAMP website).

Dominguez Channel is listed as impaired due to benthic infaunal community effects. Benthic samples were collected at five of the estuarine stations within Dominguez Channel during the SWAMP study. The results confirm that the benthic community is adversely impacted within at least parts of Dominguez Channel, as three of the five stations were classified as being in poor condition (CRWQCB, 2007a).

The Bight'03 sampling design resulted in sampling at 17 stations within Los Angeles/Long Beach Harbor and San Pedro Bay, most of which corresponded to SWAMP stations. DDT contamination was widespread throughout Los Angeles/Long Beach Harbor in 2003. It is estimated that 94% of Los Angeles/Long Beach Harbor has DDT contamination greater than the Effects Range-Low (ER-L) threshold, while 43% of the harbor was contaminated with DDT at concentrations greater than the Effects Range-Median (ER-M) threshold (CRWQCB, 2007a).

Copper contamination was widespread throughout Los Angeles/Long Beach Harbor in 2003. Other trace organic and trace metal contaminants were less widespread throughout the study area. About half of the sites sampled exhibited sediment toxicity. Benthic infaunal community analysis indicated that in Los Angeles/Long Beach Harbor, 75% of the sampling sites were classified as being in good condition, while the remaining 25% were classified as being in poor condition. The poor stations were all located in the innermost areas of Los Angeles Inner Harbor. The outermost portions of Los Angeles Harbor and all of Long Beach Harbor were in good condition (CRWQCB, 2007a).

The State Water Resources Control Board adopted sediment quality objectives (SQOs) for enclosed bays and estuaries in September 2008 which are based upon integration of a triad of indicators (benthic infaunal community, sediment toxicity and sediment chemistry) to produce a characterization of sediments at a given sampling location. Although the formal review and approval process by USEPA for the SQOs is not yet complete and thus they are subject to change, the report evaluated how Los Angeles/Long Beach Harbor and San Pedro Bay stations would be classified via the proposed SQO approach. Based on past monitoring data at probabilistic sampling sites (primarily Bight'98 and Bight'03 monitoring study data), approximately half of the Los Angeles/Long Beach Harbor sites fall into the two unimpacted categories (unimpacted and likely unimpacted), while the other half fall into the three impacted categories (possibly impacted, likely impacted, clearly impacted). All of the most impacted (clearly impacted and likely impacted) sites are located within the inner harbor areas of Los Angeles/Long Beach Harbor, while approximately two-thirds of the outer harbor areas are unimpacted or likely unimpacted. In San Pedro Bay, approximately 40% of the sites fell into the three impacted categories, but nearly all of these sites were only possibly impacted (only one site was likely impacted and none were clearly impacted) (CRWQCB, 2007a).

It appears that at least half of Los Angeles/Long Beach Harbor has degraded bottom conditions, whether assessed based on individual sediment contamination levels of trace metals and trace organics, sediment toxicity results, the health of the benthic infaunal community or through an integration of these three indicators. Degradation appears to be worse in the inner harbor areas, where industrial activities predominate, than in the more open water areas of the outer harbors. However, the low levels of trace metals and trace organics in the surface waters of Los Angeles/Long Beach Harbor and at depth and the absence of water column toxicity indicate that water quality within the harbor is good, suggesting that the contaminants drop out of the water column and accumulate in the sediments, as would be expected (CRWQCB, 2007a).

Sampling by AMEC/USEPA in Dominguez Channel and Consolidated Slip During 2002

A sediment characterization study was conducted in Dominguez Channel and Consolidated Slip during 2002 funded by USEPA Region IX, as part of their Superfund investigation into the former Montrose facility, and by members of the Los Angeles Contaminated Sediments Task Force (CSTF). Samples were collected at 77 locations; sediment cores were collected where feasible. The results of the sampling found that for several chemicals, the maximum concentrations observed in Dominguez Channel and Consolidated Slip sediments exceeded the ER-M values. Average concentrations were close to or above the ER-M for copper, lead, mercury, DDT, PCB and chlordane. At many sites, higher concentrations were found in the deeper parts of the cores (AMEC, 2003).

Discussion of Combined Sediment Quality Dataset

Sediment data were evaluated from a number of sources. The bulk came from the CSTF's database (SCCWRP – SQO website) which includes the results of monitoring conducted for dredge projects, the State's Bay Protection and Toxic Cleanup Program, various Bight- or Harbor-wide sampling programs, and sampling results from the U.S. Navy. In addition, results from monitoring conducted by the refineries discharging to Dominguez Channel and special studies conducted in Consolidated Slip and Dominguez Channel, SWAMP sampling, and recent sampling by the Ports were evaluated. Only data for sites with latitude/longitude information were used since it was intended that all sediment data from 1996 to 2006 would be mapped (in

ArcGIS 9.2) in order to be evaluated. Sediment sampling sites are rarely visited repeatedly and since changes in the sediment are relatively slow (except when sediments are dredged), collectively examining ten years of data is reasonable. Information on which of the sites sampled for proposed dredging were eventually dredged was supplied by the Ports and those sites that were clearly dredged after sampling took place were removed. In the absence of firm information to the contrary, those sites thought to be somewhat questionable as to their dredging status were left in. About one-half of the sites related to pre-dredge monitoring were removed. Some of the Bight'98 and US Navy sampling sites were also removed utilizing the provided information. Only data from grab samples or the surface layer of core samples were used. Sediment data were evaluated against sediment quality guidelines (SQGs) where available and assigned red or green dots on maps to designate the results as above or below the SQG, respectively. In many cases, triad data were not available (toxicity and benthic infauna results in conjunction with chemistry) and, in any case, sediment quality objectives which utilize triad data are still undergoing the formal review and adoption process.

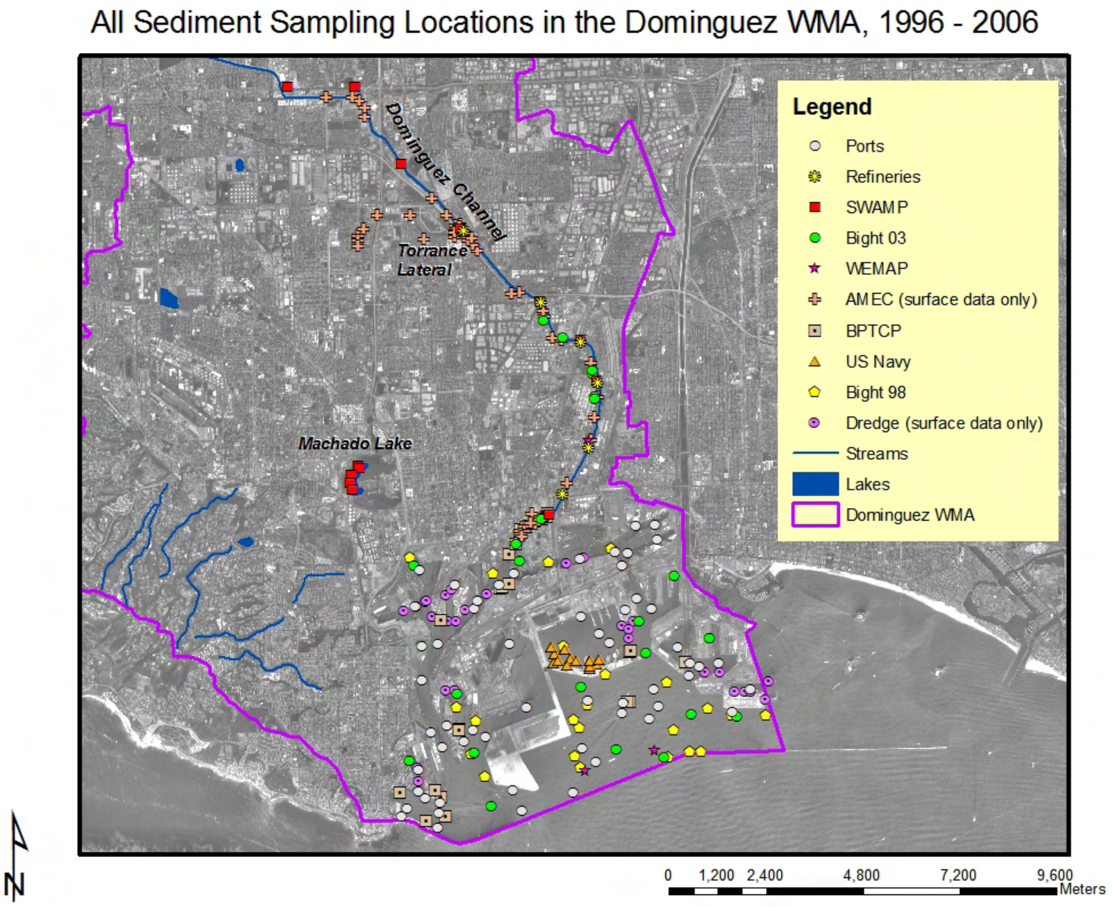
The SQGs utilized can be found in Table 12 of the State Water Resources Control Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List Policy Functional Equivalent Document. They are based on either ER-Ms, Probable Effects Levels (PELs), or other published effects-related data for marine or estuarine sediments. The table below shows the numbers (in dry weight) used when evaluating the combined sediment database (SWRCB, 2004). Not all parameters evaluated were mapped. All data evaluated are available electronically by contacting the author.

Table 3. Sediment Quality Guidelines Utilized When Evaluating Data

Chemical	**ER-M**	**PEL**	**Other sediment quality guideline**
Arsenic	70 ug/g		
Cadmium		4.21 ug/g	
Chromium	370 ug/g		
Copper	270 ug/g		
Lead		112.18 ug/g	
Mercury			2.1 ug/g
Silver		1.77 ug/g	
Zinc	410 ug/g		
Total PCBs			400 ng/g
Total Chlordane	6 ng/g		
2-methylnaphthalene		201.28 ng/g	
Phenanthrene		543.53 ng/g	
Low molecular weight PAHs		1442 ng/g	
Benz[a]anthracene		692.53 ng/g	
Benzo[a]pyrene		763.22 ng/g	
Chrysene		845.98 ng/g	
Dibenz[a,h]-anthracene	260 ng/g		
Pyrene		1397.4 ng/g	
High molecular weight PAHs	9600 ng/g		
Total PAHs			1800 ug/g

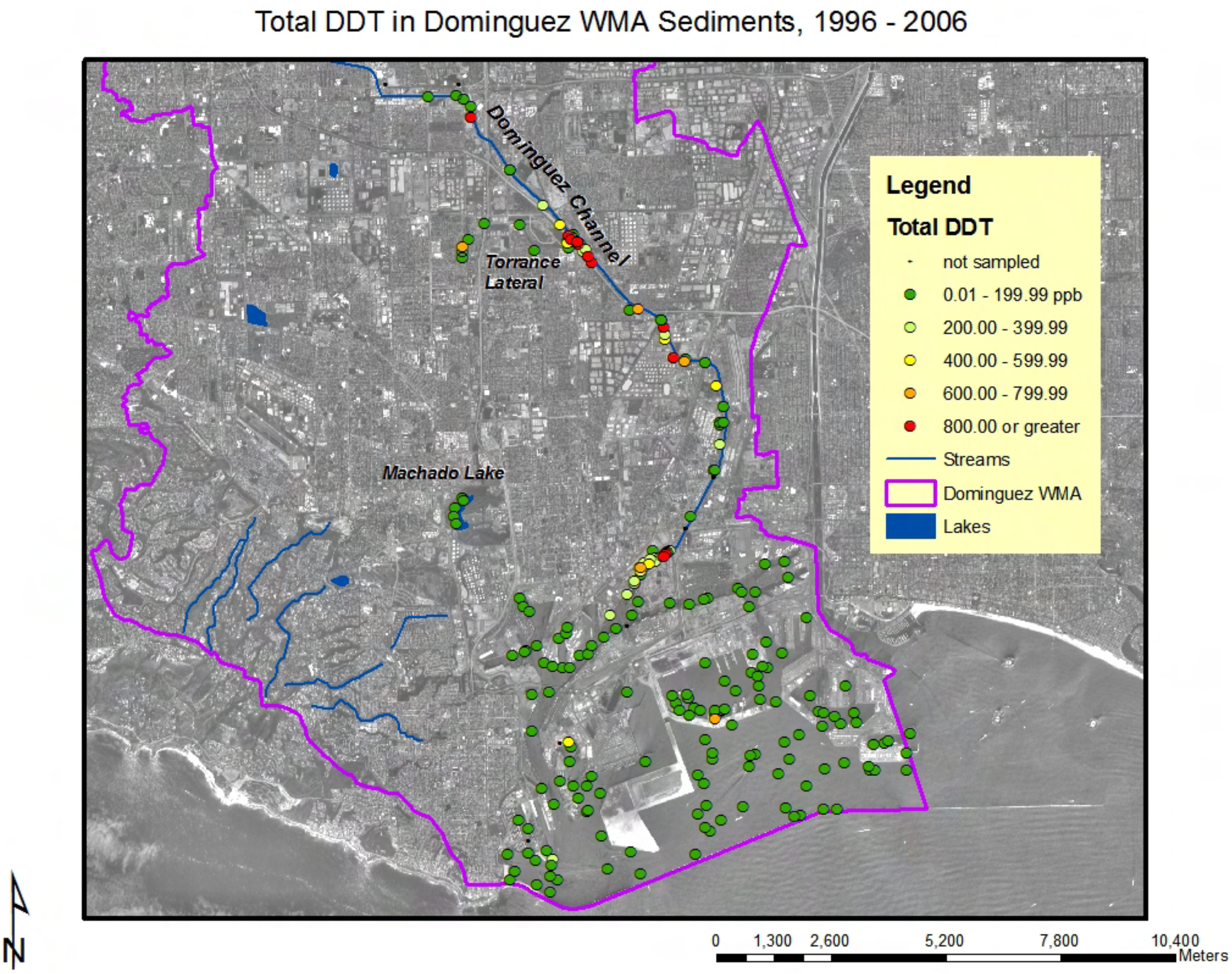
The locations of sampling sites from the various programs are shown in the figure below.

Figure 13



Since there is no SQG for DDT in marine sediments provided in the State Board's 303(d) listing policy, those data were depicted by graduated coloration from green shades to yellow to red shades to show smaller to larger concentrations of DDT as can be seen in the figure below. It is clear that the highest concentrations of DDT continue to persist in Dominguez Channel and Consolidated Slip with some higher levels elsewhere in Inner and Outer Harbors.

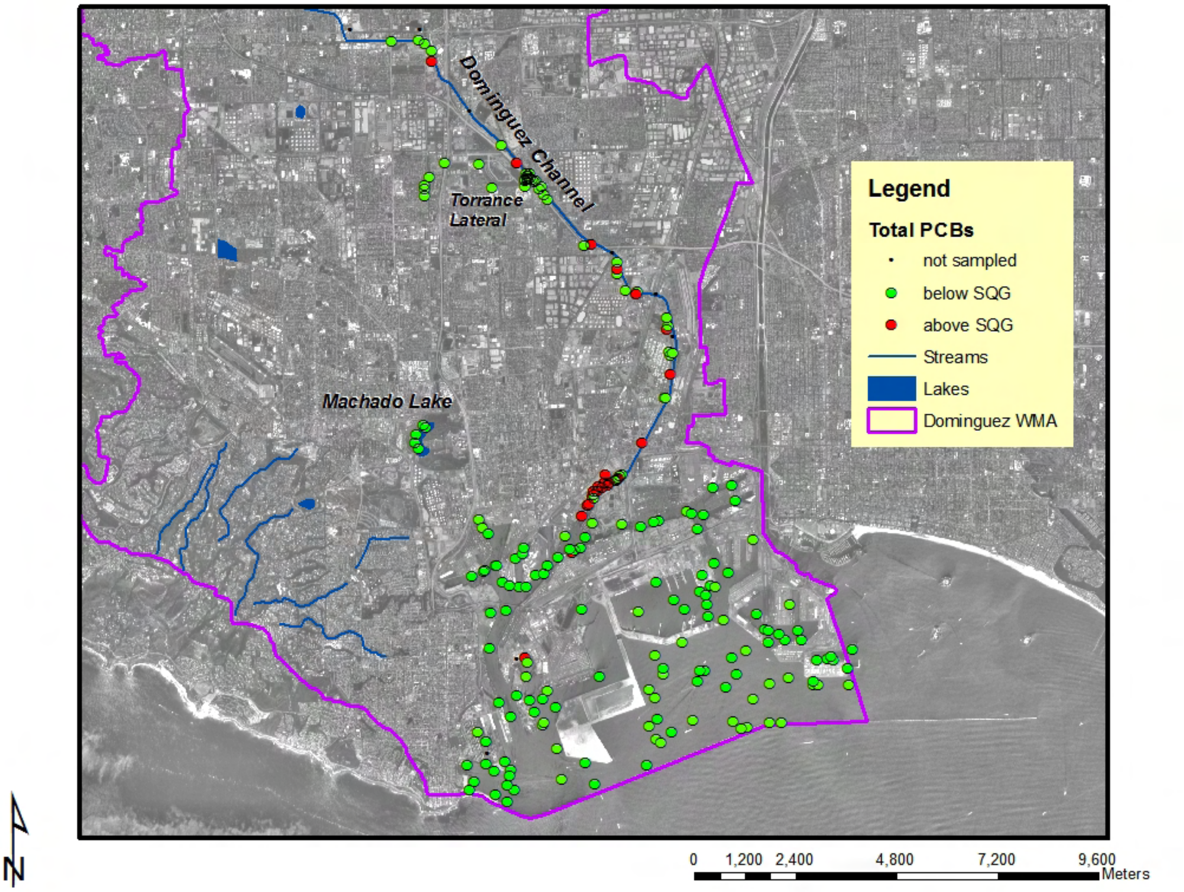
Figure 14



The pattern is very similar with total PCBs (sum of congeners if available or sum of Arochlors if no congener data available) as can be seen below.

Figure 15

Total PCBs in Dominguez WMA Sediments, 1996 - 2006



The pattern for high and low molecular weight polycyclic aromatic hydrocarbons (HPAHs and LPAHs) is somewhat different as can be seen in the following figures. Sediments in the main channels and at major docking locations have some elevated concentrations as well as sediments in Dominguez Channel and Consolidated Slip. LPAHs (2-methylnaphthalene, anthracene, fluorene, naphthalene, and phenanthrene) are considered petrogenic in origin - indicative of spills. HPAHs (fluoranthene, dibenzo(a,h)anthracene, chrysene, benz(a)anthracene, benzo(a)pyrene, and pyrene) are considered pyrogenic in origin - indicative of combusted petroleum, likely from street runoff or aerial deposition. Fluorene, fluoranthene, and anthracene, however, do not have SQGs for marine sediments, only sediments in freshwater.

Figure 16

Low Molecular Weight PAHs in Dominguez WMA Sediments, 1996 - 2006

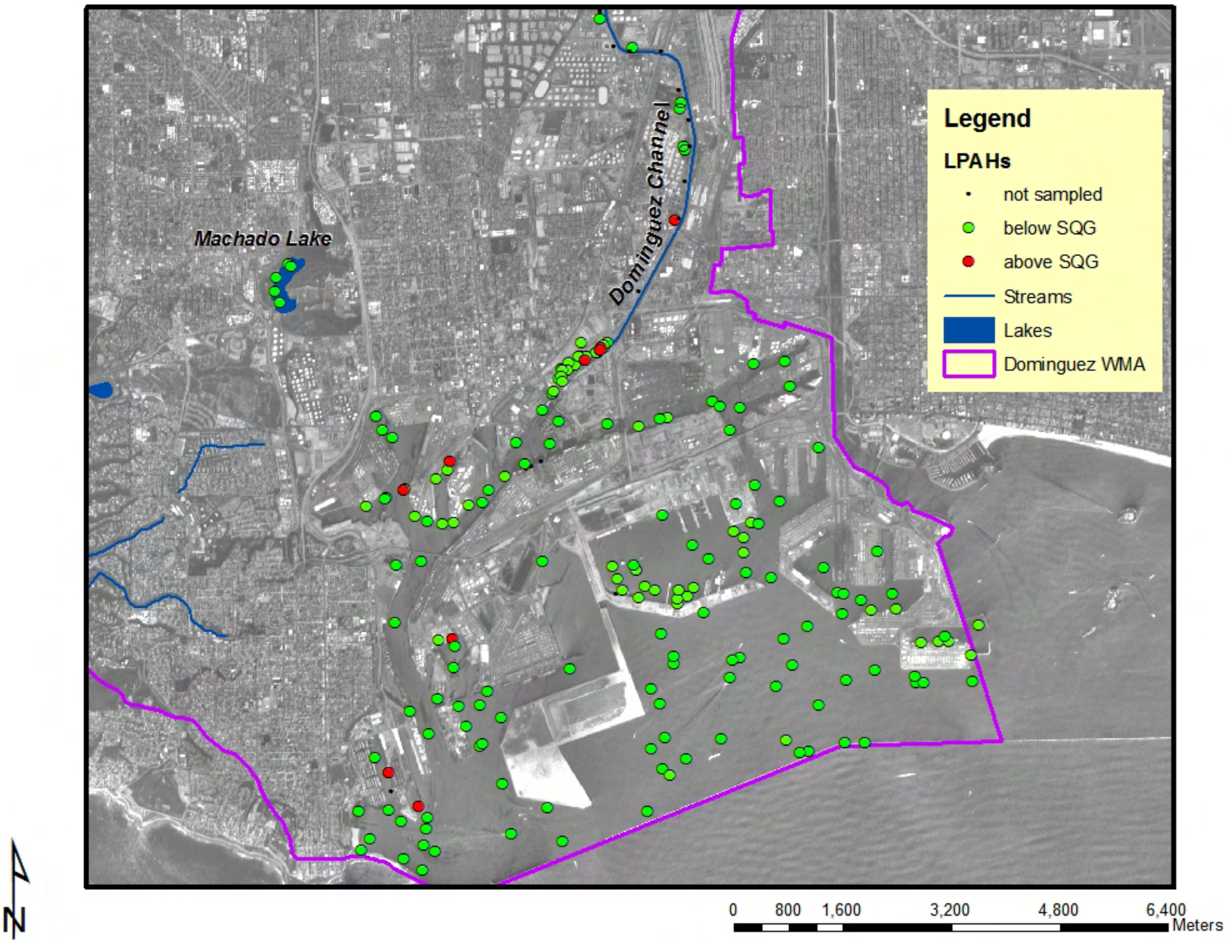


Figure 17

High Molecular Weight PAHs in Dominguez WMA Sediments, 1996 - 2006

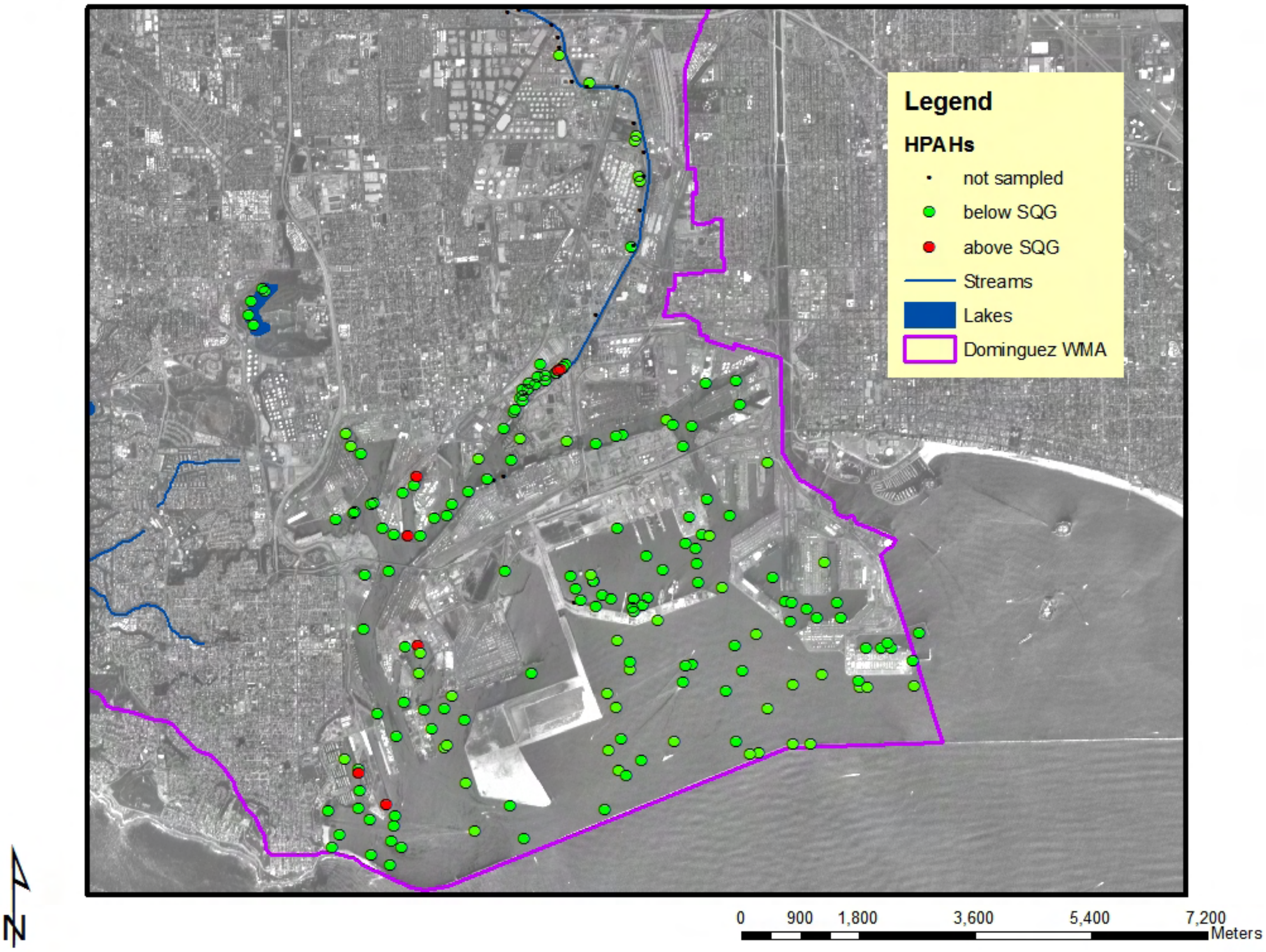


Figure 18

Dibenz[a,h]-anthracene in Dominguez WMA Sediments, 1996 - 2006

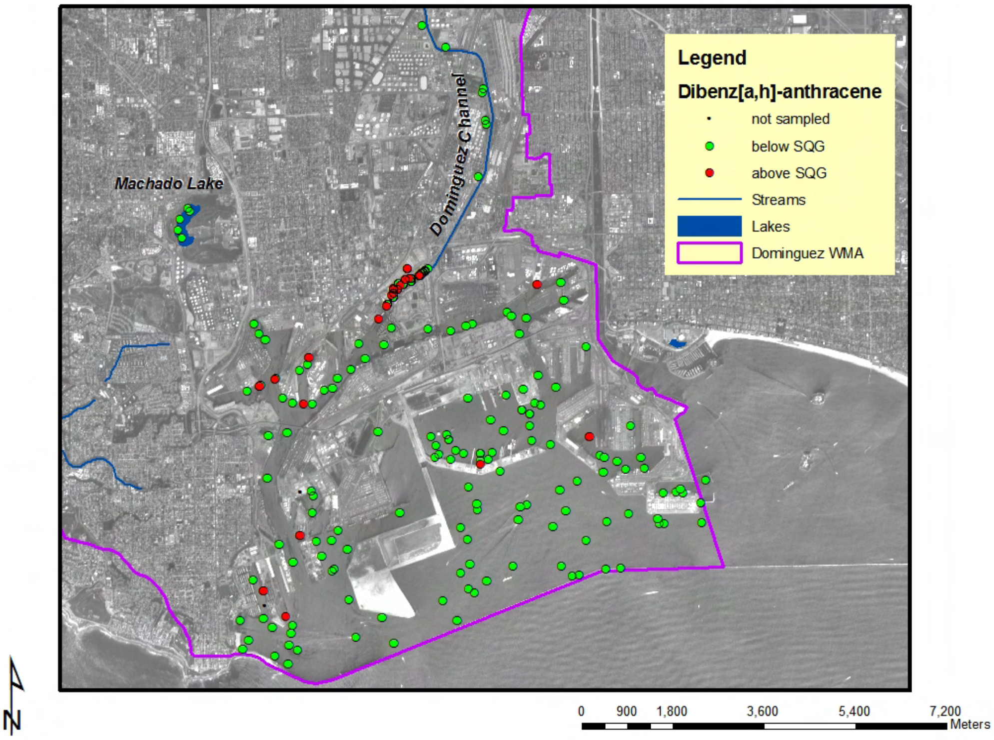


Figure 19

Benzo[a]anthracene in Dominguez WMA Sediments, 1996 - 2006

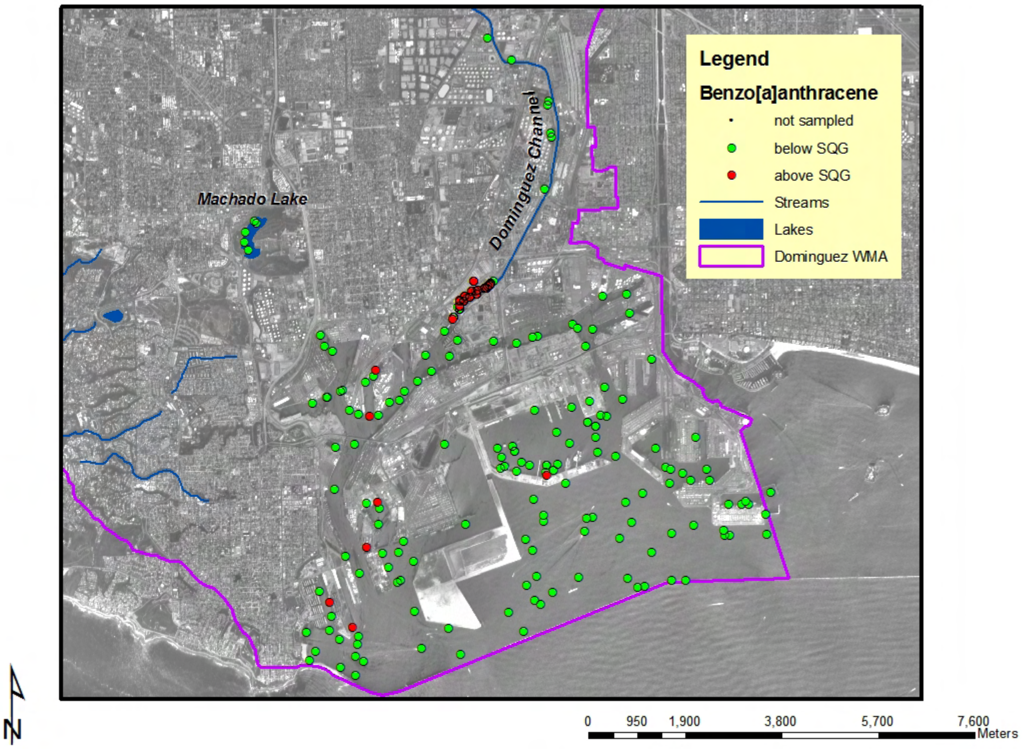


Figure 20

Benzo[a]pyrene in Dominguez WMA Sediments, 1996 - 2006

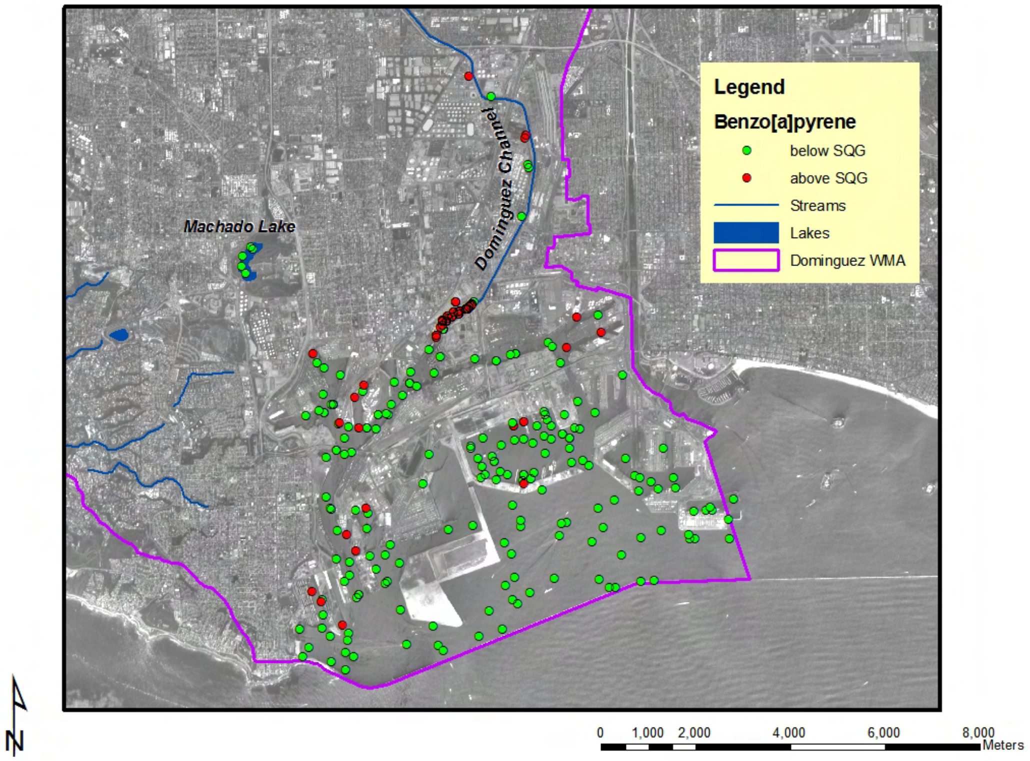


Figure 21

Chrysene in Dominguez WMA Sediments, 1996 - 2006

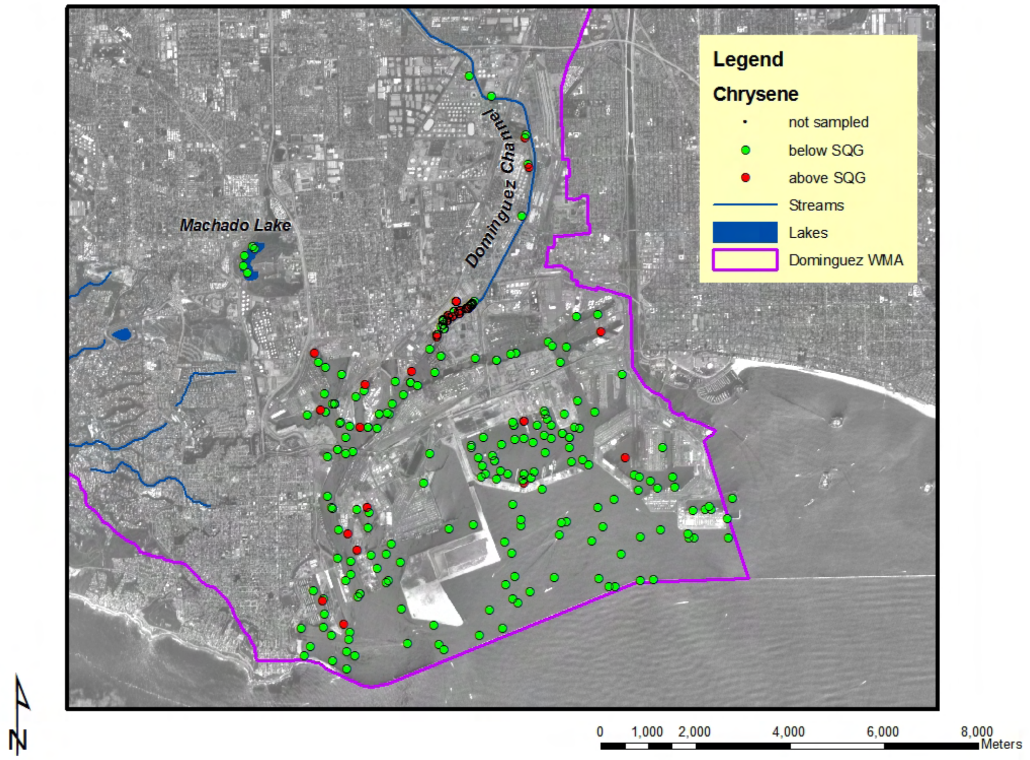


Figure 22

Phenanthrene in Dominguez WMA Sediments, 1996 - 2006

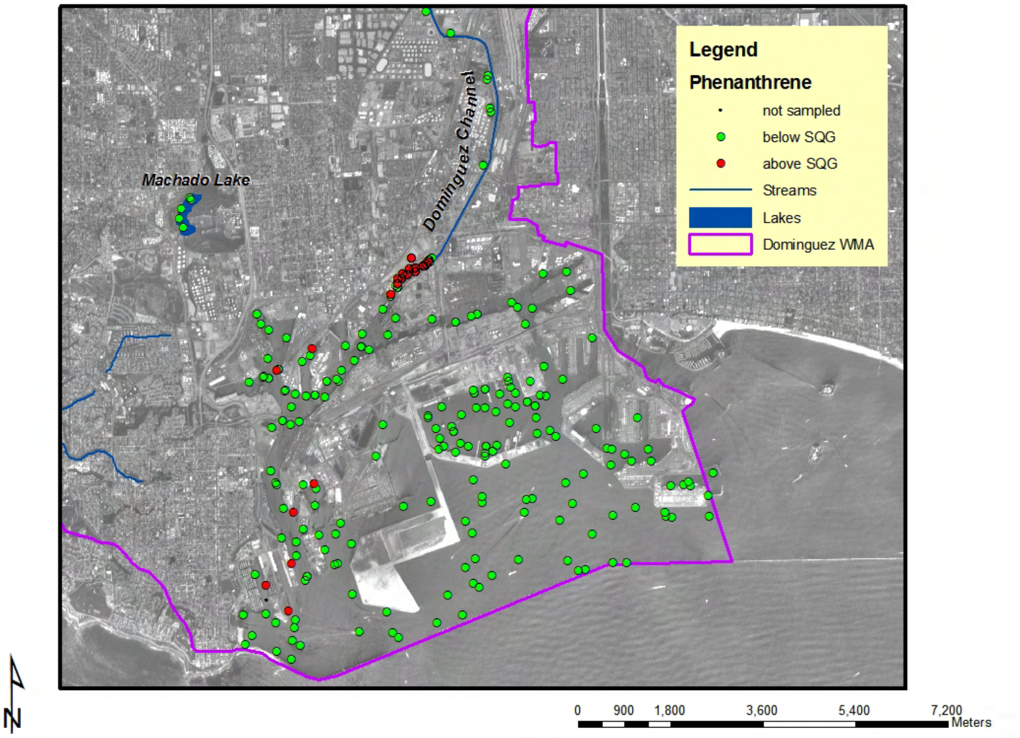
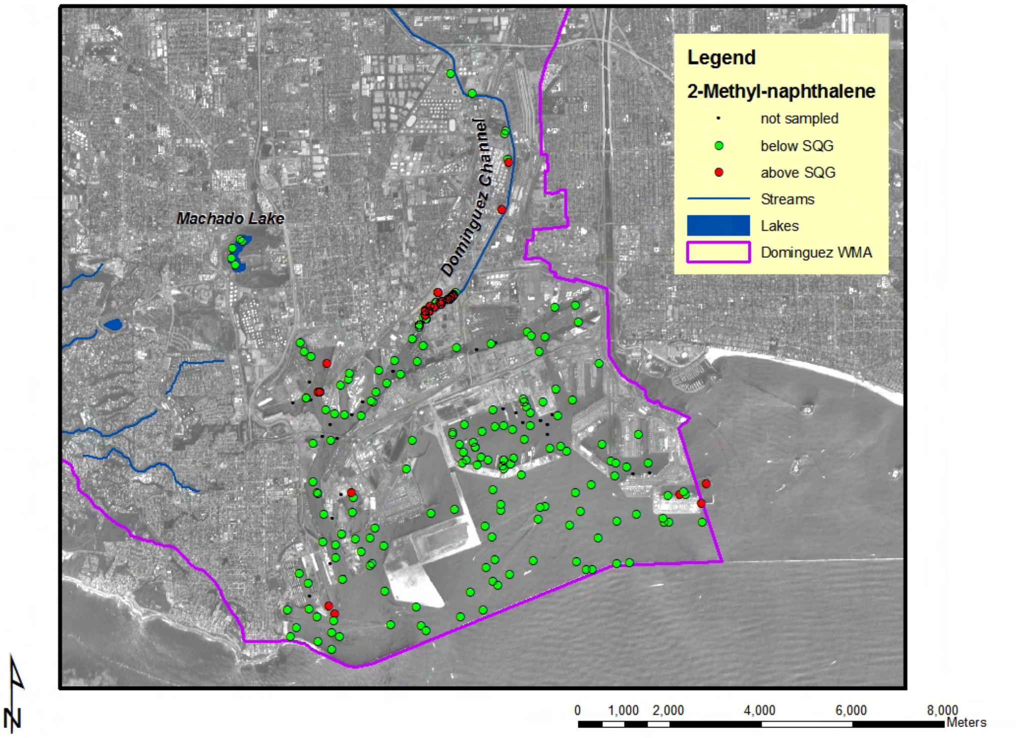


Figure 23

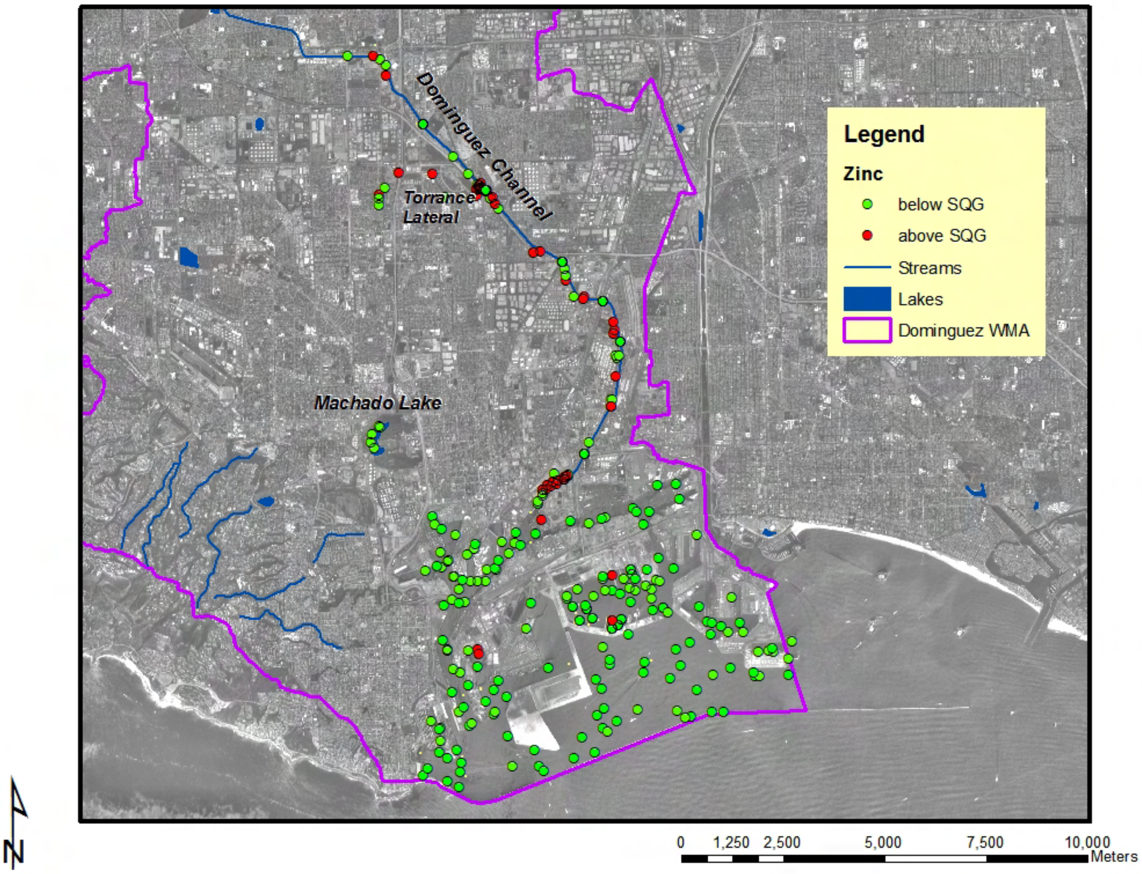
2-Methyl-naphthalene in Dominguez WMA Sediments, 1996 - 2006



Elevated concentrations of zinc in sediment (above the SQG) are found at many locations in the WMA's waterbodies as can be seen in the figure below.

Figure 24

Zinc in Dominguez WMA Sediments, 1996 - 2006

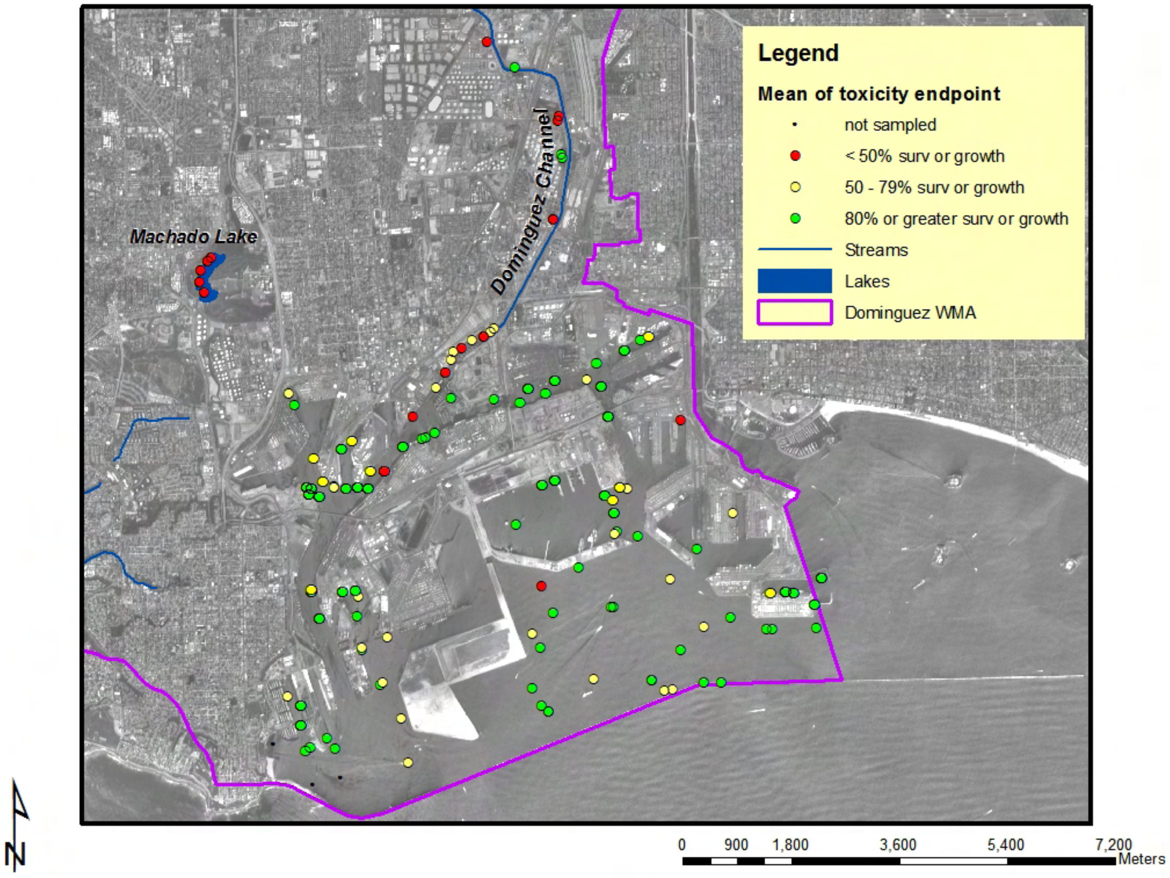


On the other hand, bulk sediment toxicity is somewhat more widespread than might be predicted by those areas with SQG exceedances or by an impaired benthic community (the latter for the most part limited to Consolidated Slip/Dominguez Channel) as seen in the figure below.

The more severe toxicity (defined here as less than 50% survival) is highlighted separately from moderate or no toxicity and continues to be concentrated in Dominguez Channel and Consolidated Slip, as well as, in Machado Lake. The results are based on toxicity tests conducted on multiple species including various amphipods, mysids, and polychaetes.

Figure 25

Toxicity in Dominguez WMA Sediments, 1996 - 2006



Recommendations for Future Water Quality and Sediment Monitoring

Sediment and water column sampling occurs on a fairly regular basis within the ports. Biological sampling is conducted on a less frequent but fairly regular basis. There is great need, however, for coordinated and more extensive monitoring within the Dominguez Channel and its tributaries. The only ongoing regular monitoring in the Dominguez Channel estuary is conducted by the refineries and consists of sampling surface sediments for a large suite of constituents annually. Water column sampling for TMDL development purposes occurs on an as-needed basis in the Channel. A sampling site in the Channel has been established by the Los Angeles County Flood Control District for the purposes of fulfilling monitoring requirements in the Municipal Stormwater Permit. While overall sampling within the Ports is fairly coordinated and has established goals, multiple sampling programs do exist that are often not coordinated. Much less sampling and coordination occurs within the Channel.

Activities Addressing Water Quality Issues

Stormwater Regulation

The Dominguez WMA falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was adopted on December 13, 2001 and amended on September 14, 2006, to incorporate the Santa Monica Bay Beaches Bacteria TMDL Waste Load Allocations for summer dry weather discharges from MS4 outfalls to Santa Monica Bay beaches. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit on June 30, 1999. The Los Angeles County Flood Control District is the Principal Permittee for the Los Angeles stormwater permit. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permits can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/index.shtml.

An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system.

TMDLs

Those in effect as of October 2008 (approved by the Regional Board, by the State Board's Office of Administrative Law, and by USEPA):

- Los Angeles Harbor Bacteria (includes Cabrillo Beach)
- Machado Lake Trash

Those in development or under review:

- Machado Lake Nutrient
- Dominguez Channel and the Los Angeles and Long Beach Harbors Toxic and Metal (includes Los Angeles River estuary)

Additional information on TMDLs may be found at http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml .

Contaminated Sediment Long-term Management Strategy

The Los Angeles County's coastline includes two of the nation's largest commercial ports and several major marina complexes and small-vessel harbors. Maintenance of authorized depths in existing channels and berthing areas and expansion and modernization of ports, harbors, and marinas, requires periodic dredging in virtually all of these facilities. Some of the sediments dredged from these harbors contain elevated levels of heavy metals, pesticides, and other contaminants. In most cases, the concentrations of these contaminants do not approach hazardous levels. However, the sediments can contain enough contaminants that they are not suitable for unconfined ocean disposal. The State's Bay Protection and Toxic Cleanup Program identified bays and estuaries containing areas with contaminated sediments. Remediation of these sites may require dredging and disposal of this material. Disposal of any contaminated dredged materials requires special management, such as placement in a confined aquatic disposal site, capping, or disposal in an upland site. Additionally, some ports and harbors have considered other management techniques, such as treatment and beneficial re-use (CRWQCB, 2007b).

To enhance a regional perspective on management alternatives, cumulative impacts, and long-term solutions to prevent re-contamination of sediment, the regulatory and resource agencies, ports and harbors, environmental groups, and other interested parties established a task force. The mission of the **Contaminated Sediment Task Force** (CSTF) was to prepare a Contaminated Sediment Long-Term Management Strategy (Strategy) for the Los Angeles Region (limited to Los Angeles County). Past projects suggested that the major sources of contaminated dredge material would continue to be Marina del Rey Harbor, the ports of Los Angeles and Long Beach, and the mouth of the Los Angeles River (CRWQCB, 2007b).

The members of the CSTF agreed that the Strategy would consider confined aquatic and upland disposal, sediment treatment, beneficial re-use, other management techniques, and contamination source control. The CSTF agreed on a number of goals including identifying the scope of the contaminated sediment problem, an analysis of management and disposal alternatives, development of a unified regulatory approach, and identification of contaminant inputs to coastal waters and ongoing regional efforts to reduce such inputs with a view towards promoting efforts that would reduce the inflow of contaminants. Initially, the CSTF worked with existing watershed management programs (CRWQCB, 2007b).

The CSTF was established through a Memorandum of Understanding (MOU) among the state and federal agencies with regulatory jurisdiction over dredging and disposal activities, as identified by SB 673, and other agencies representing ports, harbors, and marinas. The following agencies are signatory to that MOU: U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; California Coastal Commission; Regional Water Quality Control Board, Los Angeles Region; County of Los Angeles Department of Beaches and Harbors; City of Long Beach; Port of Long Beach; and Port of Los Angeles (CRWQCB, 2007b).

The CSTF carried out its operation by two main committees (Executive and Management Committees), and five strategy development committees (Watershed Management and Source Reduction, Aquatic Disposal and Dredging Operations, Upland and Beneficial Re-use, Sediment Screening Thresholds, and Implementation Committees). The membership of the Management Committee included those parties that signed the MOU and one organization selected to represent the environmental community (Heal the Bay). This committee was the main decision-making group with the CSTF. The Executive Committee consisted of the chief executives of the four major agencies that regulate and manage dredging and disposal in Southern California. This committee facilitated final agency concurrence, adoption, and implementation of the completed strategy. The strategy development committees developed specific elements of the long-term management plan (CRWQCB, 2007b).

The CSTF completed a Contaminated Sediment Long-Term Management Strategy in 2005 and the document is available at http://www.coastal.ca.gov/sediment/long-term-mgmt-strategy-5-2005.pdf . Other relevant documents may be found at http://www.coastal.ca.gov/sediment/sdindex.html. The CSTF recommended a long-term goal of 100% beneficial re-use of contaminated sediments (constructed fill is considered re-use) but recognized this will be difficult to achieve. Although there are pilot projects underway to develop reliable and effective treatment processes such as centrifugation, issues still need to be resolved and eventually land sites will need to be identified where the treatment equipment would be located and treated sediments could be stored. End-users of the treated material also need to be identified (CRWQCB, 2007b).

Consolidated Slip Restoration Project

Consolidated Slip is located in the East Basin area of the Port of Los Angeles. Much of the WMA empties into the northeast side of Consolidated Slip through Dominguez Channel. Approximately 96% of the watershed area is developed. Tributaries to Dominguez Channel include several storm drains and minor channels. From the 1910s until several years ago, millions of gallons per day of industrial wastewater had been discharged into the Dominguez Channel, significantly contributing to the contaminant loading within Consolidated Slip. In addition, stormwater runoff from the Montrose Chemical Corporation’s pesticide manufacturing facility in Torrance, which operated from 1947 to 1982, probably contributed to DDT contamination of the watershed and Consolidated Slip (CRWQCB, 2007b).

Numerous sediment characterization studies have identified elevated levels of heavy metals, organochlorine pesticides, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in sediment and resident organisms from Consolidated Slip. In addition, the unlined portion of Dominguez Channel, as well as, Consolidated Slip are listed as a Superfund site by USEPA. Based on available information, over 1 million cubic yards of sediment may be impacted and require remedial actions to address water quality problems and restore beneficial uses (CRWQCB, 2007bB).

The Los Angeles Regional Board, in cooperation with the USEPA, Port of Los Angeles, US Army Corps of Engineers, and other interested parties, initiated the Consolidated Slip Restoration Project. The goals of this project are to describe the extent of sediment contamination in Consolidated Slip, identify the appropriate project stakeholders, evaluate remediation and restoration options, select an approach to solve the water quality problems and restore beneficial uses, develop a cost estimate for the proposed solution, identify funding sources to implement the project, and prepare and execute a restoration plan (CRWQCB, 2007bB).

The Port of Los Angeles prepared a draft conceptual plan on behalf of the Consolidated Slip Restoration Project. This plan described the extent of sediment contamination in Consolidated Slip and the site's history, discussed potential cleanup alternatives and possible funding sources, and identified data gaps. Although considerable sediment quality data had been collected for the project area, it was not adequate for directing the actual clean up of the site. Additional sediment sampling was required to characterize the areal extent and vertical depth of contamination in Consolidated Slip. The potential for recontamination of Consolidated Slip sediments from upstream areas of the watershed also needed to be evaluated (CRWQCB, 2007bB).

The USEPA conducted a monitoring study in 2002 to assess current sediment distributions and concentrations of DDT in sediments within the surface water drainage pathway leading from the Montrose Chemical Corporation's Torrance manufacturing facility site. The USEPA agreed to work with the Los Angeles Regional Board to expand the scope of this sampling program to include additional sediment chemistry analyses (e.g., trace metals and other trace organics), deeper cores and additional monitoring stations. This extra monitoring effort was paid for by several of the stakeholders of the Consolidated Slip Restoration Project (CRWQCB, 2007b).

Although cleanup targets have not been formally established for each contaminant of concern, it appears that approximately 1.3 million cubic yards of contaminated sediments would have to be addressed in some fashion within the Consolidated Slip area. In addition, approximately 700,000 cubic yards of contaminated sediments are present in portions of Dominguez Channel upstream from Consolidated Slip; this material may require removal to prevent recontamination of Consolidated Slip following remediation efforts in that area (CRWQCB, 2007b).

Several potential remediation alternatives to deal with the sediment contamination problem have been evaluated for technical and economic feasibility. The Restoration Project's Steering Committee recommended more detailed analysis of several alternatives, including partial capping of contaminated sediments, on-site fill of a portion of the slip as part of channel reconfiguration, removal and off-site disposal of contaminated sediments, removal and disposal of contaminated sediments to a Class I landfill, and treatment and possible beneficial re-use of contaminated sediments. A final alternative has not yet been selected; however, Dominguez Channel cleanup will likely need a total of $20-25 million for an alternative involving dredging and remediation with eventual re-use. Potential additional funding sources include cost recovery from responsible parties as well as the Water Boards' Cleanup and Abatement Account. This effort would likely be led jointly by the Regional Board and the US Army Corps (CRWQCB, 2007b).

The actual cost of the proposed cleanup of Consolidated Slip will depend on the volume of contaminated sediments to be processed and the remediation alternative selected. The project could cost as much as $75 million (based on a potential maximum of 1 million cubic yards of sediment at an estimated average handling and disposal cost of $75 per cubic yard). However, there will likely be an emphasis on dredging, capping, and slip reconfiguration which would reduce the final cost. The Port of Los Angeles will lead this effort which is expected to be a multi-year endeavor. Potential funding sources include cost recovery from responsible parties, the Water Boards' Cleanup and Abatement Account, the U.S. Environmental Protection Agency, or assistance from other interested parties (CRWQCB, 2007b).

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California
Regional Water Quality Control Board
Los Angeles Region

Watershed Management Initiative Chapter

December 2007

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EXECUTIVE SUMMARY

LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD
WATERSHED MANAGEMENT INITIATIVE CHAPTER
December 2007

OVERVIEW

Water resource protection efforts of the State Water Resources Control Board and the Regional Water Quality Control Boards are guided by a five-year Strategic Plan. A key component of the Strategic Plan is utilization of a watershed management approach for water resources protection.

To protect water resources within a watershed context, a mix of point and nonpoint source discharges, ground and surface water interactions, and water quality/water quantity relationships must be considered. These complex relationships present considerable challenges to water resource protection programs. The State and Regional Boards respond to these challenges within the context of our organization's Watershed Management Initiative (WMI). The WMI is designed to integrate various surface and ground water regulatory programs while promoting cooperative, collaborative efforts within a watershed. It is also designed to focus limited resources on key issues and use sound science.

Previously, State and Regional Board programs tended to be directed at site-specific problems. This approach was reasonably effective for controlling pollution from point sources. However, with diffuse nonpoint sources of pollutants, a new regulatory strategy was needed. The WMI uses a strategy to draw solutions from all interested parties within a watershed, and to more effectively coordinate and implement measures to control both point and nonpoint sources.

For the initial implementation of the WMI, during the late 1990s, each Regional Board identified the watersheds in their Region, prioritized water quality issues, and developed watershed management strategies. These strategies and the State Board's overall coordinating approach to WMI are contained in the *Integrated Plan for Implementation of the WMI* which is updated on an as-needed basis. In following years, the Regional Boards have continued to build upon their early efforts to utilize this approach. The full version of our WMI Chapter outlines our ongoing efforts to continue implementation of the WMI.

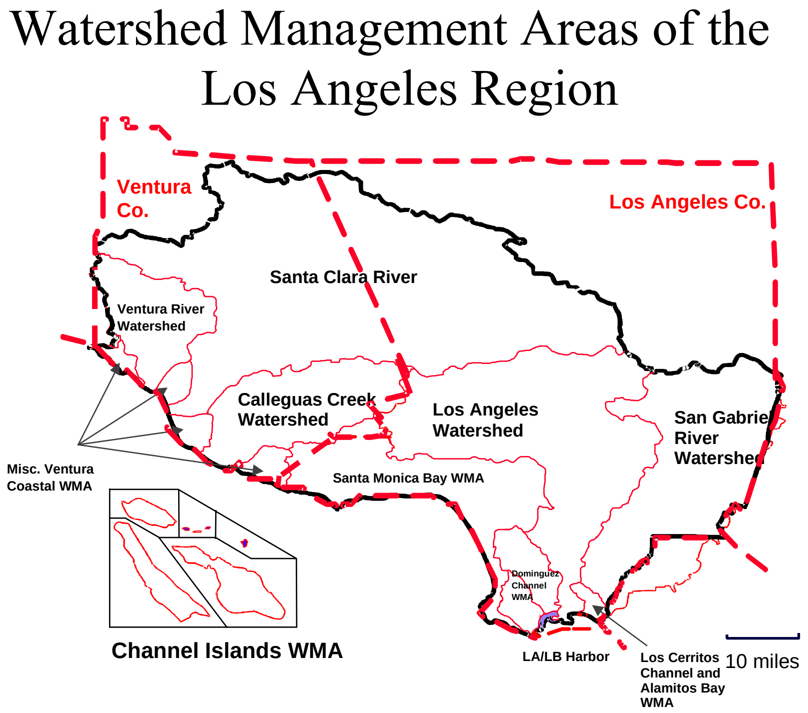
The Los Angeles Regional Board and Watershed Management

The Los Angeles Region has jurisdiction over all coastal drainages flowing to the Pacific Ocean between Rincon Point (on the coast in western Ventura County) and the eastern Los Angeles County line, as well as the drainages of five coastal islands (Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente). The Regional Board's jurisdiction also includes all coastal waters within three miles of the continental and island coastlines.

The Los Angeles Region is the State's most densely populated and industrialized region. Over 1,000 discharges of wastewater from point sources in this Region are regulated by the Los Angeles Regional Board. Over 700 of these point source discharges are discharged to surface waters, and are regulated under the National Pollutant Discharge Elimination System (NPDES). In addition, the Regional Board prescribes Waste Discharge Requirements (WDRs) for the remaining discharges, which are primarily to ground waters and landfills. However, the quality of many waters continue to be degraded from pollutants discharged from diffuse and diverse nonpoint sources. Future success in reducing pollutants from nonpoint sources and achieving additional reductions in pollutants from point sources requires a shift to a more geographically-targeted approach.

Our watershed management approach integrates activities across the Regional Board's many diverse programs, to the extent feasible, particularly permitting, planning, and other surface-water oriented programs which have tended to operate somewhat independent of each other. This approach enables us to better assess cumulative impacts of pollutants from all (point and nonpoint) sources, and more efficiently develop watershed-specific solutions that balance the environmental and economic impacts of our actions.

We have designated ten watershed management areas in the Los Angeles Region as shown in the figure below.



Initially, implementation of watershed management in the Los Angeles Region occurred in phases over a seven-year cycle for our pilot watersheds Ventura River and Calleguas Creek. We now utilize a five-year cycle to be in line with the standard permit life (of an NPDES permit). This shift in our watershed cycle is illustrated in the table below.

It should be pointed out that the involvement of stakeholders is critical to the success of watershed management; however, the process to involve stakeholders demands more of regulators in terms of public outreach, education, and consensus building.

Watershed Management Initiative Timeline

Dominguez Channel-LA/LB Harbor	FY 2007/08
Santa Monica Bay	FY 2008/09
Los Angeles River	FY 2009/10
San Gabriel River Los Cerritos Channel Channel Islands	FY 2010/11
Ventura River Misc. Ventura Coastal Santa Clara River Calleguas Creek	FY 2011/12

The Watershed Management Initiative Chapter

This document is the eighth iteration of what we call our "Chapter" which is part of the integrated WMI document for the whole state. The participants in implementation of the WMI in California (the nine Regional Boards, State Board, and USEPA) were asked in 1996 to begin preparation of a document which identified priorities and resource needs, across programs, in a watershed context. The Chapter is currently used both as an outreach and as a planning tool to identify the Region's priorities, as well as, where we need additional resources. The Chapter is organized into sections including the Introduction, Watershed Sections, and Region-wide Section. Included in each Watershed Section is an overview of that watershed, a description of its water quality concerns and issues, past significant Regional Board activities in the watershed, current (funded) activities, near-term (usually unfunded) activities that would benefit the watershed, and activities which may happen on a longer time-scale (usually unfunded). The Region-wide Section includes a description of activities not easily associated with particular watersheds.

Programs and Funding Under WMI

Programs covered under WMI include core regulatory, monitoring and assessment, basin planning and water quality standards, watershed management, wetlands, TMDLs, 401 certifications, groundwater, and nonpoint source management activities, as appropriate. Many of these programs also have region-wide components. It turns out most of our highest priority needs fall into areas that have little to no funding. Areas with particular shortages include nonpoint source management, CEQA review, basin planning, 401 certifications, stormwater, and more than minimal work on NPDES pretreatment, enforcement, compliance, and monitoring report review. This watershed effort is intended to result in resource flexibility and augmentation to address these deficiencies.

Integration of Multiple Mandates Under WMI

While the Watershed Management Initiative strives to integrate and coordinate the various Regional and State Board programs and address the highest priority funding needs for those programs, there is also need to respond to and accommodate priorities established by the individual Regional and State Boards' members, priorities established prior to the WMI which run on their own timelines, legal or legislative mandates, or other new mandates which may affect the way the WMI is implemented in a Region. It is important to re-state here that the WMI is not a program but rather an approach to integrating existing and newly evolving programs and mandates.

For example, a high priority statewide mandate is development of TMDLs. High priority Regional Board activities include implementation of an effective enforcement strategy, development of a septic tank policy initiative, development and implementation of a strategy to assess nonpoint source loadings, TMDLs, and better communication and coordination of Board programs and policies through improved outreach. More information is included in the Introduction of the full chapter. It is clear many of the Regional Board high priority activities are of primary importance in fulfilling not only the WMI but also Board mandates.

However, some mandates present challenges to fully implementing watershed management. These include USEPA, State Board, and legislative requirements for reducing permit backlog, conflicts with the timing of scheduled TMDLs, lengthy delays incurred by public processes (e.g., hearings, workshops), and insufficient funding or staff.

SUMMARY OF SIGNIFICANT WATERSHED ISSUES

The Region encompasses ten Watershed Management Areas (WMAs) which are the geographically-defined watershed areas where the Regional Board implements the watershed approach. These generally involve a single large watershed, within which exist smaller subwatersheds. However, in some cases they may be an area that does not meet the strict hydrologic definition of a watershed (e.g., several small Ventura coastal waterbodies in the region are grouped together into one WMA). Watersheds in the strictest sense are geographic areas draining into a river system, ocean or other body of water through a single outlet and include the receiving waters. They are usually bordered, and separated from other watersheds, by mountain ridges or other naturally elevated areas.

Many of the watersheds in this Region range over large areas that are highly diverse. A Designated Wilderness Area may occur in one part of a watershed while extensive development dominates another part and possibly agriculture exists in yet a different area of the watershed. This results in a great diversity of issues of concern to this agency in any particular watershed with the concomitant need to balance priorities among existing stakeholders. The following summarizes significant watershed issues in our watershed management areas. More detail may be found by consulting the full version of the WMI Chapter

Watershed Management Areas
Significant Watershed Issues

1) Dominguez Channel/LA-LB Harbor WMA

- Eight major NPDES discharges: one POTW, two generating stations, five refineries (five Channel discharges, three Harbor discharges)
- 38 minor individual permits (15 Channel, 23 Harbor)
- 56 discharges covered by general NPDES permits (32 Channel, 24 Harbor)
- Industrial storm water – 448 discharges
- Construction storm water – 214 discharges
- Historical deposits of DDT and PCBs in sediment
- Discharges from POTW & refineries
- Spills from ships and industrial facilities
- Leaching of contaminated groundwater
- Stormwater runoff
- 96 impairments including: metals, PCBs, PAHs, historic pesticides, coliform, trash, nitrogen
- Completed TMDL: LA Harbor bacteria (2005)
- Currently scheduled TMDLs: Machado Lake trash, harbor metals and toxics

2) Santa Monica Bay WMA

- Key recreational resource (beaches)
- Seven major NPDES discharges: three POTWs, one refinery, and three generating stations
- Eleven minor discharges
- 176 discharges covered by general NPDES permits
- Industrial storm water – 100 discharges
- Construction storm water – 401 discharges
- 224 impairments including: mercury, selenium, other metals, historical pesticides, PAHs, PCBs, nitrogen, coliform, trash, habitat alteration, exotic vegetation, salts

Coastline

- Acute health risk associated with swimming in runoff-contaminated surfzone waters
- Chronic risk associated with consumption of seafood in areas impacted by DDT and PCB contamination
- Reduction of loadings from the two major POTWs in light of projected population increases
- Other impacts from urban runoff/storm water
- Historic deposits of DDT and PCBs in sediment
- Loadings of pollutants from other sources: sediment resuspension, atmospheric deposition
- The need to have a better understanding of the Bay's resources
- Completed TMDLs: Santa Monica Bay beaches dry weather coliform (2003), Santa Monica Bay beaches wet weather coliform (2003)

Malibu Creek Watershed

- Excessive freshwater, nutrients, and coliform in lagoon; contributions from POTW and other sources
- Urban runoff from upper watershed
- Impacts to swimmers/surfers from lagoon water
- Septic tanks in lower watershed
- Appropriate restoration and management of lagoon
- Access to creek and lagoon by endangered fish
- Completed TMDL: Malibu Creek coliform (2006)
- Currently scheduled TMDLs: Malibu Creek nutrients

Ballona Creek Watershed

- Trash loading from creek
- Wetlands restoration
- Sediment contamination by heavy metals from creek to Marina del Rey Harbor and offshore)
- Sediment contamination by heavy metals and trace organics within Ballona Creek Entrance Channel
- Toxicity of both dry weather and storm runoff in creek
- High bacterial indicators at mouth of creek
- Completed TMDLs: Marina del Rey back basins coliform (2004); Ballona Creek trash (2005); Ballona Creek metals (2006); Ballona Creek Estuary toxics (2006); Marina del Rey toxics (2006); Ballona Creek coliform (2006)

3) Los Angeles River Watershed

- Six major NPDES discharges (four POTWs)
- 15 minor individual permits
- 114 discharges covered by general NPDES permits
- Industrial storm water – 1,365 discharges
- Construction storm water - 759 discharges
- Nitrogen and coliform contributions from septic systems
- Other nonpoint sources (horse stables, golf courses)
- Cross-contamination between surface and groundwater
- Protection and enhancement of fish and wildlife habitat and recreational areas
- Removal of exotic vegetation
- Balancing removal of vegetation for flood control with the need for urban habitat
- Attaining a balance between water reclamation and minimum flows to support habitat
- leakage of MTBE from underground storage tanks
- Contaminated sediments within the LA River estuary
- 111 impairments including: nitrogen, trash, selenium, other metals, coliform, PCBs, historic pesticides, chlorpyrifos
- Completed TMDLs: LA River nutrients (2004); LA River metals (2005)

4) San Gabriel River Watershed

- Six major NPDES discharges (four POTWs)
- Eleven minor individual NPDES permits
- 58 discharges covered under general NPDES permits
- 570 discharges covered by the industrial storm water permit
- 446 discharges covered by the construction storm water permit
- Sluicing and disposal of sediments from reservoirs
- Protection of groundwater recharge areas
- Ambient toxicity
- Excessive trash in recreational areas of upper watershed
- Mining/stream modifications
- Extensive stream modification for mining and water reclamation
- Urban and storm water runoff quality
- Nonpoint source loadings from nurseries and horse stables
- Lack of understanding of estuary dynamics (e.g. salinity profile)
- Septic systems
- 39 impairments including: nitrogen and effects, trash, metals, historic pesticides, coliform, chlorides, PCBs
- Completed TMDL: East Fork trash (2000)
- Currently scheduled TMDLs: Legg Lake trash

Watershed Management Areas
Significant Watershed Issues

5) Los Cerritos Channel/Alamitos Bay WMA

- Two minor NPDES discharges
- Twelve discharges covered under general NPDES permits
- 37 discharges covered by the industrial storm water permit
- 31 discharges covered by the general construction storm water permit
- Loss of wetlands habitat in Los Cerritos area
- Impacts from antifouling paint in marinas
- Urban and storm water runoff impacts on isolated water bodies
- Loss of tidal exchange
- 19 impairments including: ammonia, metals, historic pesticides and effects, PCBs, PAHs

6) The Channel Islands WMA

- Five islands
- One major NPDES discharge, four minor discharges
- One discharge covered by general NPDES permit
- Four discharges covered by the industrial storm water permit
- One discharge covered by the construction storm water permit
- Areas offshore of islands designated as Areas of Special Biological Significance
- High quality marine and rocky intertidal habitat
- Heavy use by marine mammals and endangered species
- Impairment: coliform (Avalon Beach)
- Lack of information on water quality

7) Ventura River Watershed

- Eutrophication, especially in estuary
- TDS concerns in some subwatersheds
- One major NPDES discharge (POTW)
- Eight discharges covered under general NPDES permits
- Industrial storm water – 36 discharges
- Construction storm water – 33 discharges
- Impediments (dams, diversions) to steelhead trout migration
- 15 impairments including: DDT, algae, coliform, low DO, diversions, selenium, other metals, trash
- Currently scheduled TMDLs:: Ventura River Estuary trash

8) Miscellaneous Ventura Coastal WMA

- Three major NPDES discharges (one POTW), six minor NPDES discharges, and eight discharges covered by general NPDES permits
- Industrial storm water – 67 discharges
- Construction storm water – 91 discharges
- 21 impairments

The harbors

- Accumulation of metals, PCBs, and historic pesticides in sediment and tissue
- Considerable marine life subject to impacts
- Impairments: DDT, PCBs, PAHs, metals, TBT, coliform
- Currently scheduled TMDLs: pesticides FY08/09 and coliform FY08/09

The wetlands and coast

- Historic pesticide contamination
- Loss of quality habitat
- Impacts from oil spills and agriculture
- Use by endangered species
- Impairments: historic pesticides and effects, coliform
- Currently scheduled TMDLs: Ventura beaches coliform

9) Santa Clara River Watershed

- High quality natural resource
- Four major NPDES discharges (POTWs)
- Eight minor NPDES discharges
- 48 discharges covered under general NPDES permits
- Industrial storm water – 125 dischargers
- Construction storm water – 367 dischargers
- Impacts from exotic vegetation
- Impacts from agriculture
- Increasing urbanization, flows, and channelization in upper watershed; impacts on middle and lower watershed
- 43 impairments including: nitrogen and effects, salts, coliform, trash, historic pesticides
- Completed TMDLs: Upper Santa Clara chloride (2005); nutrients (2004)
- Currently scheduled TMDLs: Lake Elizabeth, Munz Lake, Lake Hughes trash

10) Calleguas Creek Watershed

- Five major NPDES discharges (POTWs)
- Three minor NPDES discharges
- Thirteen discharges covered under general permits
- Industrial storm water – 90 dischargers
- Construction storm water – 292 dischargers
- Highly modified watershed
- Impacts from agriculture and naval facility
- Sediment inputs to Mugu Lagoon, one of the largest wetlands in southern California
- Competing urban uses; development pressures, particularly in upper watershed
- Severe lack of benthic and riparian habitat in watershed
- 159 impairments including: nitrogen and effects, water-soluble pesticides and effects, salts, historic pesticides, PCBs, siltation, selenium, mercury, other metals, trash
- Completed TMDLs: nitrogen (2003); toxicity (2006); organochlorine pesticides, PCBs, and siltation (2006); metals and selenium (2006)
- Currently scheduled TMDLs: trash; salts

SUMMARY OF REGIONWIDE ACTIVITIES

There are many activities conducted at the Region which do not apply to a specific watershed; instead they represent ongoing regionwide strategies and policies, or programs which are not directly linked to the rotating watershed cycle. Also, statutory, regulatory, or funding requirements may dictate completion of some activities at odd intervals throughout the five-year watershed cycle (such as increased emphasis on pretreatment inspections). The table below gives examples of watershed versus non-watershed related activities.

Watershed Tasks	*Non-Watershed Tasks*
Renew permits	Issue new permits
	Develop new general permits, reduce backlog, pretreatment
Integrate municipal storm water program	Issue individual industrial and storm water permits
Conduct inspections for watershed permits	Conduct inspections on new permits
Enforcement (in-cycle compliance)	Enforcement (spills, out of cycle compliance)
Implement NPS controls	Develop regional strategies to address NPS problems
TMDL/WLAs	
Develop, coordinate and implement watershed monitoring	Coordinate monitoring on a regional scale
Water Quality Assessments (State of the Watershed Reports, partial updates to 305(b) by watershed)	Biennial 305(b) Reports to USEPA
Develop watershed policies	Develop regional policies
Watershed-specific Basin Plan Updates	Regional Basin Plan Updates, Triennial Reviews
Data management (input and use by watershed)	Regional Database management
GIS (input of watershed-specific layers and information)	GIS (development and input of regional layers and Maintenance of system)
Watershed-specific outreach/education	General outreach education
Incorporation of CEQA and 401 Decisions into watershed planning (as groups are formed, and as timing permits)	Timely review of CEQA documents, 401 certifications per statutory deadlines

While the Watershed Management Initiative strives to integrate and coordinate the various Regional and State Board programs and address the highest priority funding needs for those programs, there is also need to respond to and accommodate priorities established by the individual Regional and State Boards' members, priorities established prior to the WMI which run on their own timelines, or other new mandates which may affect the way the WMI is implemented in a Region. The following briefly describes our overall approach to implementing a subset of programs (some statewide mandates) and other Board priorities on a regionwide scale.

Core Regulatory – General Permits

There are many dischargers in this Region covered by general permits for discharges to surface water through a letter issued by the Executive Officer. This activity occurs independent of the watershed cycle as the need arises. Many of these are for short-term projects such as dewatering. 40 CFR §122.28 provides for issuance of general permits to regulate a category of point sources if the sources: a) involve the same or substantially similar types of operations, b) discharge the same type of waste, c) require the same type of effluent limitations or operating conditions, d) require similar monitoring, and e) are more appropriately regulated under a general permit rather than individual permits.

Core Regulatory – Storm Water Permits

Storm water activities include those involving the three municipal permits (and Standard Urban Storm Water Mitigation Plans associated with the two urban ones) in the Region, the 2842 facilities regulated under the State's general industrial permit, and the approximately 2678 construction sites regulated under the State's general construction permit.

Wetlands Protection and Management – Water Quality Certification

A key wetlands regulatory tool for the Regional Board is the CWA Section 401 Water Quality Certification Program which regulates discharges of dredge and fill materials to waters. The 401 certification program is one of the most effective tools the state has for regulating hydrologic modification projects, especially those which directly impact the region's diminishing acres of wetlands and riparian habitat.

Key program activities should include CEQA documents review/response, pre-construction meetings with applicants, site visits, application processing, follow-up monitoring and inspections, and enforcement. Unfortunately, the program is currently severely underfunded with only application processing being undertaken. Approximately 150-200 applications are processed each year

Management of Nonpoint Source Pollution

Management of NPS pollution is based upon the requirements of the Porter-Cologne Water Quality Control Act (Porter-Cologne Act). The Porter-Cologne Act, Division 7 of the California Water Code, establishes a comprehensive program for the protection of water quality and beneficial uses of the State's waters and makes explicitly clear the law applies to nonpoint as well as point source discharges. The Porter-Cologne Act also establishes the administrative permitting authority—in the form of Waste Discharge Requirements (WDRs), waivers of WDRs or basin plan prohibitions—to be used to control NPS discharges. Additional legislative requirements state that all waivers must be conditional, they are to be re-evaluated and subsequently reissued every five years, and the RWQCBs must require compliance with waiver conditions.

California's Nonpoint Source (NPS) Pollution Control Program has been in effect since 1988 and was updated in January, 2000. In August 2004 the Office of Administrative Law approved the NPS Policy. The policy supersedes certain elements of the NPS Program Plan and formally eliminates the "three-tiered approach" in informal use.

Our long-term goal for the NPS program is to improve water quality by implementing the management measures identified in *the California Management Measures for Polluted Runoff Report (CAMMPR)* by 2013.

Major current nonpoint source program priorities are: 1) oversight of workplans for grant-funded projects, 2) establishment of regional strategies to address agriculture, marinas, and septic tanks (the latter will be focused on densely populated communities and areas where ground water is a source of drinking water), 3) investigation of loading contributions from agriculture, nurseries, golf course, and horse stables (in aid of TMDL work), and 4) expansion of our public education and outreach.

Enforcement Strategy

The statewide Water Quality Enforcement Policy adopted by State Board in 1996 and revised in 2002 is intended to make all enforcement consistent, predictable, and fair throughout the state. The Regional Board adopted a resolution in 1997 which confirmed the Regional Board's desire to carry out enforcement in a manner consistent with State Board's enforcement policy and that Regional Board staff prepare a regional enforcement strategy consistent with State Board's enforcement policy.

The enforcement policy states that the Regional Board staff must bring to the attention of their Regional Board for possible enforcement action, at a minimum, an array of permit violations for a variety of dischargers as well as failure to submit reports or deficient reports, and spills. Our increased efforts have resulted in an improved enforcement record for the region and has contributed to increased compliance in some programs (e.g. industrial stormwater). The quarterly violations report is available to the public as part of the Executive Officer's Report; and is also available on the Board's web page.

Beaches/Coastal Watersheds Activities

Due to the great resource and economic value associated with the beaches and coastal watersheds of this Region, a number of activities occur that are specific to the coastal areas. Among these are a number of monitoring programs as well as a program to manage contaminated sediments. Monitoring programs include: several regional surveys of the Southern California Bight which evaluated a number of constituents to determine the spatial extent and magnitude of ecological disturbances and the Surface Water Ambient Monitoring Program (SWAMP).

Additionally, a Contaminated Sediments Task Force developed a long-term strategy to manage contaminated sediments found in the ports and marinas of Los Angeles County. This five-year effort was funded by the Karnette bill (SB 671) beginning in FY97/98.

FOR ADDITIONAL INFORMATION

Contact the Regional Board’s Watershed Coordinator, Shirley Birosik, at (213) 576-6679 or sbirosik@waterboards.swrcb.ca.gov for additional information or consult the Regional Board’s website at http://www.waterboards.ca.gov/losangeles/html/programs/regional_programs.html#Watershed .

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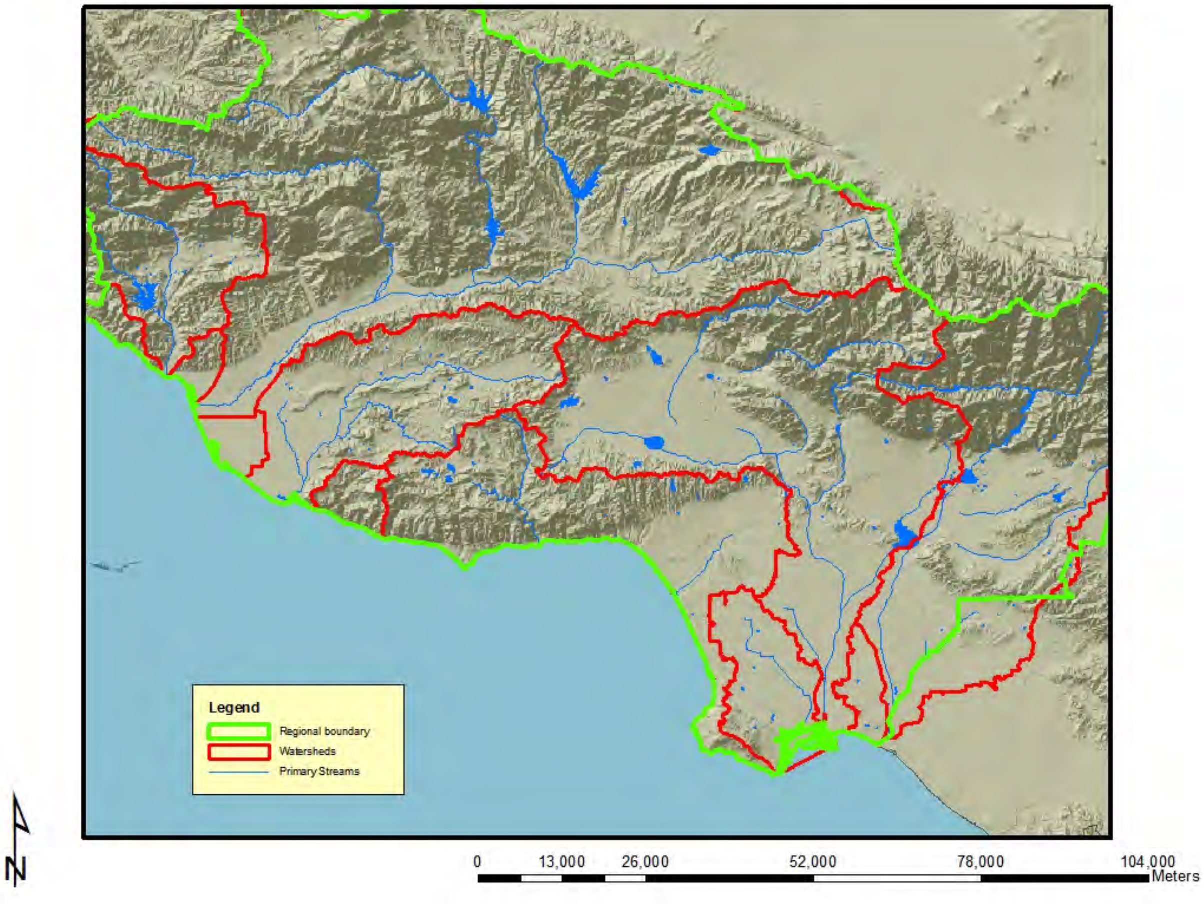
Section 1 . INTRODUCTION

THE REGIONAL WATER QUALITY CONTROL BOARD - WHY THE WATERSHED MANAGEMENT APPROACH?

The nine Regional Water Quality Control Boards (Regional Boards) are each semi-autonomous and comprised of up to nine part-time Board Members appointed by the Governor. Regional Board boundaries are primarily based on watersheds. Each Regional Board makes water quality decisions for its region. These decisions include setting water quality standards, issuing waste discharge permits, adopting policies, and taking enforcement actions.

The Los Angeles Region has jurisdiction over all coastal drainages flowing to the Pacific Ocean between Rincon Point (on the coast in western Ventura County) and the eastern Los Angeles County line, as well as the drainages of five coastal islands (Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente). The Regional Board's jurisdiction also includes all coastal waters within three miles of the continental and adjacent island coastlines. The topography of the Region is quite variable as seen in the figure below.

Topography of the Los Angeles Region



The Region is the State's most densely populated and industrialized area. Over 1,000 discharges of wastewater from point sources in this Region are regulated by the Los Angeles Regional Board. Over 700 of these point source discharges are discharged to surface waters, and are regulated under the National Pollutant Discharge Elimination System. Permits issued under this program are referred to as NPDES permits. In addition, the Regional Board prescribes Waste Discharge Requirements (WDRs) for the remaining discharges which are primarily to ground waters and landfills. Despite the large number of discharges and highly industrialized nature of some watersheds, overall, land use within the Region is quite diverse (see Watershed Sections for detailed maps).

In recent years, watershed issues have become much more complex and this has resulted in the need to respond with more coordinated solutions for water quality problems. The increased emphasis on TMDL development has resulted in the need for more cumulative assessments of pollutant loadings to waterbodies and impacts to beneficial uses. This requires acknowledgment of the growing importance of nonpoint sources to watershed pollutant loadings. And, recognizing the value of stakeholder group involvement in solving watershed problems.

Managing water quality by watershed, as much as possible within program funding and scheduling constraints, allows the Los Angeles Regional Board to address these varied demands in a more coordinated and effective manner. The control of point source pollutants through NPDES permits and WDRs is central to the Los Angeles Regional Board's strategy to protect water quality; participation in watershed stakeholder groups, and active solicitation of their involvement in TMDL, permit, and nonpoint source activities, and awarding of grant monies, allow for additional coordination.

THE WATERSHED MANAGEMENT INITIATIVE

Watershed management is not program; it is a strategy for integrating and managing resources, both human and fiscal. The goal of the state's Watershed Management Initiative (WMI) is to integrate or coordinate water quality monitoring, assessment, planning, standards, permit writing, nonpoint source management, ground water protection, and other programs at the State and Regional Boards as much as practicable to promote a more efficient use of personnel and fiscal resources while ensuring maximum water quality protection benefits. The State's watershed work integrates and supports, to the extent possible, local community watershed protection efforts to implement cost-effective strategies for natural resource protection. As characteristics and resources vary widely from watershed to watershed, this approach customizes efforts to manage resources and address problems unique to each watershed while offering stakeholders the opportunity to implement the most cost-effective solutions to problems within their watersheds.

Watershed management represents a shift from a traditional approach that focuses on regulation of point sources, to a more regional approach that acknowledges environmental impacts from other activities. Over the last thirty years, permitting programs have significantly reduced pollutants that are discharged to California's waters from point sources. However, the quality of many waters continues to be degraded from pollutants discharged from diffuse sources, referred to as nonpoint sources, and from the cumulative impacts of multiple point sources. Future success in reducing pollutants from nonpoint sources and achieving additional cost-effective reductions in pollutants from point sources requires a shift to a more geographically-targeted approach. Activities particularly amenable to a rotating cycle include monitoring, reporting, and water quality assessments.

THE WATERSHED MANAGEMENT INITIATIVE CHAPTER

This document is the eighth iteration of the Chapter. The participants in implementation of the WMI in California (the nine Regional Boards, State Board, and USEPA) were asked in 1996 to begin preparation of a document which identified priorities and resource needs, across programs, in a watershed context. The Chapter is primarily used as an information and outreach tool to describe the Regional Board's watersheds and their major water quality issues, as well as, describe the Board's program responsibilities in aid of program workplan development and grant applicants needs. This also allows for highlighting where priorities are poorly funded in this Region and can be in support of requests for additional resources through Budget Change Proposals. It turns out many of our highest priority needs fall into areas that have little to no funding. This effort will hopefully result in flexibility and augmentation to address this deficiency.

The Chapter itself is not a commitment to complete work but provides a framework to identify priorities and resource needs which should form the basis for formal commitments which are made in fund-source and program-specific workplans on an annual basis. Determinations of which activities will be funded by specific workplans may be negotiated on the basis of the information in the Chapters. Annual program workplans and grant applications will still be prepared by program managers to identify which activities are going to be funded in a particular year based on the fiscal decisions made.

And, although the Chapter identifies specific projects or types of projects we would like to see funded through grant programs, these are not complete or exclusive lists. At the heart of any request for funding from a grant program should be a proposal to solve (or get to the solution of) water quality problems identified in this Chapter as high priorities; doing so in the context of watershed management is both desirable and, increasingly, a requirement of many grant programs; the Integrated Regional Water Management Plan grant program initiated through Proposition 50 is one example.

The Chapter is organized into sections including the Introduction, Watershed Sections, and Region-wide Section. Included in each Watershed Section is an overview of that watershed, a description of its water quality concerns and issues, maps showing locations of permitted discharges, past significant Regional Board activities in the watershed, current (funded) activities, near-term (usually unfunded) activities that would benefit the watershed, and activities which may happen on a longer time-scale (also usually unfunded). The Region-wide Section includes a description of activities not easily associated with particular watersheds as well as more detailed information on implementation of certain programs (such as nonpoint source) in the Region. Lists of permits organized by watershed are available as separate documents on the Regional Board website.

WMI DEFINITIONS

The following represent commonly used terms and definitions utilized throughout the document:

A **watershed** is the geographic area draining into a river system, ocean or other body of water through a single outlet and includes the receiving waters. Watersheds are usually bordered, and separated from other watersheds, by mountain ridges or other naturally elevated areas.

The **watershed management approach** is the specific method by which the Regional Board implements watershed management. Features include the targeting of priority problems, stakeholder involvement, developing integrated solutions, and evaluating measures of success. The entire watershed, including the land mass draining into the receiving water, is considered.

Watershed Management Areas (WMAs) are the geographically-defined watershed areas where the Regional Board will implement the watershed approach. These generally involve a single large watershed within which exists smaller subwatersheds but in some cases may be an area that does not meet the strict hydrologic definition of a watershed e.g. several small Ventura coastal waterbodies in the region are grouped together into one WMA.

State of the Watershed Reports are reference documents produced by Regional Board staff that describe the existing water quality conditions, data gaps, and sources of pollutants within a WMA. Strategies to resolve the water quality concerns, either in progress or proposed, are described. Preliminary versions of these reports are produced by the Regional Board in order to stimulate discussion and input on issues from other stakeholders. These documents will be updated as needed. First edition reports have been prepared for Calleguas Creek, Santa Monica Bay, Los Angeles River, San Gabriel River, Ventura River, and Santa Clara River Watersheds.

A **Watershed Management Plan** is a planning document often produced by watershed stakeholder groups which addresses water quality, land use, economic, habitat, recreation, and other concerns and recommends specific management strategies to resolve identified problems in a cooperative and coordinated manner. Few of these existed prior to 2000. Grants recently awarded under Proposition 13 to develop watershed management plans are beginning to fill in the gaps.

Nonpoint sources of pollution are those with no single point of origin. Pollutants may often be carried off the land by stormwater or be part of urban runoff. Common nonpoint sources are agricultural, urban (runoff from residential areas, parking lots, streets, etc.), and construction activities. **Point sources**, on the other hand, by definition originate from a discrete source such as a pipe or outfall through which a facility may discharge while regulated by a NPDES permit.

Beneficial uses are those uses of water identified in state and regional water quality control plans that must be achieved and maintained. Uses include contact water recreation, municipal water supply, navigation, agricultural supply, wildlife habitat, and groundwater recharge, among others. **Designated** beneficial uses, together with water quality objectives, form water quality standards as mandated under the California Water Code and Federal Clean Water Act.

The California Water Code defines **water quality objectives** as “the allowable limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or prevention of nuisance within a specific area." These objectives are both narrative (descriptive) and numerical and appear in each Regional Board's water quality control plan (**Basin Plan**) which also describes implementation programs to protect all waters in the Region.

Best Management Practices (BMPs) are intended to reduce the amount of pollutants and prevent pollutants from leaving a facility and reaching a waterbody. BMPs include good facility housekeeping methods and such things as scheduling certain types of work around periods of rainfall or high winds, controlling runoff from a facility and modifying practices to reduce the possibility of pollutants leaving a facility. These are often used in regulating stormwater and other nonpoint sources.

The **Total Maximum Daily Load (TMDL)** is a number that represents the assimilative capacity of a receiving water to absorb a pollutant. The TMDL is the sum of the individual wasteload allocations for point sources, load allocations for nonpoint sources plus an allotment for natural background loading, and a margin of safety. TMDLs can be expressed in terms of mass per time (the traditional approach) or in other ways such as toxicity or a percentage reduction or other appropriate measure relating to a state water quality objective. A TMDL is implemented by reallocating the total allowable pollution among the different pollutant sources(through the permitting process or other regulatory means) to ensure that the water quality objectives are achieved.

- **TMDLs** establish the loading capacity of a watershed, identify needed reductions, identify sources, and recommend allocations for point and nonpoint sources.

- The **Margin of Safety** is a required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody.

- **Grouping TMDLs** is a reasonable and logical way to collapse the total number of individual TMDLs to make the most effective use of resources we currently have and any which we may obtain in the future. This is largely due to the fact that some of the "pollutants" for which a water may be listed are actually "effects" of pollutants. The TMDL chart in each watershed section of this report reflects this collapsed approach. For example, many reaches of the Los Angeles River are listed for ammonia. Some of the same reaches are listed for pH problems while other reaches are listed for algae, scum, and odors. It is very likely the presence of these "pollutants" are interrelated. Excessive nitrogen (reflected here as high levels of ammonia) may lead to a condition of eutrophication (excessive nutrient loading) which can influence pH levels as well as promote increased algal growth. Scum may be evident due to floating algal material and odors may result when excessive algae starts to die off. Thus, it makes sense to group these TMDLs and approach the problem by determining the sources of nitrogen loading into the watershed and the appropriate allocations in order to reduce loadings.

OVERVIEW OF ONGOING REGIONAL BOARD PROGRAMS AND ACTIVITIES

The Regional Board implements a wide variety of programs with different mandates, requirements, etc. Many of these (primarily surface water programs) are already fully or partially integrated into the watershed approach; others (primarily ground water) may be incorporated later and a few will likely remain separate from the WMI process. The following gives a brief description of these major program areas, current priority activities for each, and whether they are considered Category One or Two activities. **Category One** activities are those of high priority which are required by federal or state statute or regulation that need to be completed at least once during the 5-year planning cycle. **Category Two** activities are considered very important but are not required by statute or regulation. Additionally, more specific program objectives and implementation activities are included in the watershed or region-wide sections as appropriate. Updated information on Regional Board activities and programs may be also found on the Board's webpage at http://www.waterboards.ca.gov/losangeles.

SURFACE WATER

Core Regulatory ***(Category One)***

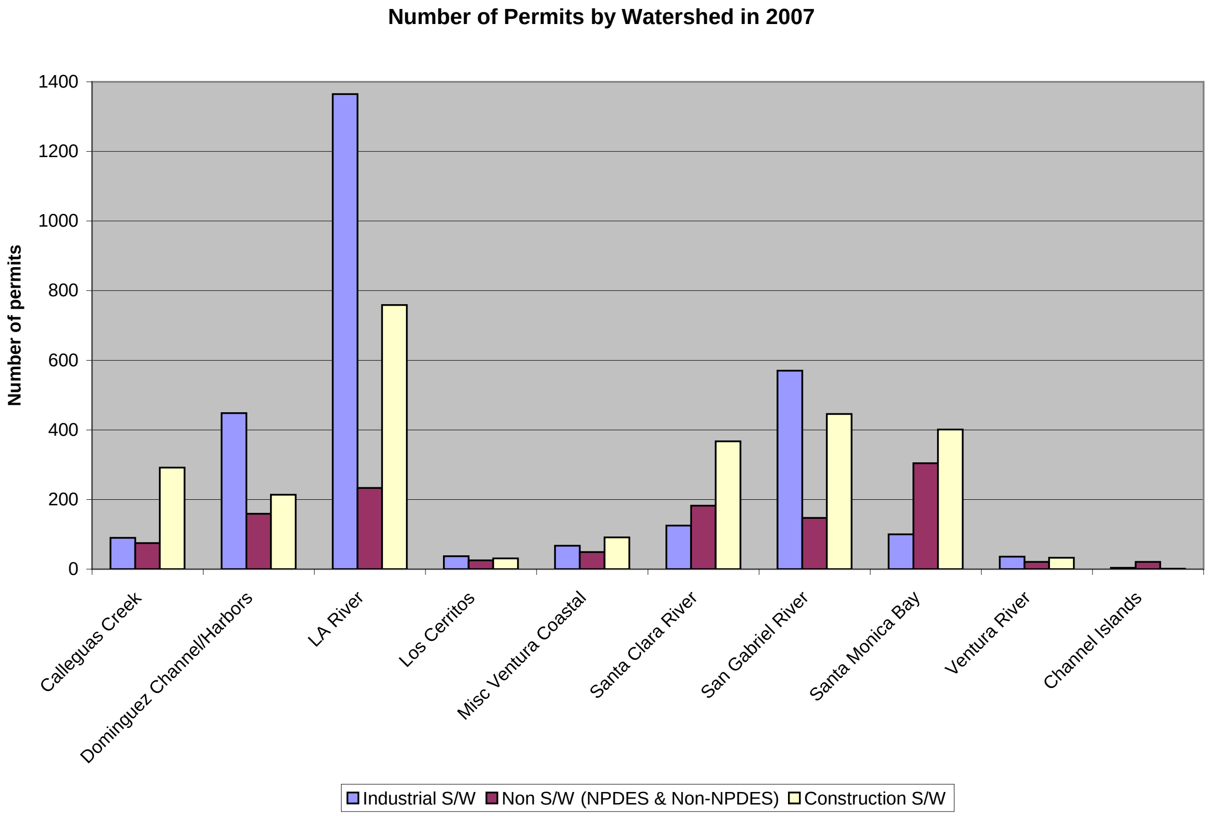
Core regulatory activities include NPDES (individual permits - updates and revisions, issuance of general permits, stormwater permits/program, enforcement actions, response to complaints, compliance and pretreatment inspections, pretreatment audits, and review of monitoring reports), groundwater protection activities (issuance of Waste Discharge Requirements), issuance of Water Reclamation Requirements, and land disposal under Chapter 15 California Code of Regulations.

Issuance of new permits continues to be a high priority. Reduction of backlog and increased efforts in compliance and enforcement are also very high priorities. Currently, POTW permits are being renewed in a timely manner but there are shortages in staff resources for renewals of industrial general permits which are experiencing backlogs. The goal is to inspect major NPDES dischargers at least once annually and inspect minor NPDES dischargers at least once in each permit reissuance cycle (20% of the total per year). However, since 19 staff are needed to fully implement the inspections on that schedule as well as review discharger self-monitoring reports, conduct enforcement, and enter data into CIWQS, our data management system, while only four are available, inspections have been prioritized to focus on the 25 major and 35 minor NPDES dischargers considered problem facilities. Investigation and followup on spills are also severely limited due to need for the additional identified PYs.

Our watershed efforts will focus on coordinating receiving water monitoring and implementing bioassessment. This involves integrating receiving water monitoring with the Surface Water Ambient Monitoring Program to the extent practicable through periodic reallocation of discharger receiving water monitoring resources to accomplish watershed-wide monitoring.

Core regulatory must also implement waste load allocations established by TMDLs during renewal of existing permits or issuance of new permits.

The number of permits by watershed are shown in the following figure. Currently, there are a total of 1,216 non-stormwater permits being managed in the Region. In addition, 2,842 facilities are covered by the general industrial stormwater permit, and 2,678 facilities are covered by the general construction stormwater permit (the number of facilities covered by the construction stormwater permit will change frequently as construction is completed and new projects are started). Most permitting activity, including stormwater permits related to construction, continues to be focused in the urban areas of the Region.



Monitoring and Assessment *(Categories One and Two)*

Category One activities include preparation of the biennial Water Quality Assessment 305(b) Report and implementation of the Surface Water Ambient Monitoring Program (SWAMP). Category Two activities include Los Angeles Basin Contaminated Sediment Task Force work (a former Category One activity), involvement with special studies (e.g., Bight-wide regional surveys), and assistance with volunteer monitoring.

Monitoring and/or assessment efforts are occurring on both regional and watershed scales. Implementation of SWAMP is the major regional monitoring activity with direct coordination provided by Regional Board staff (SWAMP and the Contaminated Sediment Task Force are both described in more detail in the Region-wide Section of this document while activities specific to each watershed are described in the appropriate watershed sections). Also, every two years an update of the 305(b) report is required; emphasis will be put on updating targeted watersheds at those times but all data received will be evaluated. The next update is scheduled for 2008 and is currently underway.

Monitoring can have a number of goals. It may be used to assess trends over time and obtain general assessment information on a regional scale. It may be used to pinpoint "hot spots" and track sources on a watershed scale. It may also be used to assess loadings for TMDLs. An increasing use will be to better judge impairments of beneficial uses on a watershed scale and to assess effectiveness of nonpoint source BMPs and other water quality improvement strategies.

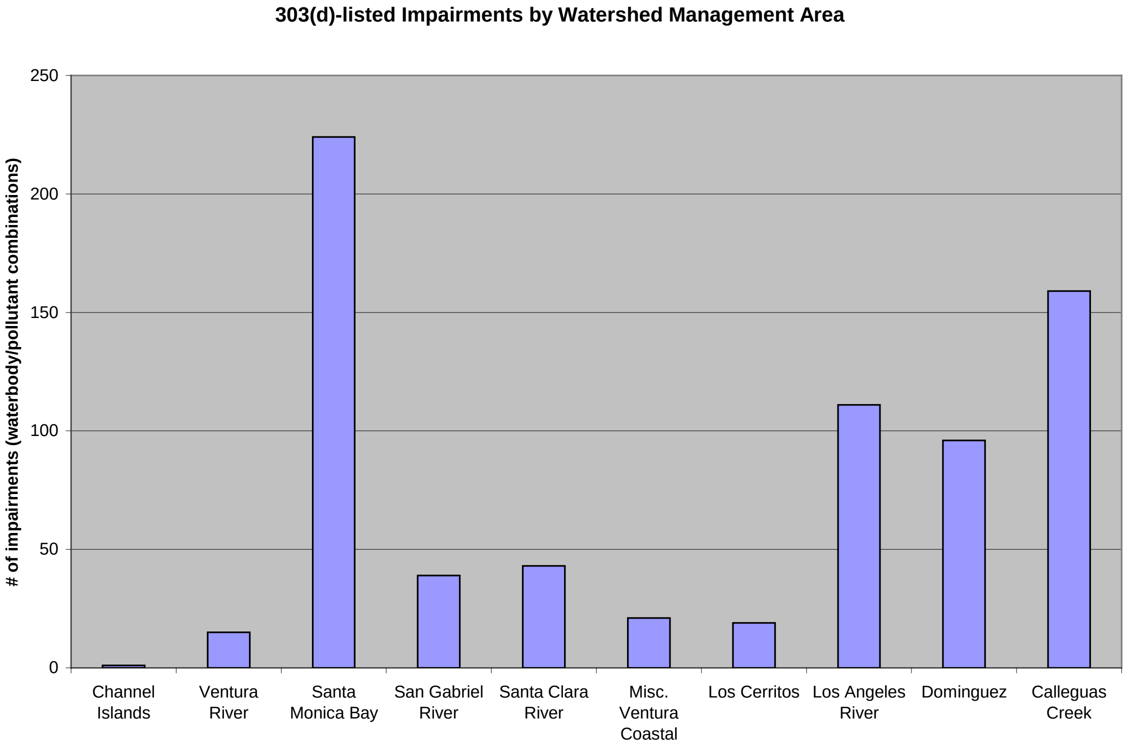
A major long-term monitoring and assessment goal is to increase utilization of biological assessments including incorporating them in monitoring requirements for dischargers.

Basin Planning and TMDLs ***(Categories One and Two)***

Category One basin planning activities include conducting triennial reviews of planning priorities, development of water quality standards and implementation plans and policies, development of TMDLs, and preparation of Basin Plan amendments (some of which follow from development of TMDLs).

A triennial review is a fundamental planning function at Regional Boards. This activity provides the Board with the opportunity to review the status of water quality, identify issues and problems, and solicit direction and comment from concerned parties as well as the public in general. The triennial review process sets the stage for possible changes (i.e. amendments) to the Basin Plan, which may be needed to more effectively protect water quality. Amendments to the Basin Plan also ensure that the Regional Board's approach to protecting water quality is legally sound. The current triennial review is from 2005-2007; the next triennial review will begin shortly.

There are 728 total reach/constituent impairments; TMDLs will be completed on the approximately 95 grouped impairments. About eleven percent of the impairments are based on excessive indicator bacteria while historic DDT and PCBs contribute to somewhat lesser numbers of impairments (9% and 7.5%, respectively). The number of current impairments (2006 303(d) list) by watershed is reflected in the figure below:



Another important planning function is interaction with the public and other agencies that are planning projects that may impact the environment. Under the California Environmental Quality Act, the Regional Board has an opportunity and responsibility to work with the public to ensure projects that may affect water quality are properly designed to reasonably mitigate adverse impacts. This responsibility to participate in the planning processes at other agencies extends to the development of regulations (such as the California Toxics Rule and State Implementation Policy) and guidelines (such as irrigation practices). Review of environmental documents is a Category Two activity.

<u>Wetlands Protection and Management</u> *(Categories One and Two)*

Wetlands acres in the Region have diminished greatly over the past several decades as coastal development, in particular, has increased. Wetlands provide habitat, serve to slow down water flow, decrease total volume through infiltration, and filter out a number of pollutants through active uptake by plants as well as deposition in sediments. Wetlands such as coastal estuaries are a buffer zone between ocean and inland water resources and are heavily utilized by aquatic organisms. Continuous stretches of riparian habitat function as wildlife corridors to allow animal movement between increasingly isolated populations. They also serve as popular recreational destinations for residents and visitors. Unfortunately, many of our Region's wetlands are impacted by varying kinds and amounts of pollutants and alterations.

The Regional Board participates in the Southern California Wetlands Recovery Project (WRP), which for the first phase effort, conducted an inventory of coastal wetlands from Santa Barbara to the U.S.-Mexico border. This inventory included information on twelve wetlands in seven watersheds for our region.

When compared to estimated historical acreages, Los Angeles County has lost 93% of its wetlands while Ventura County has lost 58% of its wetlands. A regional wetland plan and strategy for prioritizing and restoring sites has been developed. Currently, the WRP funds wetlands projects which involve planning, restoration, or acquisition. More information about the Project may be found on its webpage at http://www.scwrp.org. This is a Category Two activity.

Our wetlands regulatory tools include:

1. **Wetlands beneficial use designation**: The Region's Basin Plan includes a beneficial use category for Wetland Habitat.

2. **Water Quality Objective**: The Region's Basin Plan has a narrative objective for wetlands protection which addresses the protection of hydrologic conditions and physical habitats to sustain the functional values of regional wetlands.

3. **Water Quality Certification (401) Program**: A key Category One activity associated with wetlands protection and management is CWA Section 401 certification which regulates discharges of dredge and fill materials to waters. The 401 certification program is one of the most effective tools the state has for regulating hydrologic modification projects, especially those which directly impact the region's diminishing acres of wetlands and riparian habitat.

Additionally, in Spring 2007, the State Water Resources Control Board began public scoping meetings on a proposed Wetland and Riparian Area Protection Policy that would apply throughout the state. An information document released for the scoping meetings outlined four alternative approaches to wetlands protection. The website http://www.waterboards.ca.gov/cwa401/ contains information on both the 401 program and proposed Wetlands Policy. There is also a statewide effort underway to develop a wetlands monitoring program (estuarine wetlands to begin with) and develop regional databases to support tracking of wetlands mitigation and restoration – the Integrated Wetlands Regional Assessment Program (IWRAP).

***Nonpoint Source Program** (Categories One and Two)*

Nonpoint source Category One activities include coordination of 319(h) grant project activities; and implementing the Plan for California Nonpoint Source Pollution Control Program, TMDLs, and Coastal Zone Act Reauthorization Amendments provisions. Participation in stakeholder/watershed groups meetings and activities and public/agency outreach are Category Two activities.

Management of NPS pollution is based upon the requirements of the Porter-Cologne Water Quality Control Act (Porter-Cologne Act). The Porter-Cologne Act, Division 7 of the California Water Code, establishes a comprehensive program for the protection of water quality and beneficial uses of the State’s waters and makes explicitly clear the law applies to nonpoint as well as point source discharges. The Porter-Cologne Act also establishes the administrative permitting authority—in the form of Waste Discharge Requirements (WDRs), waivers of WDRs or basin plan prohibitions—to be used to control NPS discharges. Additional legislative requirements state that all waivers must be conditional, they are to be re-evaluated and subsequently reissued every five years, and the RWQCBs must require compliance with waiver conditions.

California's Nonpoint Source (NPS) Pollution Control Program has been in effect since 1988 and was updated in January, 2000. In August 2004 the Office of Administrative Law approved the NPS Policy. The policy supersedes certain elements of the NPS Program Plan and formally eliminates the "three-tiered approach" in informal use.

The NPS Program has also been upgraded to conform with the Clean Water Act Section 319 (CWA 319) and Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA). The lead State agencies for the NPS Program are the SWRCB, the nine RWQCBs, and the California Coastal Commission.

The Plan for California's Nonpoint Source Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. These areas include Environmentally Sensitive Habitat Areas (ESHAs) currently designated in California's Coastal Zone Management (CZM) program, as well as areas adjacent to Areas of Special Biological Significance (ASBS), California's National Estuarine Research Reserves (NERRs), National Estuary Program (NEP), and National Marine Sanctuaries. The 2002 CCA Draft Strategic Plan identifies 101 CCAs statewide of which 13 are in the Los Angeles Region. These will be described further in later sections of this document.

Our long-term goal for the NPS program is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013. The short-term plan to achieve this goal is to identify, educate, and promote stakeholder involvement.

Current nonpoint source program priorities are: 1) oversight of workplans for 319(h) and bond fund projects, and 2) establishment of regional strategies addressing agriculture and marinas.

GROUND WATER

The following programs under our Groundwater Division are currently not managed under our watershed schedule but some aspects are integrated to some degree with other watershed activities, particularly with regard to coordination of monitoring and assessment activities and GIS. Steps taken to date include the mapping of drinking water wells and underground storage tank and Well Investigation Program (WIP) sites in a Geographic Information System (GIS).

***Underground Storage Tanks Regulation and Remediation* (Category One)**

Responsibilities include oversight of investigations into groundwater pollution and any corrective actions which may be needed which result from leaking underground storage tanks. Cases are roughly organized along watershed boundaries.

***SLIC Program* (Category One)**

Response to reports of unauthorized discharges, such as spills and leaks from above-ground storage tanks which may impact any of the region's waterbodies, are investigated through the Spills, Leaks, Investigation and Cleanup (SLIC) Program and remediation actions are implemented.

DOD and DOE Sites Cleanup Program ***(Category Two)***

The Regional Board works with a number of other agencies involved with remedial investigation and cleanups at U.S. Department of Defense (DOD) and U.S. Department of Energy (DOE) sites. Agreements with the DOD and DOE provide for accelerated cleanups at military bases and other Defense sites schedule for closure.

Well Investigation Program ***(Category One)***.

Followup investigation of volatile organic compounds in public water supply wells is conducted through the Well Investigation Program (WIP). Investigations focus on identification and elimination of sources of pollutants in public water supply wells, the identification of responsible parties, and oversight of soil and ground water remediation. This program is somewhat watershed-based as it focuses on two areas – the San Gabriel and San Fernando Valleys – that fall within two watersheds, the Los Angeles River (upper) and Gabriel River Watersheds.

FUNDING

Many high priority (in terms of Regional Board as well as statutory priorities) activities are unfunded or underfunded. For example, monitoring and assessment, basin planning, and nonpoint source activities are grossly underfunded. Some resources must be utilized for required activities such as triennial Basin Plan reviews and Water Quality Assessments. The latter activity tells us where our impaired waters are and there are federal requirements to conduct TMDLs on 303(d)-listed waters although more money is needed to do TMDL work on the problem waters. If a TMDL is completed and a remediation strategy developed despite this, there is then little money for followup work, particularly with regards to dealing with nonpoint source contributions. This means that our involvement in nonpoint sources must be very time-conservative. While it may take years of work to cooperatively fix a nonpoint source problem, direct enforcement could take a lot less time and be an immediate action. However, the latter is contrary to the cooperative spirit of watershed management. Each watershed will require difference site-specific approaches depending on a variety of factors. Additionally, enforcement is another underfunded activity, particularly when dealing with nonpoint source discharges. On the other hand, priorities may shift due to the influx of “new” money to fund a previously underfunded, and often times, lower priority activity. Use of the new money may be specific to certain activities such as increased pretreatment inspections in the core regulatory program. See the table below for the funding status and priority of Regional Board activities and programs in greater detail.

Funding Status of Major Regional Board Activities and Programs

Program/Activity (and Subcategories)	**Import-ance (High, Med, Low)**	**Man-dated?**	**Current Funding**	**What We Can Do With Existing Funds**	**What Could Be Done with More Funds**
Basin Planning					
Triennial reviews	H	Y	*Under-funded*	*Delayed and/or limited Triennial Reviews*	*Conduct more regular comprehensive reviews of the Basin Plan and associated issues; act on an increased number of triennial review-listed items*
Evaluation of beneficial uses	H	Y	*Under- to unfunded*	*Field observations in conjunction with other activities, limited studies*	*Comprehensive beneficial use surveys on a more frequent basis(necessary to set and refine use designations)*
Development of WQ objectives	H	Y	*Under- to unfunded*	*Utilize existing objectives.*	*Develop new and/or site-specific objectives; participate on State/Federal Task Forces; develop regional policies for implementation of water quality standards*
Development of watershed/ regional priorities	H	N	*Under-funded*	*Solve the easiest problems*	*Development of complex watershed solutions*
Watershed Coordination and Plan Development					
Development of watershed plans	M	N	*Under to unfunded*	*Rely on stakeholders to do most of the work*	*Provide staffing better support to watershed groups to guide and prepare integrated plans for water quality along with flood protection, habitat protection, etc.*
Coordination	H	N	*Under-funded*	*Limited outreach*	*Provide staff to participate in all watershed groups*
TMDL Development	H	Y	*Under-funded*	*TMDLs with only the required elements in order to meet deadlines*	*More time spent developing TMDLs with site-specific information*

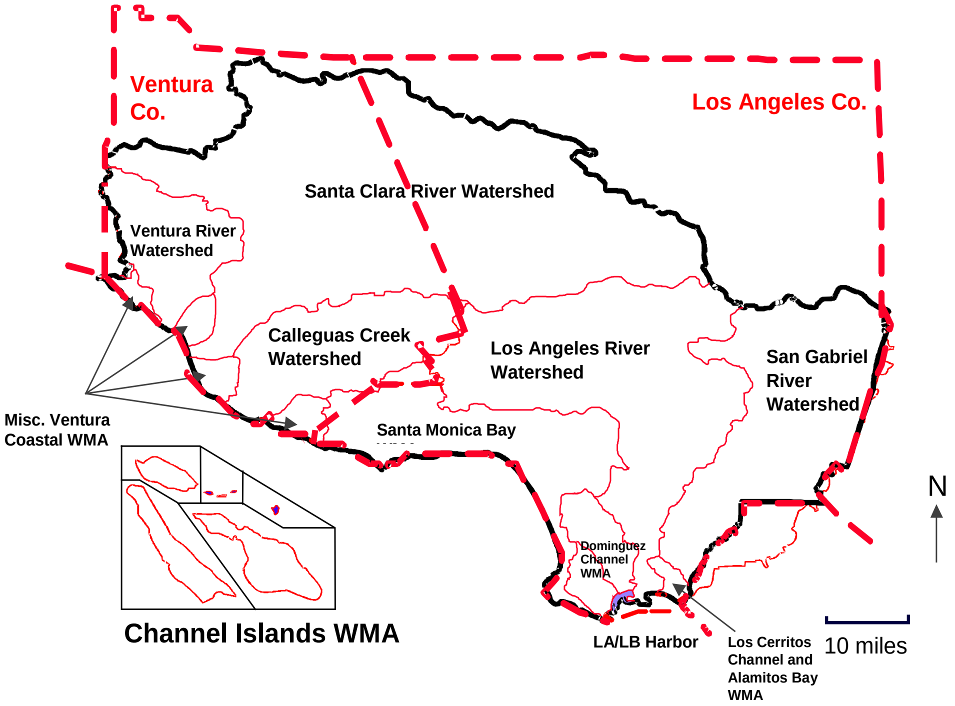
Program/Activity (and Subcategories)	**Import-ance (High, Med, Low)**	**Man-dated?**	**Current Funding**	**What We Can Do With Existing Funds**	**What Could Be Done with More Funds**
Water Quality Assessment					
Monitoring — Ambient watershed	H	Y (SWAMP)	*Under-funded*	*Do the basics required by the SWAMP; minimal staff sampling; rely on stakeholder sampling with minimal oversight; develop collaborative discharger watershed monitoring programs*	*Collect better data to assess impacts, assess for more constituents with more robust sampling; develop priorities, and evaluate successes; actively solicit and coordinate stakeholder monitoring; move beyond "snapshot" monitoring; advance special programs like biomonitoring/biocriteria*
Lab support	H	N/A	*Under-funded*	*Evaluate small subset of waters; analyze inexpensive constituents; often inadequate for decision-making*	*Collect and analyze for more constituents; have better datasets for decision-making*
Biomonitoring (training /field wk.)	H	N	*Under-funded*	*Use effluent chronic toxicity testing as surrogate*	*Real assessment of impacts to Beneficial Uses through field surveys, multiple assessment techniques*
Assessment	H	Y (WQA)	*Unfunded*	*Compile and assess as time permits ("back-burner")*	*Utilization as a critical element in watershed decision-making*
Computer data storage	H	Y	*Under-funded*	*Data stored in many locations*	*More efficient and comprehensive analyses*
Analyze data (for regional trends or for SWAMP)	H	Y (SWAMP)	*Under-funded*	*Simple statistics*	*More rigorous analyses*
Prepare state of watershed reports	M	N	*Under-funded*	*Summarize available info*	*Info sharing/priority setting/better data collection and augmentation*
Prepare biennial 305b report	M	Y	*Under-funded*	*Limited to targeted watersheds (minimal info)*	*Regular and more comprehensive updates/ better data for quality decisions*
Reporting	H	Y (SWAMP)	*Under-funded*	*Utilize established report card format; encourage other groups to develop indicators that would be useful for our Region*	*Research and develop additional indicators; prepare water quality "report cards"*

Program/Activity (and Subcategories)	**Import-ance (High, Med, Low)**	**Man-dated?**	**Current Funding**	**What We Can Do With Existing Funds**	**What Could Be Done with More Funds**
CEQA Review	M-H	Y	*Unfunded*	*Limited to highest priority projects with the greatest potential impacts*	*Provide early, meaningful comments; pre-401 coord.; early notification; be aware of piecemealing of projects*
401 Review	M-H	Y	*Under-funded*	*Review and process applications*	*Follow-up work (monitoring and enforcement), pre-construction meetings, site visits, review of draft CEQA documents, development of regional policies*
Nonpoint Source/CZARA					
Outreach	H	N	*Under-funded*	*Minimal effort - usually associated with group meetings*	*More active cooperation and outreach with individuals and groups in the watershed*
Contract/Project Management	H	N	*Under-funded*	*Minimum needed to get project through funding process*	*Receive better products and leverage from successful projects, hands on involvement and advertisement of successful projects*
Development of NPS Solutions	H	Y	*Under-funded*	*Little to none on our own: some involvement with others' work, and initiation of regulatory mechanisms (Tiers II and III)*	*Work with watershed communities to develop and implement nonpoint pollution control strategies, evaluate success of best management practices and management measures*
Permitting - Point Source (NPDES and WDRs)					
Permit development	H	Y	*Under-funded*	*Reduce backlog; process major and minor permits on watershed schedule/transfer minor permits to general permits as time allows*	*Have resources to solicit more stakeholder involvement; use higher level tools (modeling) to develop limits;have more resources for increasingly complex permits*
Inspections	H	Y	*Under-funded*	*Minimum required*	*More field presence/outreach/may reduce need for enforcement*
Enforcement	H	Y	*Under-funded*	*Only high profile major spills/violations*	*More enforcement actions taken on spills/violations that are not high profile*
Spill/complaint follow-up	H	Y/N	*Under-funded*	*Only major spills*	*Better customer service, follow-up on complaints, successful cleanups*

OUR REGION'S APPROACH TO WATERSHED MANAGEMENT

We have designated ten watershed management areas in the Los Angeles Region seen in the figure below. "State of the Watershed Reports" will be prepared or updated for the major watersheds. These reports have become very useful tools for local watershed groups for general educational value and in setting priorities.

Watershed Management Areas
of the Los Angeles Region



Timeline for Watershed Management Initiative

Dominguez Channel-LA/LB Harbor	FY 2007/08
Santa Monica Bay	FY 2008/09
Los Angeles River	FY 2009/10
San Gabriel River Los Cerritos Channel Channel Islands	FY 2010/11
Ventura River Misc. Ventura Coastal Santa Clara River Calleguas Creek	FY 2011/12

The formation of a balanced group of stakeholders for each watershed is critical to the success of watershed management, especially for resolving issues arising from nonpoint source pollutants. The major watersheds and many of the larger subwatersheds now have active stakeholder groups and, in many cases, watershed management plans have been developed. Working in partnership with stakeholders, we expect that we can achieve the following goals within each of our watershed management areas or have at least partially done so already.

- **Work with stakeholder group** or an infrastructure of stakeholder contacts which represents a range of key interest groups in the watershed but with involvement is not a barrier to timely resolution of a water quality problem.
- **Compilation of reasonably available water quality data** and related information in the form of a 'State of the Watershed Report.'
- **Assessment of data gaps** and a plan to fill the gaps.
- **Development of a** coordinated, cost-effective **watershed-wide monitoring program.**
- **Identification of high priority issues** and consensus among stakeholders as to how to proceed to resolve them.
- **Implementation of watershed-based solutions**.
- **Evaluate** success.

Some tasks may have less emphasis than others depending on the watershed, its problems, and the relative influence of point versus nonpoint source contributors.

What is important is the basic tenets of watershed management are being implemented:

- *The effort has a geographic focus,*
- *The highest priority issues are being identified and addressed,*
- *Stakeholder involvement is occurring, and*
- *A scientific basis for water quality management decisions is being created.*

This is an idealized model; many factors often change what can be done for each step such as regulatory or statutory mandates, consent decrees, legislation, and changes in Board priorities or funding.

OUR HIGH PRIORITY ISSUES

This Regional Board establishes priorities on an annual basis. While some of these priorities fall outside of the watershed management arena (it is acknowledged that some activities will likely always remain outside of the WMI), the bulk of these priorities are clearly of primary importance in fulfilling not only the WMI but also development of TMDLs and other mandates. In addition to Regional Board-directed priorities, priorities are mandated by legislation, statute, regulation, State Board, Cal-EPA, USEPA, and from sheer need to protect, restore, or enhance water quality. A list of the highest of these collective priorities follows.

TMDLs

- Development, adoption, and implementation of **TMDLs** – about 20 TMDLs (with implementation plans) have been approved by USEPA and about 10 are awaiting approval; about 10 more are scheduled for development over the short-term
- Addressing **beach closures** – a number of beach bacteria TMDLs have been adopted including the Santa Monica Bay wet weather and dry weather TMDLs. Upcoming will be the potential adjustment of implementation schedules based on development of integrated water resources approaches and a re-evaluation of the reference system approach for setting allowable exceedance days.
- Implementation of **agricultural waiver** – good success in Ventura County (80% enrollment and WQ monitoring instituted) thus far; now need increased enrollment in LA County and overall strategic implementation of BMPs

Non Point Sources

- Need for strategies to address **agriculture** and **septic systems** - implementation of the agricultural waiver to further TMDL compliance is also helping fulfill NPS program goals; new septic systems located in areas without sufficient separation from groundwater and nearby surface waters must install advanced treatment; the next challenge for septic systems will be to address cumulative effects which occur with infilling new systems in areas already dense with existing systems.

Basin Planning and Standards

- Full implementation of our **water quality standards** program is a necessity – site-specific objectives were adopted for ammonia in the Santa Clara, San Gabriel, and Los Angeles Rivers Watersheds while a water effects ratio was adopted for copper in the Calleguas Creek Watershed.
- Work is ongoing to target a **design storm** for implementation of wet weather BMPs
- **Tiered Aquatic Life Uses**, in relation to biocriteria, are in development

NPDES Permits

- Controlling compounds from point sources which continue to cause instream toxicity and/or accumulate in sediments or biota – pthalates and other **emerging chemicals**, including pharmaceuticals are becoming major issues.
- **Power plants** – the nine facilities in the Region are conducting plankton studies and investigating possible alternatives to once-through cooling water discharges
- Municipal stormwater/urban runoff – the LA County **MS4 permit** was reopened twice to incorporate the summer dry weather provisions of two bacteria TMDLs; renewals of permits are in progress.
- **New/re-development** – proactively addressing water quality issues through CEQA, 401 certifications, or stormwater permits; ensuring wet weather compliance with construction permits.

Water Reclamation Requirements/Water Conservation

- Reduce, reuse, and **recycle water** – maximize water conservation in Region.
- Addressing the **regional salt management**/salt imbalance issue which is becoming increasingly critical in the region, and balancing this issue with the need to promote the use of reclaimed water.

Habitat Protection

- Preservation of high quality habitats – ensure maintenance of beneficial uses at these sites through support of **low-impact development** coupled with minimized/avoided hydromodification
- **Habitat loss/restoration** – even with strides in improving instream water quality, unless habitat is restored (riparian/wetlands, in particular), in many cases beneficial uses can not be fully restored.

Monitoring

- Coordination of existing resources and participation in the Surface Water Ambient Monitoring Program is of great importance as is more use of **bioassessment** as a tool.
- **Coordinated watershed-wide monitoring** programs exist in the San Gabriel River, Calleguas Creek, and Malibu Creek Watersheds while programs are being developed in the Los Angeles River and Santa Clara River Watersheds.

Contaminated Sediments/Waste Discharge Requirements

- Many of the impairments in the Region, particularly in harbors, are related to **contaminated sediments**. While source reduction will decrease pollutant levels over time, remediation of these sediments will also be needed which will be a long-term project. Cleanup of contaminated sediments in Consolidated Slip in Los Angeles Harbor will be a long-term project.
- Accurately characterizing the threat from contaminated sediments throughout the Region will be aided with adoption of **sediment quality objectives** in the near future by State Board.

These Board priorities are further highlighted in the watershed and region-wide sections as appropriate. In addition, the State and Regional Board's Strategic Plan is in the process of being reviewed and updated. Stakeholder input so far has indicated basin planning, impaired water bodies, water rights, enforcement effectiveness, groundwater, and water conservation/reuse/recycling as programmatic priority areas.

Section 2 . Activities Organized on a Watershed Basis

This section describes activities organized on a watershed basis. An **overview** of each watershed or WMA is provided, its **water quality problems and issues** are described, **past significant activities** (as appropriate), **current activities** (funded activities), **near-term activities** (planned or projected high priority activities that may need funding), and **potential long-term activities** (long-term goals, beyond two years).

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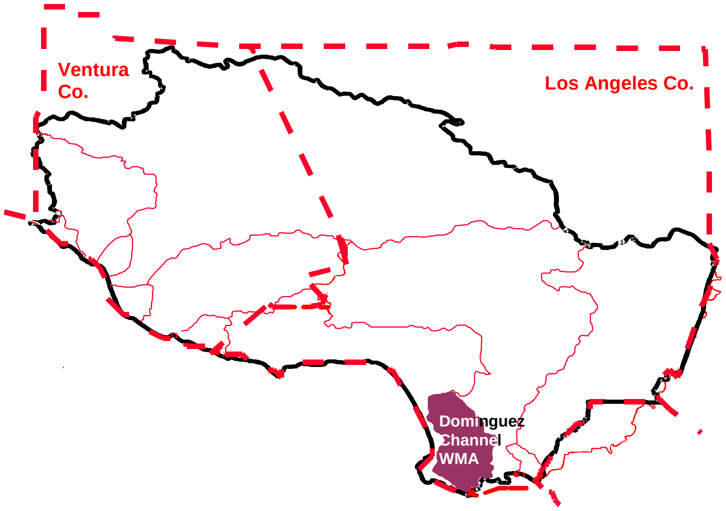
2.1 DOMINGUEZ CHANNEL AND LOS ANGELES/LONG BEACH HARBORS WMA

This watershed will be targeted in FY07/08.

Overview of WMA



The Los Angeles and Long Beach Harbors are located in the southern portion of the Los Angeles Basin. Along the northern portion of San Pedro Bay is a natural embayment formed by a westerly extension of the coastline which contains both harbors, with the Palos Verdes Hills the dominant onshore feature. Historically, the area consisted of marshes and mudflats with a large marshy area, Dominguez Slough, to the north, and flow from the Los Angeles River entered where Dominguez Channel now drains. Near the end of the19th century and during the beginning of the next century, channels were dredged, marshes were filled, wharves were constructed, the Los Angeles River was diverted, and a breakwater was constructed in order to allow deep draft ships to be directly offloaded and products be swiftly moved. The Dominguez Slough was completely channelized and became the drainage endpoint for runoff from a highly industrialized area. Eventually, the greater San Pedro Bay was enclosed by two more breakwaters and deep entrance channels were dredged to allow for entry of ships with need of 70 feet of clearance. The LA/LB Harbor complex together is now one of the largest ports in the country.

The harbors are considered to be one oceanographic unit. Despite its industrial nature, contaminant sources, and low flushing ability, the inner harbor area supports fairly diverse fish and benthic populations and provides a protected nursery area for juvenile fish. The California least tern, an endangered species, nests in one part of the harbor complex. Some wetlands do persist in the Machado Lake area.

The outer part of both harbors (the greater San Pedro Bay within the breakwaters) has been less disrupted and supports a great diversity of marine life and a large population of fish . It is also open to the ocean at its eastern end and receives much greater flushing than the inner harbors. Collectively, the fish population of both inner and outer harbors was estimated at 44 million in 2000 which makes a large portion of this WMA a valuable marine resource.

Beneficial Uses in WMA

Dominguez Channel (above estuary)	*Dominguez Channel (in estuary)*
Noncontact water recreation	Contact & noncontact water recreation
Preservation of rare & endangered species	Preservation of rare & endangered species
	Industrial water supply
	Navigation
	Commercial & sportfishing
	Marine habitat
	Estuarine habitat
	Wildlife habitat
	Migratory & spawning habitat

Water Quality Issues and Problems

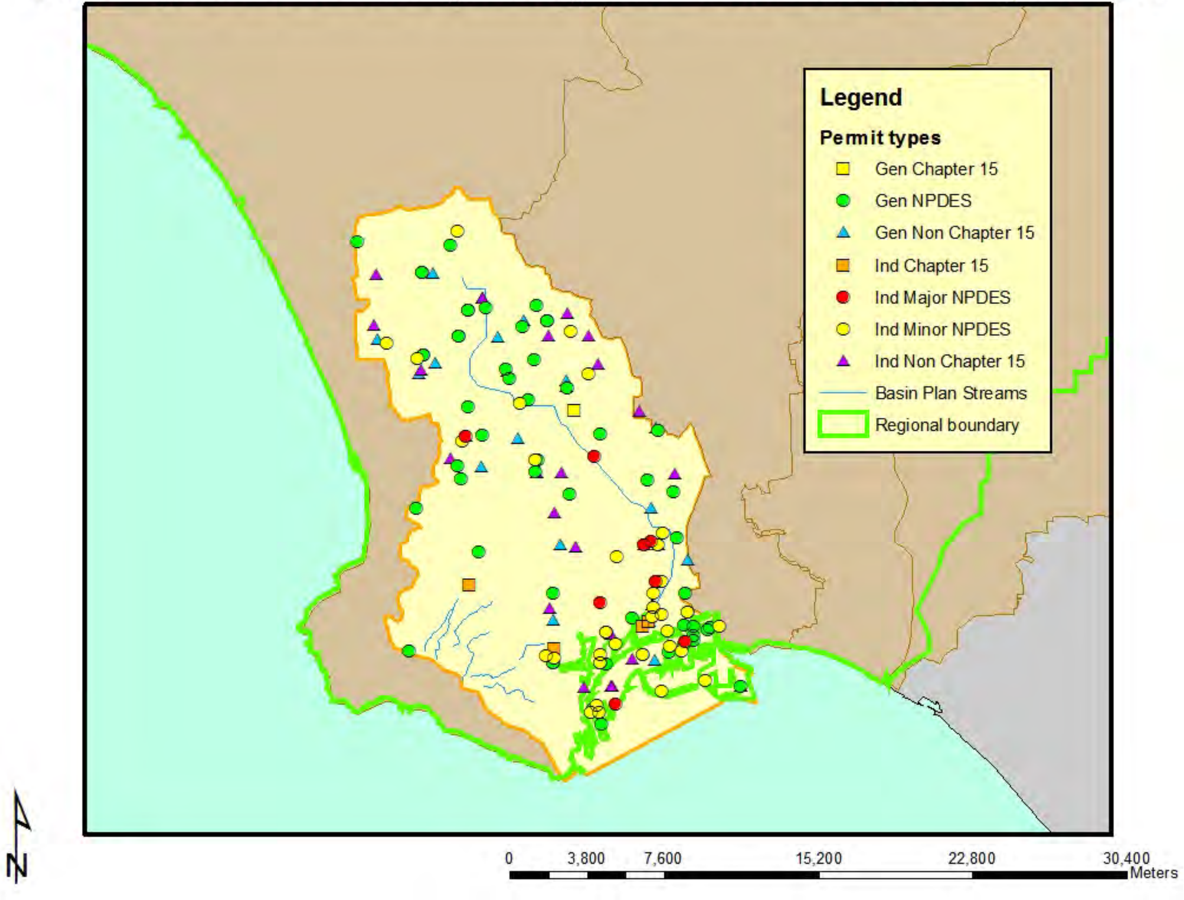
Permitted discharges:

- Eight major NPDES discharges: one POTW, two generating stations, and five refineries; 38 minor NPDES discharges; 55 discharges covered by general NPDES permits
- 399 dischargers covered under an industrial storm water permit
- 214 dischargers covered under the construction storm water permit

A POTW discharges tertiary-treated effluent to the outer LA/LB Harbor and is under a time schedule order to remove the discharge. The discharger's plan consists of achieving full reclamation (mostly for industrial reuse purposes) by 2020 which would eliminate the discharge completely. Two generating stations discharge to the inner harbor areas. Many smaller, non-process waste discharges also occur into the harbors; in addition, Dominguez Channel drains a highly industrialized area with numerous nonpoint sources of pollution for PAHs and also contains remnants of persistent legacy pesticides as well as PCBs which results in poor sediment quality both within the Channel and in adjacent Inner Harbor areas. Although highest in Dominguez Channel estuary and Consolidated Slip sediments, DDT is pervasive throughout the harbors. Metals, particularly copper, remain elevated at some locations in the sediments of the inner harbors. A likely major nonpoint source contributor to these concentrations is antifouling paint containing copper that leach from the many ships and boats in the harbors. Sediment toxicity occurs more frequently in parts of the Inner Harbor than elsewhere. Consolidated Slip, the part of Inner Harbor immediately downstream of Dominguez Channel, continues to exhibit a very impacted benthic invertebrate community.

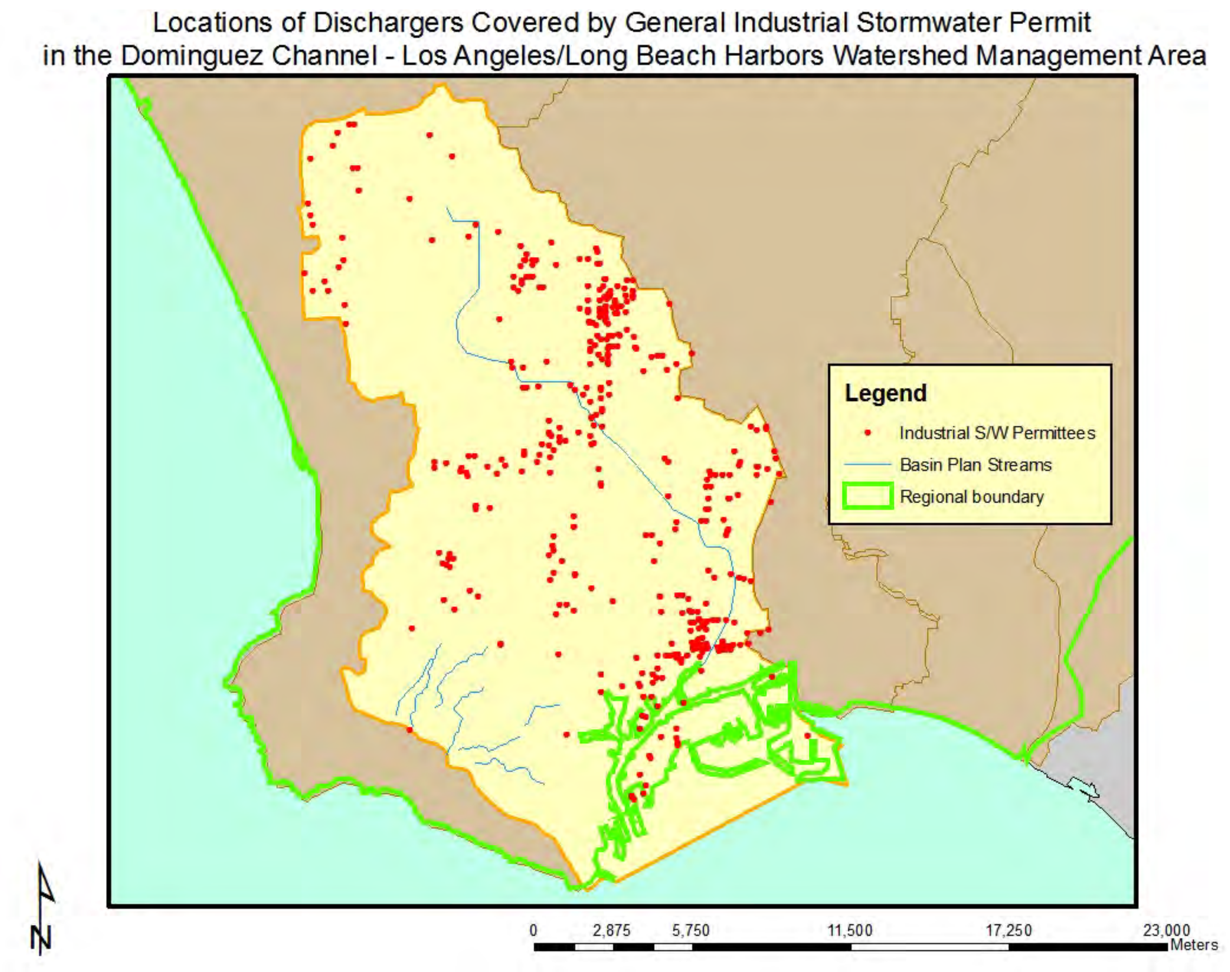
The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Dominguez Channel - Los Angeles/Long Beach Harbors Watershed Management Area



About one-half of the 101 NPDES permitted facilities discharge to Dominguez Channel; the rest discharge to the LA/LB Harbor complex.

Of the 448 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Gardena, Wilmington, Torrance, and Carson, along Dominguez Channel. Wholesale trade-durable goods, fabricated metal products, trucking & warehousing, chemicals & allied products, transportation equipment, and rubber & miscellaneous plastics products are a large component of these businesses based on their Standard Industrial Classification (SIC) code. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.



Locations of Dischargers Covered by General Industrial Stormwater Permit in the Dominguez Channel - Los Angeles/Long Beach Harbors Watershed Management Area

There are 214 sites enrolled under the general construction storm water permit. The sites are spread fairly evenly throughout the watershed and are a mix of residential, industrial, and commercial sites; about one-half of the sites are five acres or larger in size. The larger parcels of up to 500 acres in size are mostly located in the ports.

There are a total of 96 impairments in the WMA. The Los Angeles/Long Beach Inner Harbor is on the 2006 303(d) list due to bacteria, impaired benthic community, sediment toxicity, DDT, copper, zinc, PAHs, and PCBs. In addition, two areas within Los Angeles Harbor are considered to be toxic hot spots under the Bay Protection and Toxic Cleanup Program (BPTCP): Dominguez Channel/Consolidated Slip, based on sediment concentrations of DDT, PCB, cadmium, copper, lead, mercury, zinc, dieldrin, chlordane (all exceed sediment quality guidelines), sediment toxicity, and degraded benthic infaunal community; and Cabrillo Pier area, based on sediment concentrations of DDT, PCB and copper, sediment toxicity and issuance of a human health (fishing) advisory for DDT and PCB in white croaker and exceedances of National Academy of Science guidelines for DDT in fish and shellfish. Also, several locations have been listed as sites of concern under the BPTCP: Inner Fish Harbor, due to

Potential sources of pollution:

- Historical deposits of DDT and PCBs in sediment
- Discharges from POTW & refineries
- Spills from ships and industrial facilities
- Leaching of contaminated groundwater
- Stormwater runoff

sediment concentrations of DDT, PCB, copper, mercury and zinc and sediment toxicity (not recurrent); Kaiser International, due to sediment concentrations of DDT, PCB, PAH, copper and endosulfan; Hugo Neu-Proler, due to PCB sediment concentrations; Southwest Slip, due to sediment concentrations of DDT, PCB, PAH, mercury, and chromium, and sediment toxicity; Cerritos Channel, due to sediment concentrations of DDT, PCB, metal, chlordane, TBT, sediment toxicity and accumulation in mussel tissue; Long Beach Outer Harbor, due to sediment concentrations of DDT and chlordane and sediment toxicity; and West Basin, due to sediment concentrations of DDT and PCB, sediment toxicity, and accumulation in clam tissue. Potential sources of these materials are considered to be historical deposition, discharges from the nearby POTW (especially for metals), spills from ships and industrial facilities, as well as stormwater runoff. Many areas of the harbors have experienced soil and/or groundwater contamination, which may result in possible transport of pollutants to the harbors' surface waters. Dredging and disposal, capping, and/or remediation of contaminated sediments and source control of pollutants in the harbors is a major focal point for the Contaminated Sediment Task Force described further in the Region-wide Section of this document.

Los Angeles/Long Beach Inner Harbor

Although the area is dramatically cleaner now than thirty-five years ago when rigorous water quality regulation of discharges began, parts of the Inner Harbor are still suffering the effects of historic deposits of pollutants in the sediment and current point and nonpoint source discharges. Fish caught in the East Basin have exhibited histopathological abnormalities (liver lesions). The abnormalities are indicative of aromatic and chlorinated hydrocarbon contamination. There is also significant degradation in the biological community of a part of Inner Harbor with high sediment levels of PCBs and DDT. Additionally, Cal-EPA's Office of Environmental Health Hazard Assessment advises against consumption of white croaker in the harbor and recommends no more than one meal every two weeks of black croaker, queenfish, and surfperches if caught in the harbor. On the other hand, the benthic community in many other areas of the inner harbor are healthy and sediments, though high in many pollutants, do not cause ecologically significant levels of toxicity in controlled lab tests.

Some of the contamination in sediment is historic with resuspension potential. Dominguez Channel was the recipient of runoff from the Montrose Chemical Facility which manufactured DDT for several decades until the early 1970s. There are also mostly nonpoint source inputs from several problem sites, spills, and storm drain runoff. The problems tend to be exacerbated by the poor circulation and flushing. The Ports are in the process of filling in parts of Outer Harbor and deepening some channels as part of their improvement plans. Pier 400, a 590-acre site of new land in Outer Harbor created by diking and filling harbor waters, was completed in 2000. As a result, the potential exists for greater stagnation and more problems from deposition of new contaminants.

Data from the State Mussel Watch (SMW) Program documented high levels of metals, PCBs, TBT, and PAHs in mussel tissue at several locations in Inner Harbor over many years. The Bay Protection and Toxic Cleanup Program (BPTCP) found a number of Inner Harbor areas with elevated pollutant levels but a smaller subset of those exhibited sediment toxicity.

Sediment data collected over many years for various research projects and pre-dredge studies have revealed areas of heavy contamination with metals, PCBs, and DDT, and occasionally PAHs at some sites but concentrations are quite variable spatially, possibly a result of the extensive dredging which has occurred in Inner Harbor over the years. Additionally, it is difficult to separate the effects of historic contamination from current inputs; Cerritos Channel (a back channel linking LA and LB inner harbors) may continue to be impacted by flows from Dominguez Channel.

The most recent large-scale coordinated sampling occurred during Bight '03; many of the Bight stations sampled for sediment had a planned overlap with water column sampling locations utilized by SWAMP. In general, the sediment quality remains as described earlier in this section with problem areas focused in Dominguez Channel, Fish Harbor, and at sporadic other locations; water quality both at the surface and at depth is quite good by comparison.

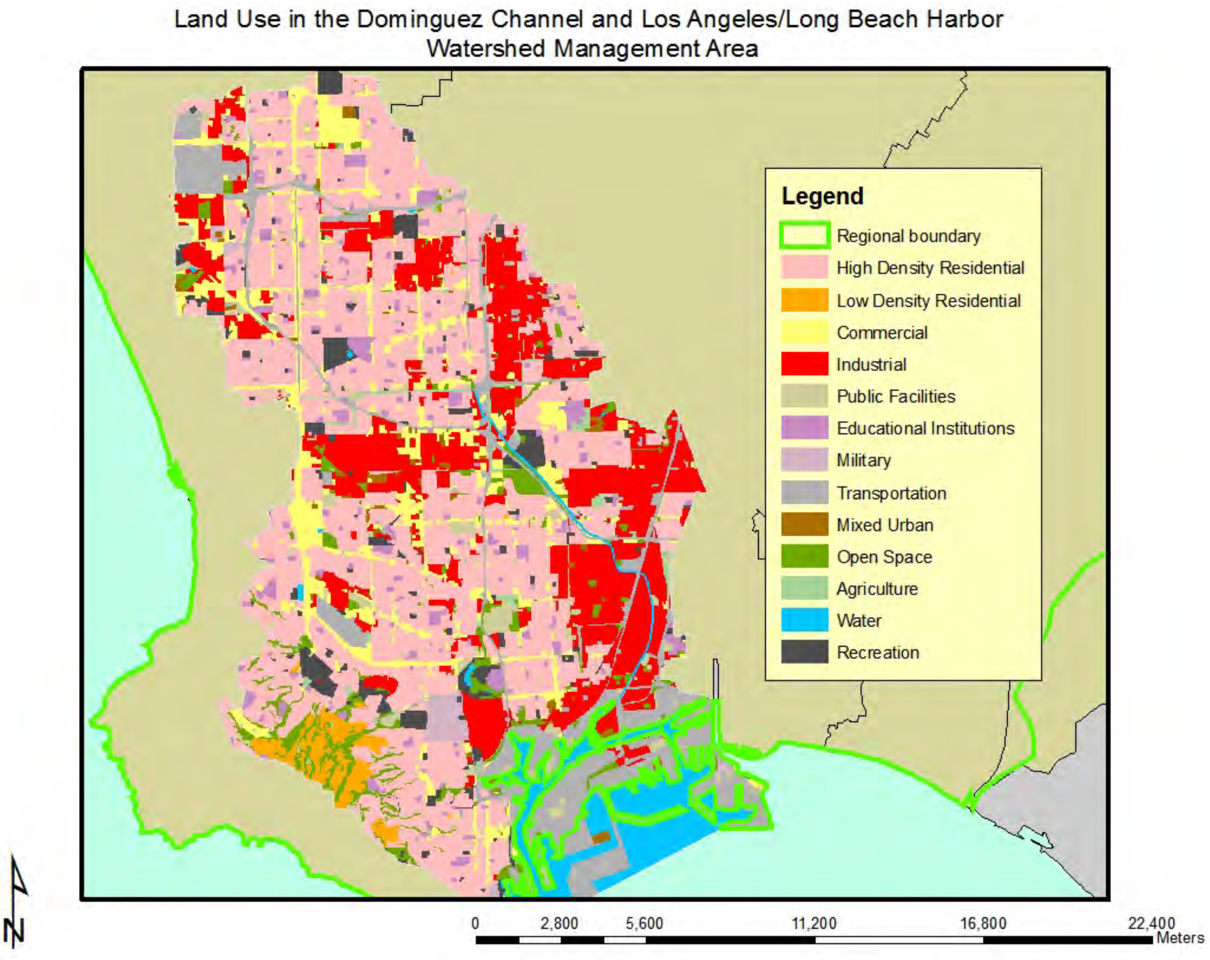
Dominguez Channel

The results of sampling in 2002 found that for several chemicals, the maximum concentrations observed in Consolidated Slip sediments exceeded the NOAA ERM values. Average concentrations were close to or above the ERM for copper, lead, mercury, DDT, PCB and chlordane.

Sediment sampling for DDT was conducted in the Channel by a consultant for Montrose during 1990. USEPA, in a letter to Montrose, cited this data and provided a comparison of those values with NOAA's "identified concentrations of DDT in sediment associated with adverse impacts. A sediment level of 3 ppb was associated with adverse impacts in 10% (ER-L) of the data reviewed by NOAA and a level of 350 ppb total DDT was associated with adverse impacts in 50% (ER-M) of the data reviewed by NOAA" (USEPA letter to Montrose Chemical Corporation, November 27, 1991). The consultant found DDT levels of 300 - 13,000 ppb in the Channel. USEPA stated that adverse impacts in the biological community of Dominguez Channel and Consolidated Slip would be expected. DDT is a highly persistent chemical and adverse impacts to the biological community continue in the Channel and Slip.

A Regional Board study conducted in 1975 found that the aquatic biota of the Channel were largely marine in origin and were a continuation of LA Inner Harbor biota. The number and abundance of aquatic species declined with distance inland from the harbor. A fairly abrupt decline in benthic species between Alameda and Wilmington Streets was attributed to the effects of pollution. *Capitella capitata* was one of the most abundant benthic species in the area and is generally associated with polluted areas. An absence of benthic fish species adjacent to one oil refinery was considered to be indicative of oxygen-poor bottom water.

The highly industrialized nature (and resultant large amount of impervious surface) of the WMA can be seen in the figure below.



The table below shows the complete list of water quality impairments.

Water Quality Limited Segment Name	Pollutant
Dominguez Channel (lined portion above Vermont Ave)	Ammonia Copper Dieldrin (tissue) Indicator bacteria Lead (tissue) Sediment Toxicity Zinc (sediment)
Dominguez Channel Estuary (unlined portion below Vermont Ave)	Ammonia Benthic Community Effects Benzo(a)pyrene (PAHs) Benzo[a]anthracene Chlordane (tissue) Chrysene (C1-C4)

	Coliform Bacteria DDT (tissue & sediment) Dieldrin (tissue) Lead (tissue) PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Zinc (sediment)
Los Angeles Harbor - Cabrillo Marina	DDT PCBs (Polychlorinated biphenyls)
Los Angeles Harbor - Consolidated Slip	Benthic Community Effects Cadmium (sediment) Chlordane (tissue & sediment) Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory) Dieldrin Lead (sediment) Mercury (sediment) PCBs (tissue & sediment) (Fish Consumption Advisory) Sediment Toxicity Toxaphene (tissue) Zinc (sediment) Benzo[a]anthracene Benzo(a)pyrene Chrysene Pyrene Phenanthrene 2-Methyl-naphthalene
Los Angeles Harbor - Fish Harbor	Benzo[a]anthracene Benzo(a)pyrene Chlordane Chrysene (C1-C4) Copper DDT Dibenz[a,h]anthracene Lead Mercury PAHs (Polycyclic Aromatic Hydrocarbons) PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Sediment Toxicity Zinc
Los Angeles Harbor - Inner Cabrillo Beach Area	Copper DDT (Fish consumption advisory for DDT)

	PCBs (Fish Consumption Advisory for PCBs) Indicator bacteria*
Los Angeles/Long Beach Inner Harbor	Beach Closures Benthic Community Effects Copper DDT PCBs (Polychlorinated biphenyls) Sediment Toxicity Zinc
Los Angeles/Long Beach Outer Harbor (inside breakwater)	DDT PCBs (Polychlorinated biphenyls) Sediment toxicity
Machado Lake (Harbor Park Lake)	Algae Ammonia ChemA (tissue)** Chlordane (tissue) (Fish Consumption Advisory) DDT (tissue) (Fish Consumption Advisory) Dieldrin (tissue) Eutrophic Odor PCBs (Polychlorinated biphenyls) (tissue) Trash
San Pedro Bay Near/Off Shore Zones	Chlordane Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory for DDT) PAHs (Polycyclic Aromatic Hydrocarbons) (sediment) PCBs (Fish Consumption Advisory for PCBs) Sediment Toxicity Zinc (sediment)
Torrance Carson Channel	Coliform Bacteria Copper Lead
Wilmington Drain	Ammonia Coliform Bacteria Copper Lead

*Los Angeles Harbor Bacteria TMDL , 2005

** ChemA refers to the sum of the chemicals aldrin, dieldrin. chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

CURRENTLY SCHEDULED TMDLS:

- Machado Lake trash
- Harbor metals and toxics

Stakeholder Group

The Dominguez Channel Watershed Advisory Council was formed in February 2001and meets on a bimonthly basis to conduct a variety of tasks including development of a Watershed Management Master Plan aimed at protecting and improving the environment and beneficial uses of the watershed. Proposition 13 funding ($200,000) was approved by the State Water Resources Control Board for the LA County Department of Public Works to work on a watershed plan which was finalized in 2004. A list of potential implementation projects/programs is included in the Plan. Many members of the group are also participating in Regional Board TMDL work in the watershed. The group's website is at http://ladpw.org/wmd/watershed/dc/.

Significant Past Activities

MONITORING AND ASSSESSMENT

SWAMP

This watershed was the focus of SWAMP monitoring for FY02/03. The WMA was been divided into six subareas based on characteristics of the area in order to simplify sampling design: (1) headwater streams, (2) the inner and outer harbors of LA and LB (integrated with Bight '03 monitoring), (3) Madrona Marsh, (4) Machado Lake, (5) the Dominguez Channel estuary, and (6) the upper channelized Dominguez Channel above normal tidal influence. The sampling design was partially a reflection of the need to supplement outdated information for some water bodies. For example, information on Machado Lake water quality was outdated and the lake is posted for fishing, therefore, studies included fish tissue analysis in conjunction with water column chemistry and toxicity, sediment chemistry and toxicity, and pathogens. A different sampling strategy was undertaken for the LA/LB harbor complex. Sampling there included water column toxicity and chemistry, metals chemistry, and PAH analysis. The ability to break down this watershed into subareas based on characteristics of the area identified allowed staff to devise sampling plans and monitor for constituents in relation to each area. The focus was on a randomized probabilistic sample design as modeled after the USEPA's EMAP program, especially for the harbor area where coordination with the Bight '03 monitoring program occurred. The triad approach (toxicity, chemistry, and benthic community) was utilized where possible.

Consolidated Slip Restoration Project

Consolidated Slip is located in the East Basin area of the Port of Los Angeles. Much of the WMA, which is comprised of approximately 110 square miles of land, empties into the northeast side of Consolidated Slip through Dominguez Channel. Approximately 96% of the watershed area is developed.

Tributaries to Dominguez Channel include several storm drains and minor channels. From the 1910s until several years ago, millions of gallons per day of industrial wastewater have been discharged into the Dominguez Channel, significantly contributing to the contaminant loading within Consolidated Slip. In addition, stormwater runoff from the Montrose Chemical Corporation's pesticide manufacturing facility in Torrance, which operated from 1947 to 1982, probably contributed to DDT contamination of the watershed and Consolidated Slip.

Numerous sediment characterization studies have identified elevated levels of heavy metals, organochlorine pesticides, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in sediment and resident organisms from Consolidated Slip. In addition, the unlined portion of Dominguez Channel was listed as a Superfund site by USEPA. Based on available information, over 1 million cubic yards of sediment may be impacted and require remedial actions to address water quality problems and restore beneficial uses.

The Los Angeles Regional Board, in cooperation with the USEPA, Port of Los Angeles, US Army Corps of Engineers, and other interested parties, initiated the Consolidated Slip Restoration Project. The goals of this project are to describe the extent of sediment contamination in Consolidated Slip, identify the appropriate project stakeholders, evaluate remediation and restoration options, select an approach to solve the water quality problems and restore beneficial uses, develop a cost estimate for the proposed solution, identify funding sources to implement the project, and prepare and execute a restoration plan.

The Port of Los Angeles prepared a draft conceptual plan on behalf of the Consolidated Slip Restoration Project. This plan described the extent of sediment contamination in Consolidated Slip and the site's history, discussed potential cleanup alternatives and possible funding sources, and identified data gaps. Although considerable sediment quality data had been collected for the project area, it was not adequate for directing the actual clean up of the site. Additional sediment sampling was required to characterize the areal extent and vertical depth of contamination in Consolidated Slip. The potential for recontamination of Consolidated Slip sediments from upstream areas of the watershed also needed to be evaluated.

The USEPA conducted a monitoring study in 2002 to assess current sediment distributions and concentrations of DDT in sediments within the surface water drainage pathway leading from the Montrose Chemical Corporation's Torrance manufacturing facility site. The USEPA agreed to work with the Los Angeles Regional Board to expand the scope of this sampling program to include additional sediment chemistry analyses (e.g., trace metals and other trace organics), deeper cores and additional monitoring stations. This extra monitoring effort was paid for by several of the stakeholders of the Consolidated Slip Restoration Project.

NONPOINT SOURCE PROGRAM

Staff have performed inspections of commercial fishing operations in the Los Angeles Harbor area and educated personnel regarding negative impacts of discharges to the harbor. Since these inspections, staff have initiated some enforcement actions.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in theDominguez Channel Watershed.

CORE REGULATORY

Continuing core regulatory activities include necessary renewal/revision of NPDES permits. There are nine major dischargers, 48 significant or minor dischargers under individual permits, as well as 60 dischargers currently covered under general permits (additional information on permits may be found in the Appendix). Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue. Due to limited resources, only the basic regulatory activities are performed: review of dischargers' monitoring reports, minimum necessary inspections and sampling, issuance/ renewal of permits, levels 1 and 2 enforcement actions (noncompliance and violation notification), case handling, and answering inquiries from the public.

The Dominguez WMA falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was adopted on December 13, 2001 and amended on September 14, 2006, to incorporate the Santa Monica Bay Beaches Bacteria TMDL Waste Load Allocations for summer dry weather discharges from MS4 outfalls to Santa Monica Bay beaches. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit on June 30, 1999. The Los Angeles County Flood Control District is the Principal Permittee for the Los Angeles stormwater permit. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permit can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/la_ms4_final.html.

An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system.

MONITORING AND ASSESSMENT

Consolidated Slip Restoration Project: Although cleanup targets have not been formally established for each contaminant of concern, it appears that approximately 1.3 million cubic yards of contaminated sediments would have to be addressed in some fashion within the Consolidated Slip area. In addition, approximately 700,000 cubic yards of contaminated sediments are present in portions of Dominguez Channel upstream from Consolidated Slip; this material may require removal to prevent recontamination of Consolidated Slip following remediation efforts in that area.

Several potential remediation alternatives to deal with the sediment contamination problem have been evaluated for technical and economic feasibility. The Restoration Project's Steering Committee recommended more detailed analysis of several alternatives, including partial capping of contaminated sediments, on-site fill of a portion of the slip, removal and off-site disposal of contaminated sediments, removal and disposal of contaminated sediments to a Class I landfill (transport to Utah by rail), and treatment and possible beneficial re-use of contaminated sediments. A final alternative has not yet been selected; however, there is $3 million ($2.5 million from the State's Cleanup and Abatement Account and $0.5 million from Supplemental Environmental Project monies) available to go toward Dominguez Channel cleanup with a total of $20-25 million likely needed for an alternative involving dredging and remediation with eventual re-use. Potential additional funding sources include cost recovery from responsible parties. This effort would likely be led jointly by the Regional Board and the US Army Corps.

The actual cost of the proposed cleanup of Consolidated Slip will depend on the volume of contaminated sediments to be processed and the remediation alternative selected. The project could cost as much as $75 million (based on a potential maximum of 1 million cubic yards of sediment at an estimated average handling and disposal cost of $75 per cubic yard). However, there will likely be an emphasis on dredging, capping, and slip reconfiguration which would reduce the final cost. The Port of Los Angeles will lead this effort which is expected to be a multi-year endeavor. However, a large amount of additional funding will be needed to implement this project. Potential funding sources include cost recovery from responsible parties, the State's Cleanup and Abatement Account, the U.S. Environmental Protection Agency, or assistance from other interested parties.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project considers the Machado Lake Habitat Restoration Project a priority on the current workplan. Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

WATERSHED MANAGEMENT

A State of the Watershed Report is being prepared for this WMA.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

Continuing core regulatory activities include compliance inspections, review of monitoring reports, response to complaints, and enforcement actions as needed relative to the watersheds NPDES permits. A watershed-wide regional monitoring program will be created in anticipation of the next cycle.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures (coordinate grant activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

Potential Mid- to Long-term Activities

As may be the case in other industrial areas with extensive sediment contamination, development of regional sediment quality guidelines would be very valuable. The CSTF has developed an electronic database of relevant local sediment monitoring data that could be used for this purpose.

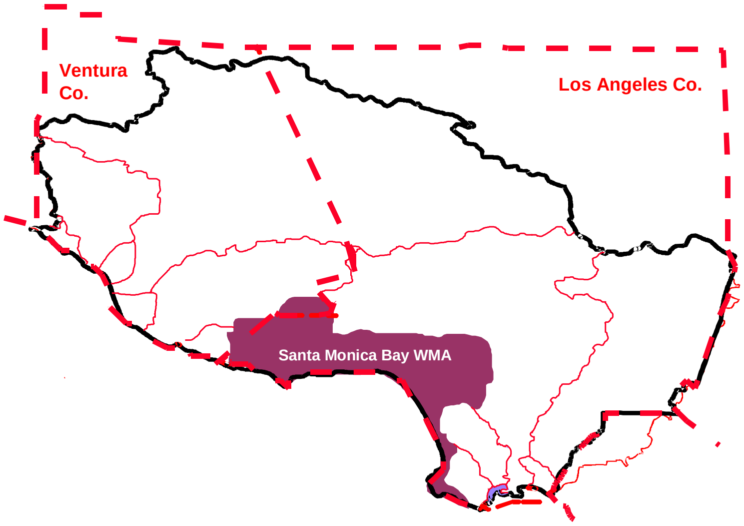
Additional long-term activities include:

- Development of a watershed-wide monitoring program
- Consideration and implementation of TMDL-related issues
- Further evaluate beneficial uses throughout the watershed
- Restoration of habitat following improvements in water quality
- Implementation of biological monitoring
- Development of sediment quality objectives (currently under development by State Board)

2.2 SANTA MONICA BAY WMA

This watershed will be targeted in FY08/09.

Overview of WMA



The Santa Monica Bay Watershed Management Area (WMA), which encompasses an area of 414 square miles, is quite diverse. Its borders reach from the crest of the Santa Monica Mountains on the north and from the Ventura-Los Angeles County line to downtown Los Angeles. From there it extends south and west across the Los Angeles plain to include the area east of Ballona Creek and north of the Baldwin Hills. South of Ballona Creek the natural drainage area is a narrow strip of wetlands between Playa del Rey and Palos Verdes. The WMA includes several watersheds, the two largest being Malibu Creek to the north (west) and Ballona Creek to the south. The Malibu Creek area contains mostly undeveloped mountain areas, large acreage residential properties and many natural stream reaches while Ballona Creek is predominantly channelized, and highly developed with both residential and commercial properties.

As a nationally significant water body, Santa Monica Bay was included in the National Estuary Program in 1989. It has been extensively studied by the Santa Monica Bay Restoration Project (now the Santa Monica Bay Restoration Commission or SMBRC) and a watershed plan was developed in 1995. The Santa Monica Bay Watershed Commission was established in 2004 to oversee implementation of the Plan.

Water Quality Problems and Issues

Though relatively small in its size compared with watersheds in other parts of the country, the Santa Monica Bay WMA embraces a high diversity in geological and hydrological characteristics, habitat features, and human activities. Almost every beneficial use defined in the Basin Plan is identified in water bodies somewhere in the WMA. Yet many of these beneficial uses have been impaired for years. While some of the impaired areas are showing signs of recovery, beneficial uses that are in relatively good condition still face the threat of degradation.

Existing and potential beneficial use impairment problems in the watershed fall into two major categories: human health risk, and natural habitat degradation. The former are issues primarily associated with recreational uses of the Santa Monica Bay. The latter are issues associated with terrestrial, aquatic, and marine environments. Pollutant loadings that originate from human activities are common causes of both human health risks and habitat degradation.

Beneficial Uses in the WMA:

All of the beneficial uses defined in the Basin Plan for the Region occur somewhere in this Watershed Management Area except for BIOL (preservation of biological habitats)

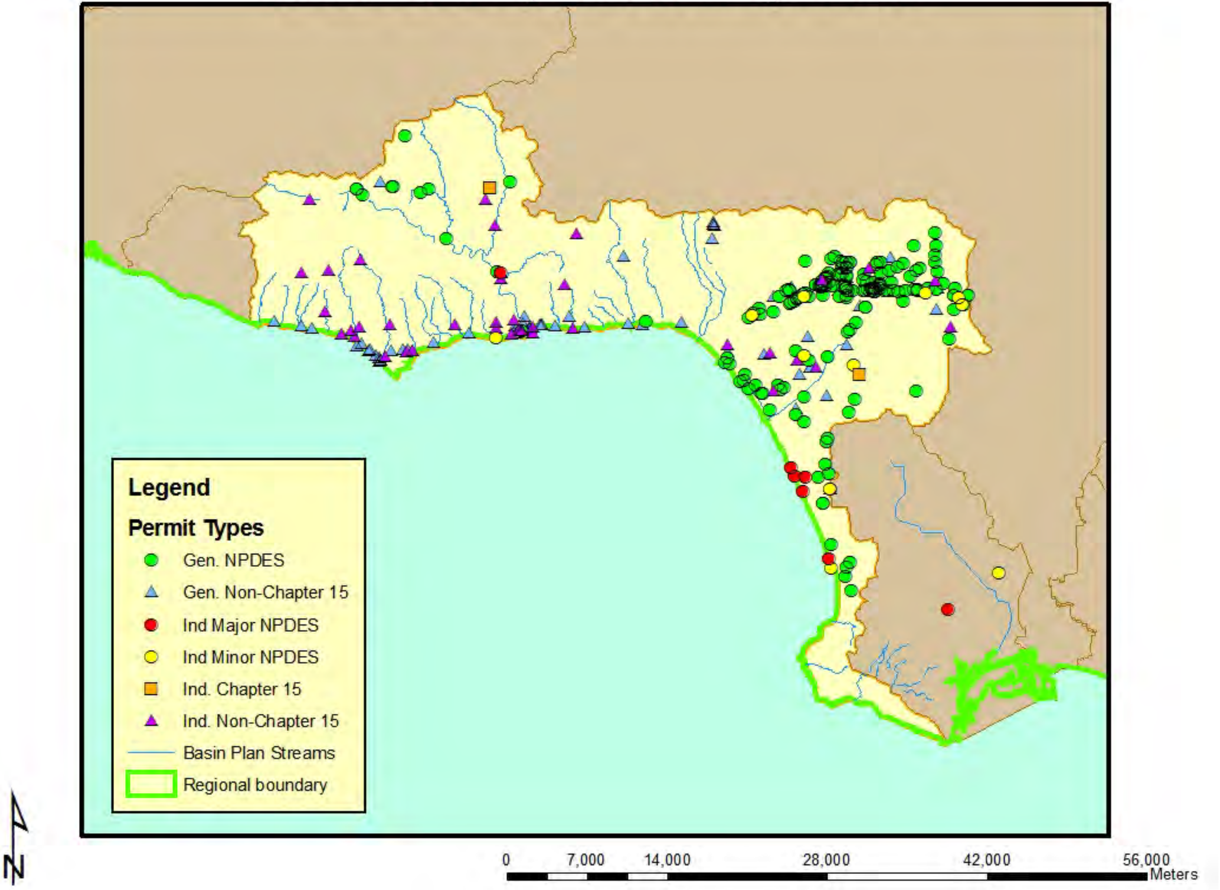
Permitted discharges:

- 193 NPDES discharges including: seven major NPDES permit discharges, three POTWs (two direct ocean discharges), one refinery, and three generating stations; 18 are minor discharges
- 175 dischargers covered under general permits
- 87 dischargers covered by an industrial storm water permit
- 401 dischargers covered by the construction storm water permit

Of the major NPDES dischargers in the Santa Monica Bay WMA, the three POTWs (particularly the two direct ocean discharges) are the largest point sources of pollutants to Santa Monica Bay. Pollutants from the minor discharges have been estimated to contribute less than two percent of the total pollutants being discharged to the Bay.

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

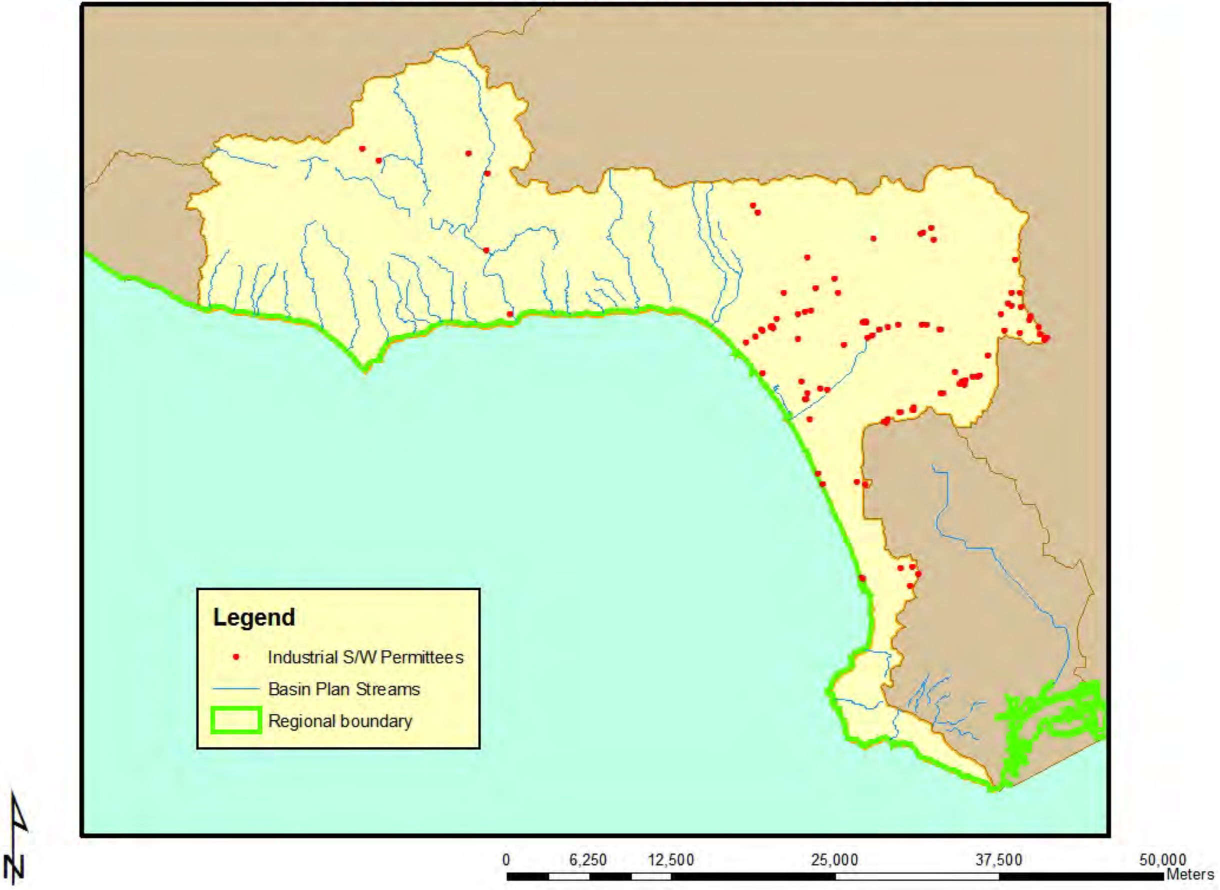
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Santa Monica Bay Watershed Management Area



Two of the mapped facilities above are located outside of the watershed but either discharge to Santa Monica Bay through a pipeline or otherwise affect the surface or ground waters of the WMA. A majority of the 193 NPDES permitted facilities in the WMA discharge to Ballona Creek.

Of the 100 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Los Angeles and Santa Monica, and are within the Ballona Creek Watershed. Electric, gas and sanitary services; local and interurban passenger transit; and fabricated metal products are a large component of these businesses based on their Standard Industrial Classification (SIC) code. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

Locations of Dischargers Covered by General Industrial Stormwater Permit in the Santa Monica Bay Watershed Management Area



There are a total of 401 construction sites enrolled under the general construction storm water permit. Many of these sites are in the Malibu Creek and Ballona Creek Watersheds. The are about twice as many residential as commercial sites under the permit with residential sites primarily located in the more rural areas of the WMA and commercial sites located in the more urban areas. About one-half of the sites are five acres or larger; about ten sites are over 100 acres in size.

A considerable number of monitoring programs have been implemented in the Santa Monica Bay WMA, particularly over the last twenty years. Sampling efforts tend to center around assessing urban runoff effects in general along the coastline and areas surrounding POTWs' ocean outfalls. Four statewide monitoring programs, State Mussel Watch, Bay Protection and Toxic Cleanup, Coastal Fish Contamination Program and Toxic Substances Monitoring, had focused on biological measurements as well. More recently, the State's Surface Water Ambient Monitoring Program has also collected chemical and biological data. Also, Bight-wide monitoring has included the coastal waters and ocean areas off of the WMA.

The data from these programs indicate that in general the open coastline is much cleaner than the Bay's enclosed waters, except with regards to DDT and PCBs on the Palos Verdes Shelf. Pollutants of particular concern are chlordane, DDT, copper, and zinc. The BPTCP has listed the Santa Monica Bay - Palos Verdes Shelf area as a toxic hot spot for DDT and PCBs human health advisories (fishing) and

NAS exceedances of DDT levels in fish. The Palos Verdes Shelf has also been listed as a Superfund site by USEPA. Marina Del Rey is listed as a toxic hot spot due to sediment concentrations of DDT, PCB, copper, mercury, nickel, lead, zinc and chlordane, and sediment toxicity; Ballona Creek Entrance Channel is listed due to sediment concentrations of DDT, zinc, lead, chlordane, dieldrin, and chlorpyrifos, and sediment toxicity. The BPTCP listed King Harbor as a site of concern, due to sediment concentrations of DDT, PCB, and sediment toxicity. The small coastal streams draining from the Santa Monica Mountains into the bay, as well as Ballona Creek, were sampled by SWAMP in 2003-2004. Nutrient problems were found at a number of drainages and many sites exhibited single sample exceedances of bacteria indicators. Metals generally did not exceed water quality objectives. Water toxicity was found at a few sites; the Index of Biological Integrity scores for benthic invertebrate health ranged from good to very poor.

Urbanization has had a significant impact on the riparian and wetland resources of the watershed, primarily through filling, alteration of flows, and decrease in water quality. It is estimated that 95% of the historic wetlands of the Santa Monica Bay WMA have been destroyed, with the remaining wetlands significantly degraded.

Although groundwater accounts for only a limited portion of the Santa Monica Bay WMA's supply of fresh water, the general quality of groundwater in the watershed has degraded from background levels.

Greater Santa Monica Bay

Santa Monica Bay is heavily used for fishing, swimming, surfing, diving etc., activities classified as water contact recreation (REC-1). However, there is an acute health risk associated with swimming in runoff-contaminated surfzone waters, and chronic (cancer) risk associated with consumption of certain sport fish species in areas impacted by DDT and PCB contamination.

The general public has also been concerned about potential health risks associated with consumption of contaminated seafood from Santa Monica Bay. This is the primary pathway through which humans are exposed to toxic chemicals found in the marine environment. Recent studies, however, have shown that health risks are limited to consumption of certain seafood species found at certain locations.

Major Issues of Concern in Greater Santa Monica Bay

- Acute health risk associated with swimming in runoff-contaminated surfzone waters
- Chronic risk associated with consumption of certain sport fish species in areas impacted by DDT and PCB contamination
- Reduction of loadings from the two major POTWs in light of projected population increases
- Other impacts from urban runoff/storm water
- Historic deposits of DDT and PCBs in sediment; high levels in fish (Palos Verdes Shelf a Superfund site)
- Loadings of pollutants from other sources: sediment resuspension, atmospheric deposition
- The need to have a better understanding of the Bay's resources

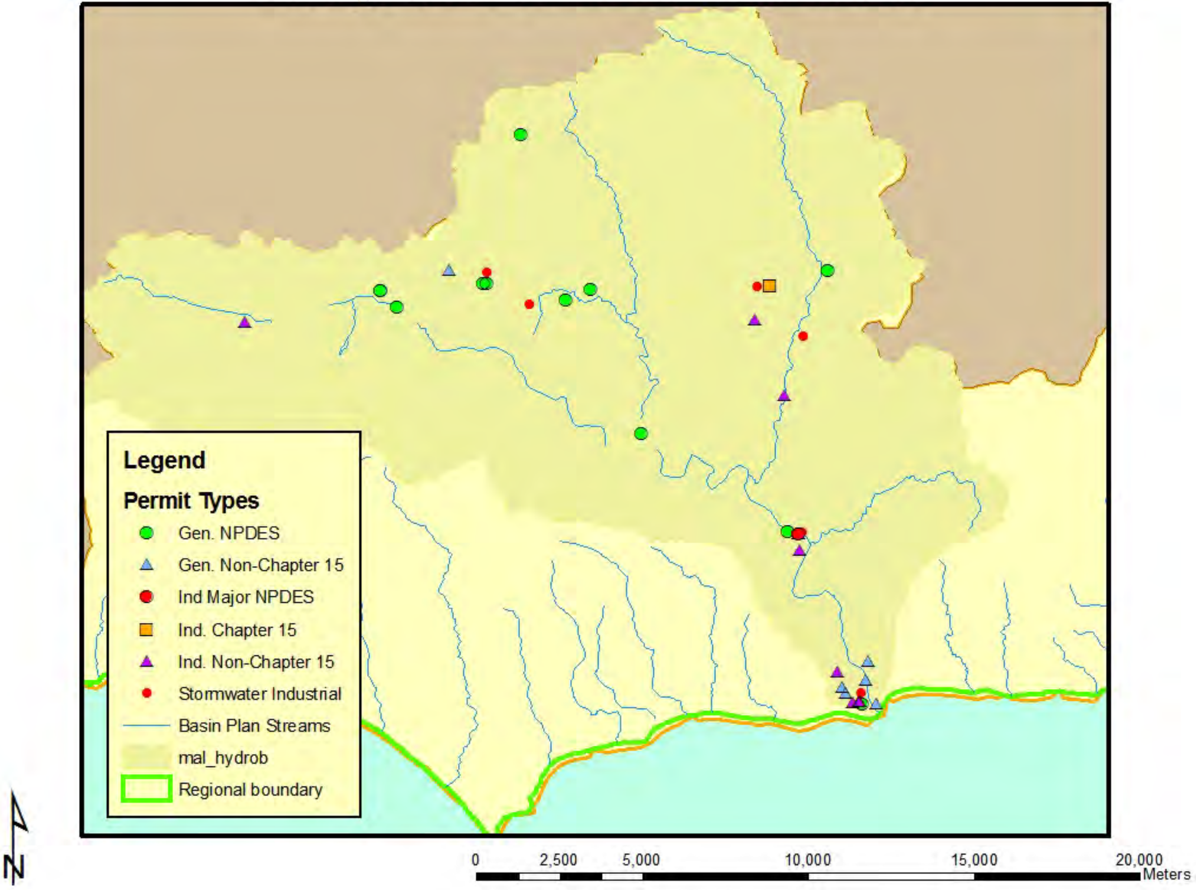
One of the impacts in marine habitats is sediment contamination and damage to marine life that the contaminants cause when they are released from the sediment (through natural fluctuations or through disturbance of the sediment) into the food chain. Organic compounds such as DDT, PCBs, polycyclic aromatic hydrocarbons (PAHs), and chlordane are found in sediments in concentrations that are harmful to marine organisms at various locations in the Bay. Also found in Bay sediments are heavy metals such as cadmium, copper, chromium, nickel, silver, zinc, and lead. The major historic sources of sediment contamination have been wastewater treatment facilities; thus the accumulations are highest near treatment plant outfalls off of Palos Verdes and Playa del Rey.

Bioaccumulation of DDT in white croaker, Dover sole, and California brown pelicans are well-known examples of the impacts caused by sediment contamination. Prior to the 1980s, high concentrations of DDT were found in muscle tissues of these organisms. DDT in these organisms was implicated in fin erosion and other diseases in fish as well as eggshell thinning and subsequent species decline in the California brown pelican.

Malibu Creek Watershed

The most recent Water Quality Assessment Report finds water quality in some streams within the Malibu Creek Watershed is impaired by nutrients and their effects, coliform and their effects, trash, and, in some instances, metals. While natural sources contribute, nonpoint source pollution from human activities is implicated including ill-placed or malfunctioning septic systems and runoff from horse corrals. Nutrient inputs are also contributed by urban runoff and the POTW which discharges tertiary-treated effluent into the Creek about five miles upstream of Malibu Lagoon. There are relatively few discharges into the watershed which are shown in the map below:

Non-Stormwater NPDES, Non-Chapter 15, Chapter 15; and Stormwater Industrial Discharger Locations in the Malibu Creek Watershed



Major Issues of Concern in Malibu Creek Watershed

- Excessive freshwater, nutrients, and coliform in lagoon; contributions from POTW
- Urban runoff from upper watershed
- Impacts to swimmers/surfers from lagoon water
- Septic tanks in lower watershed
- Appropriate restoration and management of lagoon
- Access to creek and lagoon by endangered fish (steelhead trout and tidewater goby)
- Infestation by non-native species

A nutrient TMDL is being developed for the Creek by the Regional Board although ecologically-relevant nutrient objectives are still a work in-progress. A study completed by UCLA provided recommendations which should lead to more effective management of the Lagoon and its resources as the restoration process continues.

Historically, the Lagoon was much larger than its current day size. Although the flow dynamics of the Creek as well as the ocean's influence on the Lagoon in the past can only be extrapolated, it is likely Creek flow was much less than today during the dry season, partially due to increased imported water demands upstream. Marine influence may have dominated, keeping the lagoon entrance open much of the year as occurs in the larger Mugu Lagoon to the north. An open Lagoon would have facilitated migration of the now endangered steelhead trout. And though continual Creek flow was likely less, more of the watershed was available for the trouts' use, at least prior to the construction of Rindge Dam in the 1920's. Most important, during the dry season there would be access to deep shaded pools in many parts of the watershed where the fish could mature until rain created the flows needed to reach the ocean.

Today, the flow regime is quite different and now a major issue of concern. Both increased urban runoff from the more developed upper watershed and discharges from the POTW have increased baseline flows. However, the POTW which discharges to Malibu Creek is now under a discharge prohibition starting each April 15 through November 15 of each year, except during times of plant upset, storm events, or the existence of minimal streamflow conditions that require flow augmentation in Malibu Creek to sustain endangered species.

The lagoon size is much reduced from historic times and it remains closed much of the year except for during the winter when ocean influences breach the sandbar and Creek flows help maintain the opening. This had led to decreasing salinity or, at times, greatly fluctuating salinity which has disturbed efforts to restore the Lagoon. This also leads to elevated groundwater levels adjacent to the lagoon, which affects the function of septic system leachfields in the area. Additionally, surfing and swimming is popular off the beaches in the immediate area and there is considerable concern over contaminated Lagoon water reaching these people.

Riparian habitats throughout the watershed have been adversely impacted by infestation of non-native species. Major invasive plant species of concern include Arundo, castor bean, pampas grass, fennel, tree tobacco, and tree of heaven. Major invasive animal species of concern include mudsnail and crayfish.

Several man-made structures such as a dam, an Arizona crossing, and culverts exist along the Creek and its tributaries and are barriers to steelhead trout migration. The largest such barrier on the Creek is Rindge Dam. Some segments of the tributaries have also been channelized in the more developed upper watershed.

Ballona Creek Watershed

The 2006 303(d) list indicates impairment in this watershed due to coliform and its effects such as shellfish harvesting advisories; trash; PCBs and pesticides of historical origin such as DDT, chlordane, and dieldrin, as well as their effects such as sediment toxicity; metals such as lead, silver, arsenic, copper, cadmium, and zinc, as well as their effects such as water column toxicity; and tributyltin.

Ballona Creek is completely channelized except for the estuarine portion which has a soft bottom. While at one time it drained into a large wetlands complex, it now has no direct connection to the few wetlands remaining in the area, although tide gates exist in the channel which connect to Ballona Wetlands. However, Ballona Creek may more often affect the nearby wetlands due to wave action moving trash, suspended material and dissolved contaminants from the ocean to the nearby Ballona Wetlands and Marina del Rey Harbor within which complex Ballona Lagoon is located.

Major Issues of Concern in Ballona Creek Watershed and Wetlands

- Trash loading from creek
- Wetlands restoration
- Stream restoration (including daylighting)
- Sediment contamination by heavy metals from creek to Marina del Rey Harbor and offshore)
- Toxicity of both dry weather and storm runoff in creek
- High bacterial indicators at mouth of creek

The U.S. Army Corps of Engineers (USACE) and Los Angeles County Department of Beaches and Harbors have several times conducted dredging operations in order to keep the entrance to Ballona Creek and Marina del Rey Harbor open although this is not a routine procedure. Led by the Los Angeles Basin Contaminated Sediment Task Force (for further information on this Task Force, see the Regionwide Section of this document), the USACE completed a study to identify sources of heavy metals loadings within the watershed as well as source control and treatment measures as alternatives to dredging..

Both dry weather and storm runoff from the main channel and two major tributaries were found to be toxic to marine organisms. Toxicity was also found during storms in the ocean near the mouth of Ballona Creek. Preliminary investigations showed that the sources of toxicity varied, and were associated with metals on one occasion and with organic chemicals on another occasion. Further efforts are needed to identify the sources of toxicity.

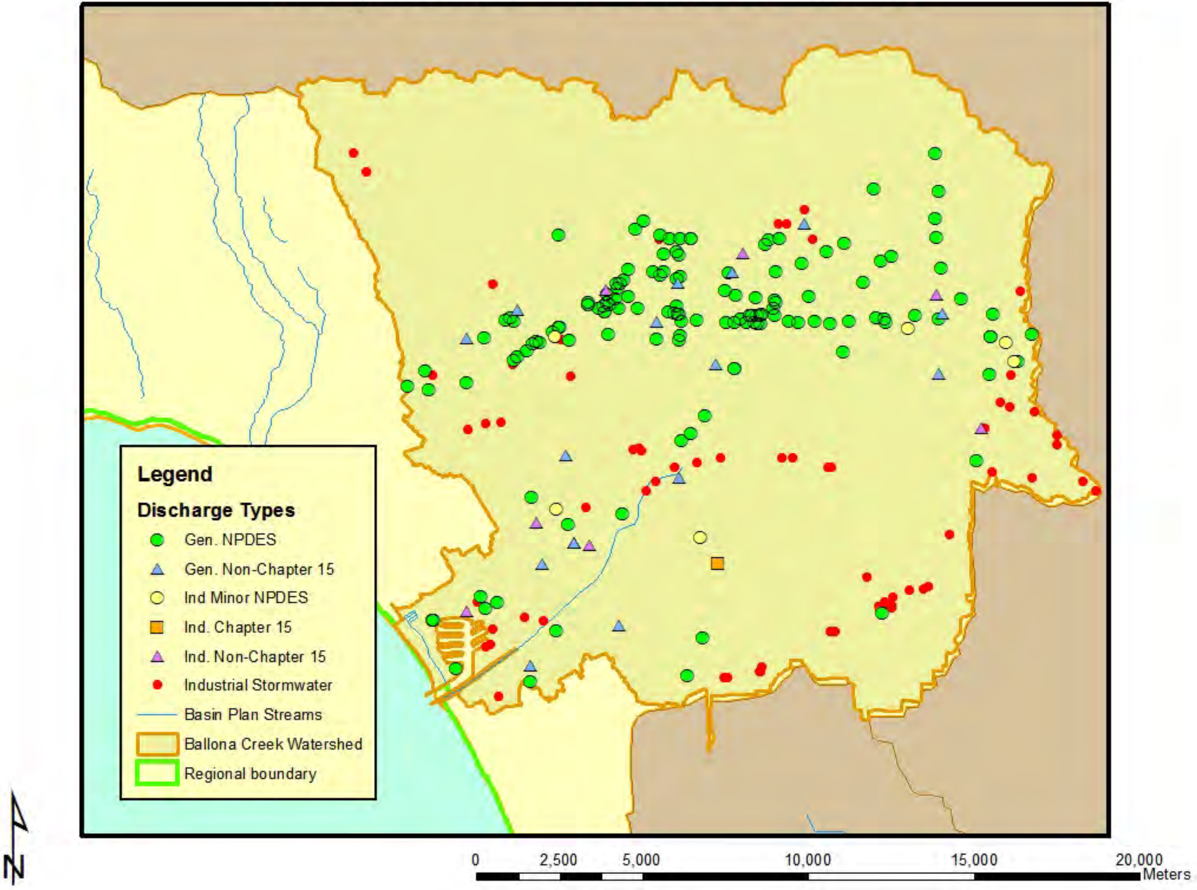
Bacterial indicator levels measured at stations near the mouth of Ballona Creek frequently exceed the level of concern. As a result, warning signs are posted permanently on each side of the Creek. The number of beach closures due to sewage spills rose again in 1998 after a long declining trend over the last ten years. The standards used to determine whether a beach should be closed are now based on AB 411 and, since its passage, a greater number of beach closures have been seen statewide.

The BPTCP lists the sediments in the Ballona Creek Entrance Channel and Marina del Rey back channels as Toxic Hot Spots; however, since they are not high priority sites, the Regional Board has not yet developed preliminary radiation plans or cost estimates.

Tributaries of the Creek throughout the watershed have also been substantially channelized and/or converted to underground channels. It is estimated that 96% of historical natural streams and associated riparian habitats in the watershed have been lost to channelization and urbanization. The USACE is currently conducting a lower Ballona Creek restoration feasibility study to explore opportunities and evaluate potential riparian habitat restoration concepts.

There are a large number of permitted discharges in the watershed as shown in the map below. Many of these facilities are located along Wilshire Boulevard.

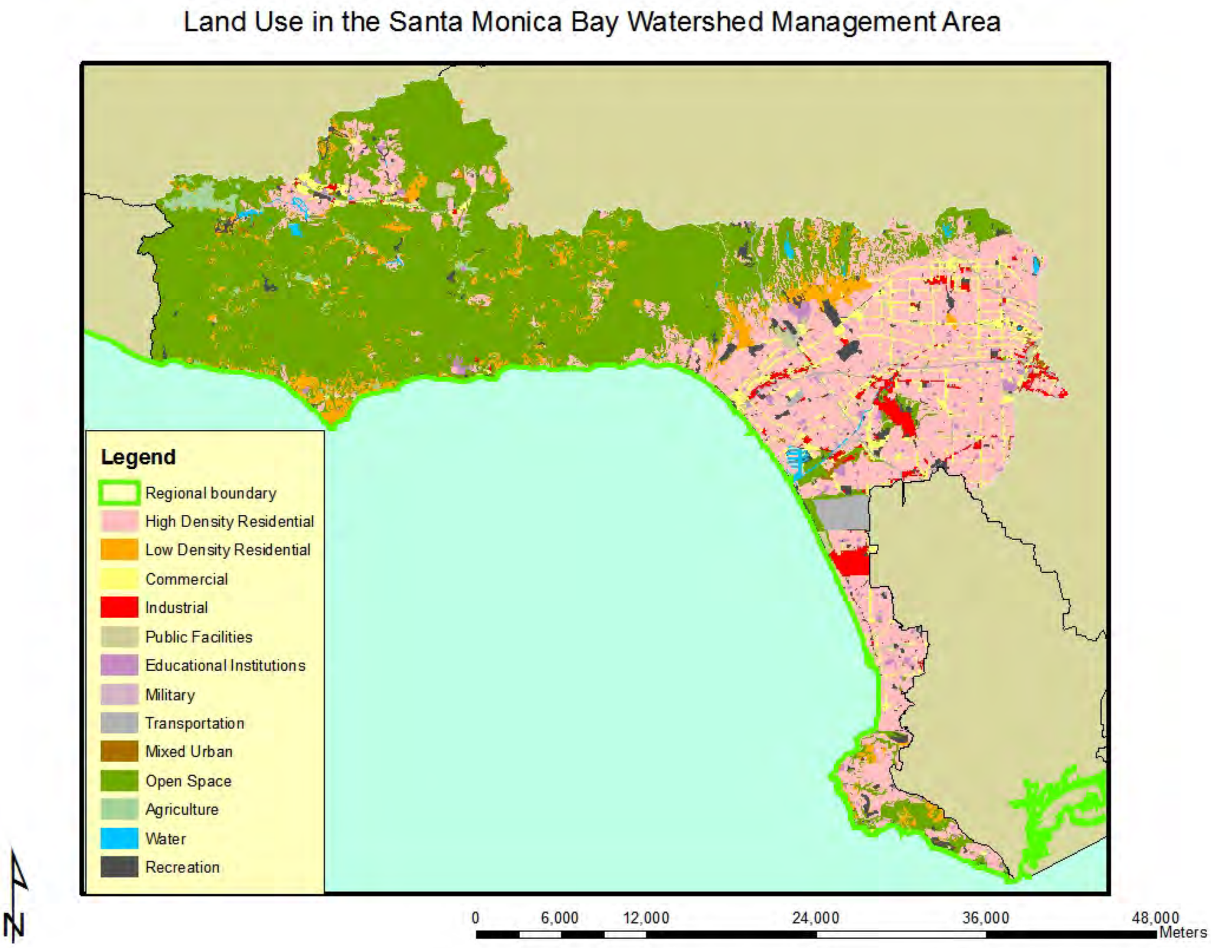
Non-Stormwater NPDES, Non-Chapter 15, Chapter 15; and Stormwater Industrial Discharger Locations in the Ballona Creek Watershed



Other Urban Watersheds

The most recent Water Quality Assessment Report indicates impairment in many of these smaller drainages, which discharge directly to the ocean, due to one or several of the following: coliform, ammonia, lead, copper (and toxicity likely associated with metals), trash, and low dissolved oxygen. Due to the frequency of high bacterial indicator levels, warning signs are posted permanently at many of these locations (i.e., storm drain outlets). It should be noted that flow from most of these storm drains have been diverted to the sewer system during dry weather.

The contrasting nature of land use in the WMA (particularly between the northern (western) and southern portions) can be seen in the figure below.



The table below shows the complete list of 2006 303(d) water quality impairments impairments.

Water Quality Limited Segment Name	Pollutant
Abalone Cove Beach	DDT (sediment) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Amarillo Beach	DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Ballona Creek	Cadmium (sediment)[2] Coliform Bacteria[4] Copper, Dissolved[2] Cyanide Silver (sediment)[2] Toxicity[2] Trash[3] Viruses (enteric)[4]

Ballona Creek Estuary	Chlordane (tissue & sediment)[5] Coliform Bacteria[4] Copper[5] DDT (sediment)[5] Lead (sediment)[5] PAHs (sediment)[5] PCBs (tissue & sediment)[5] Sediment Toxicity[5] Shellfish Harvesting Advisory[4] Zinc (sediment)[5]
Ballona Creek Wetlands	Exotic Vegetation Habitat alterations Hydromodification Reduced Tidal Flushing Trash[3]
Big Rock Beach	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Bluff Cove Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Cabrillo Beach (Outer)	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Carbon Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Castlerock Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Dan Blocker Memorial (Coral) Beach	Coliform Bacteria[1]
Dockweiler Beach	Indicator bacteria[1]
Escondido Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Flat Rock Point Beach Area	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Hermosa Beach	Indicator bacteria[1]
Inspiration Point Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
La Costa Beach	DDT (Fish Consumption Advisory)

	Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Lake Lindero	Algae Chloride Eutrophic Odor Selenium Specific Conductivity Trash
Lake Sherwood	Algae Ammonia Eutrophic Mercury (tissue) Organic Enrichment/Low Dissolved Oxygen
Las Flores Beach	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Las Tunas Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Las Virgenes Creek	Coliform Bacteria[6] Nutrients (Algae) Organic Enrichment/Low Dissolved Oxygen Scum/Foam-unnatural Sedimentation/Siltation Selenium Trash
Latigo Canyon Beach/Dan Blocker Memorial Beach	Indicator bacteria[1]
Leo Carillo Beach (South of County Line)	Coliform Bacteria[1]
Lindero Creek Reach 1	Algae
	Coliform Bacteria[6] Scum/Foam-unnatural Selenium Trash
Lindero Creek Reach 2 (Above Lake)	Algae
	Coliform Bacteria[6] Scum/Foam-unnatural Selenium Trash
Long Point Beach	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Lunada Bay Beach	Indicator bacteria[1]
Malaga Cove Beach	DDT (Fish Consumption Advisory)

	Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Malibou Lake	Algae Eutrophic Organic Enrichment/Low Dissolved Oxygen
Malibu Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1]
Malibu Creek	Coliform Bacteria[6] Fish Barriers (Fish Passage) Nutrients (Algae) Scum/Foam-unnatural Sedimentation/Siltation Selenium Sulfates Trash
Malibu Lagoon	Benthic Community Effects Coliform Bacteria[6] Eutrophic pH Shellfish Harvesting Advisory[6] Swimming Restrictions[6] Viruses (enteric)[6]
Malibu Lagoon Beach (Surfrider)	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Manhattan Beach	Indicator bacteria[1]
Marina del Rey Harbor - Back Basins	Chlordane (tissue & sediment)[7] Copper (sediment)[7] DDT (tissue)[7] Dieldrin (tissue)[7] Fish Consumption Advisory[7] Indicator bacteria[8] Lead (sediment)[7] PCBs (tissue & sediment) (Shellfish harvesting advisory)[7] Sediment Toxicity[7] Zinc (sediment)[7]
Marina del Rey Harbor Beach	Indicator bacteria[1]
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Algae
Medea Creek Reach 1 (Lake to Confl. with Lindero)	Coliform Bacteria[6] Sedimentation/Siltation

	Selenium Trash
Medea Creek Reach 2 (Abv Confl. with Lindero)	Algae Coliform Bacteria[6] Sedimentation/Siltation Selenium Trash
Nicholas Canyon Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Palo Comado Creek	Coliform Bacteria[6]
Palo Verde Shoreline Park Beach	Pathogens[1] Pesticides
Paradise Cove Beach	DDT (Fish Consumption Advisory) Fecal Coliform[1] PCBs (Fish Consumption Advisory)
Point Dume Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Point Fermin Park Beach	DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory) Total Coliform[1]
Point Vicente Beach	Indicator bacteria[1]
Portuguese Bend Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Promenade Park Beach	Indicator bacteria[1]
Puerco Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Redondo Beach	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Resort Point Beach	Indicator bacteria[1]
Robert H. Meyer Memorial Beach	Beach Closures
	DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Royal Palms Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Santa Monica Bay Offshore/Nearshore	DDT (tissue & sediment) (Centered on Palos Verdes Shelf) Debris

	Fish Consumption Advisory PCBs (tissue & sediment) Sediment Toxicity
Santa Monica Beach	Indicator bacteria[1]
Santa Monica Canyon	Indicator bacteria[1] Lead
Sea Level Beach	DDT (Fish Consumption Advisory) Indicator bacteria[1] PCBs (Fish Consumption Advisory)
Sepulveda Canyon	Ammonia Indicator bacteria[4] Lead[2]
Solstice Canyon/Dan Blocker Memorial (Coral) Beach	Indicator bacteria[1]
Stokes Creek	Coliform Bacteria[6]
Surfers Point at Seaside	Indicator bacteria[1]
Topanga Beach	Coliform Bacteria[1] DDT (Fish Consumption Advisory) PCBs (Fish Consumption Advisory)
Topanga Canyon Creek	Lead
Torrance Beach	Coliform Bacteria[1]
Trancas Beach (Broad Beach)	DDT (Fish Consumption Advisory)
Trancas Beach (Broad Beach)	Fecal Coliform[1]
Trancas Beach (Broad Beach)	PCBs (Fish Consumption Advisory)
Triunfo Canyon Creek Reach 1	Lead
Triunfo Canyon Creek Reach 1	Mercury
Triunfo Canyon Creek Reach 1	Sedimentation/Siltation
Triunfo Canyon Creek Reach 2	Lead
Triunfo Canyon Creek Reach 2	Mercury
Triunfo Canyon Creek Reach 2	Sedimentation/Siltation
Venice Beach	Indicator bacteria[1]
Westlake Lake	Algae
Westlake Lake	Ammonia
Westlake Lake	Eutrophic
Westlake Lake	Lead
Westlake Lake	Organic Enrichment/Low Dissolved Oxygen
Whites Point Beach	DDT (Fish Consumption Advisory)
Whites Point Beach	Indicator bacteria[1]
Whites Point Beach	PCBs (Fish Consumption Advisory)
Will Rogers Beach	Indicator bacteria[1]
Zuma Beach (Westward Beach)	DDT (Fish Consumption Advisory)
Zuma Beach (Westward Beach)	Indicator bacteria[1]
Zuma Beach (Westward Beach)	PCBs (Fish Consumption Advisory)

[1] Santa Monica Bay Beaches Wet Weather and Dry Weather Bacteria TMDLs, 2003

[2] Ballona Creek Metals TMDL, 2005
[3] Ballona Creek Trash TMDL, 2002
[4] Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL, 2007
[5] Ballona Creek Estuary Toxic Pollutants, 2005
[6] Malibu Creek Bacteria TMDL, 2006
[7] Marina del Rey Harbor Toxics TMDL, 2006
[8] Marina del Rey Back Basins Bacteria TMDL, 2004

CURRENTLY SCHEDULED TMDLS:

- Nutrients (Malibu Creek)

Stakeholder Groups

- *Malibu Creek Watershed Council (with subcommittees)* A number of stakeholders began meeting in the late 1980's/early 1990's in the Malibu area. Through their efforts, a list of priority issues that need to be resolved was formulated. This lead to the development of a Natural Resources Plan for the watershed which was prepared by the U.S. Natural Resources Conservation Service. Separate task forces and subcommittees have formed over the years to address specific issues. The Watershed Council consists of members from State and local agencies and organizations, environmental groups, business and dischargers, special districts and the general public. Their mission is to oversee and implement actions that will protect, enhance and restore habitats of the watershed, as well as improve water quality. Current active committees/task forces under the Council include those focusing on habitat/species, monitoring/water quality, education, and Rindge Dam. The Council's Malibu Lagoon Task Force served as an advisory group to a recently completed lagoon restoration plan. A copy of the final lagoon restoration plan funded by the Coastal Conservancy may be found at http://www.healthebay.org/currentissues/mlhep/default.asp. The Monitoring Subcommittee also meets regularly to serve as a Technical Advisory Committee to a Proposition 13-funded watershed-wide monitoring program. A Malibu Creek Ecosystem Restoration Feasibility Study is underway. The U.S. Army Corps of Engineers and California Department of Parks and Recreation are the major partners in this effort which will evaluate, among other options, the feasibility of restoring the ecosystem through removal of Rindge Dam. The technical advisory group for the effort meets approximately monthly while a larger stakeholder focus group meets as needed. Watershed Council meetings occur every other month while subcommittees may meet intermittently or regularly. More information may be found at http://www.malibuwatershed.org/.

- *Santa Monica Bay Restoration Commission (Watershed Council, Governing Board, Executive Committee, and Technical Advisory Committee)* The SMBRC was formed in 1989 under the National Estuary Program and was originally called the Santa Monica Bay Restoration Project; it is charged with the responsibility of assessing the Bay's problems, developing solutions, and identifying implementation procedures. A Bay Restoration Plan was developed and is in the process of being implemented. A Regional Board member and sometimes a staff member attend the bimonthly meetings of the Commission's Governing Board, while another staff member attends the bi-monthly Technical Advisory Committee meetings. More information about the SMBRC may be found at their website http://www.santamonicabay.org/

- *Ballona Creek Watershed Task Force* The task force was formed in 2000 as a stakeholder group addressing water quality and habitat issues in the watershed and developing a Ballona Creek Watershed Management Plan which can be found at http://www.ladpw.org/wmd/watershed/bc. The group continues to meet in pursuit of Plan implementation.

- *Topanga Watershed Committee* The committee was formed in 1998 as a followup to previous a community group working on developing alternatives to traditional flood control measures. Their focus has expanded to include general watershed management and protection activities as well as volunteer monitoring. Work has also been completed to define the extent of restoration feasible to Topanga Lagoon. A 205(j) grant-funded project conducted baseline water quality monitoring for two years during both dry and weather. A watershed management plan was finalized in 2002. Watershed residents continue work on implementation of actions identified in the Management Plan. The group meets on an as-needed basis. More information about this group may be found at their website http://www.topangacreekwatershedcommittee.org.

Past Significant Activities

WATERSHED MANAGEMENT

The Los Angeles County Department of Public Works received a Proposition 13 grant in 2001 to develop a Ballona Creek Watershed Management Plan. This work was completed in 2004. Although the greater Santa Monica Bay has a restoration plan, this subwatershed with its many urban impacts needs special attention. Since the Creek has also been shown to impact the nearshore environment of Santa Monica Bay, additional benefits will result.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has funded a number of acquisition/planning/restoration projects in the WMA. These include:

- Ballona Wetlands Acquisition
- Topanga Lagoon Restoration Technical Assessments
- Topanga Lagoon and Watershed Restoration Feasibility Study
- Upper Zuniga Road Acquisitions
- Tuna Canyon Significant Ecological Area Acquisition
- Cold Creek Riparian Acquisitions, Part 1
- Cross Creek Road Fish Passage
- Malibu Creek Arundo Removal project
- Solstice Creek Steelhead Enhancement Design Plans

MONITORING AND ASSESSMENT

SWAMP: This watershed was the focus of SWAMP monitoring in FY02/03 with analyses repeated at some sites in FY03/04. Approximately 30 directed sites in coastal subwatersheds (generally one site in the lower watershed and one in the upper subwatershed) were sampled for conventional water chemistry, bacteriology and bioassessment. A subset of these stations were samples for toxicity, metals and pesticide chemistry in water column. Sampling occurred during the spring in 2003 and 2004. Potential reference sites sampled during spring 2003 were resampled during spring 2004.

TMDL Research and Monitoring: UCLA was under contract with the State Board to provide data needed for establishment of nutrient TMDLs in several watersheds within the Region including Calleguas Creek, Santa Clara River, and Malibu Creek. By understanding the inter-relationships between water quality and habitat condition and the resulting effects that these interactions have on the biological communities of coastal watersheds, this research was intended to further our understanding of the ecology of southern California watersheds. Besides providing information supporting the establishment of nutrient TMDLs for these three impaired coastal watersheds, the data collected would provide insight into how these TMDLs might be complied with in the future. The work is a continuation and extension of a Regional Environmental Monitoring and Assessment Program (R-EMAP) project in the Calleguas Creek Watershed. R-EMAP us part of a larger national effort by the USEPA to assess the condition of the nation's ecological resources.

The Southern California Coastal Water Research Project (SCCWRP) was under contract with the State Board to provide technical support for the Regional Board's TMDL development efforts. Several related tasks conducted in the Malibu Creek Watershed included: 1) an assessment of the current level of impairment to water quality from algal biomass in the Creek through dissolved oxygen measurements, 2) an assessment of the current level of impairment to water quality from algal biomass in the Creek through a survey of algal biomass and species composition at multiple locations as well as collection of water quality samples and surveys of habitat types, and 3) a determination of whether nitrogen or phosphorus limits algal growth in order to develop appropriate water quality objectives.

NONPOINT SOURCE PROGRAM

A number of nonpoint source control strategies have been undertaken in the Malibu Creek Watershed. Those that involved restoration of aquatic life beneficial uses include streambank and riparian corridor habitat restoration projects funded by 319(h) monies undertaken by the Resource Conservation District of the Santa Monica Mountains and the Department of Parks and Recreation. Additionally, the Resource Conservation District has prepared a manual for horse owners in the areas detailing ways to prevent nonpoint source inputs from their land (funded by 319(h) monies). Also, the City of Calabasas is using 319(h) money to develop and coordinate a watershed education center and library. Another 319(h) project involved restoration of Zuma Lagoon.

The SMBRP report, "Making Progress: Restoration of the Malibu Creek Watershed" (January 2001) includes Table 1.3, Key Watershed Projects, Studies, Stakeholder Groups and Partnerships. It lists 17 different non-point source projects that have been implemented in the Malibu Creek Watershed over the past decade to address water quality and habitat issues.

Septic Systems: In January 2000, the Santa Monica Bay Restoration Commission (SMBRC) convened a Task Force to address the issue of septic system management throughout the northern Santa Monica Bay watersheds. The area of focus covers three jurisdictions: the City of Malibu, the City of Los Angeles, and areas of unincorporated Los Angeles County. In order to bring together the various perspectives and expertise on this issue, the Task Force was composed of representatives from various stakeholder organizations including: State Department of Health Services (SDHS); Los Angeles Regional Water Quality Control Board (RWQCB); California Coastal Commission; Los Angeles County Departments of

Public Works, Health Services and Regional Planning; City of Los Angeles Department of Building and Safety; City of Malibu Environmental and Building Safety Department; Los Angeles County Board of Supervisors Office - Third District; and Heal the Bay.

The Task Force's goal was to develop solutions to the problems associated with septic systems and their impact on water quality, while at the same time identifying the obstacles that must be faced in trying to mitigate the situation. By bringing an understanding of these obstacles into the formulation of its recommendations, the Task Force tried to ensure that the solutions are implementable and still fully address the problem at hand.

After its review of the existing management and regulatory framework for septic system management in the Bay's watersheds, the Task Force's recommendations suggested that improving management of septic systems would require significantly greater oversight by both state and local agencies as well as improved coordination between them.

The Task Force recommended a comprehensive approach to septics system management in northern Santa Monica Bay that included the following elements:

- **Issue waste discharge requirements (WDRs) for all existing multi-family and commercial establishments in northern Santa Monica Bay watersheds.**
- **Establish a comprehensive permitting program for operation, inspection and monitoring of all septic systems.**
- **Design and implement a comprehensive groundwater monitoring program to improve assessments of septic system impacts to receiving waters and groundwaters.**
- **Establish a coordinated approach for oversight of septic systems, including modification/update of the WDR waivers between the RWQCB and local agencies.**
- **Develop a grants program for qualified homeowners to provide financial assistance to upgrade failing systems.**
- **Develop more stringent requirements for installation and operation of wastewater management systems in environmentally sensitive areas.**
- **Establish local septic system maintenance districts to oversee and fund the permitting, inspection and monitoring activities.**
- **Conduct public outreach to residents regarding proper operation and maintenance of septic systems.**

The SMBRC is working to incorporate these recommendations into the Bay Restoration Plan and continue to work with agencies responsible for their implementation.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Santa Monica Bay WMA.

CORE REGULATORY

Ongoing work related to individual NPDES permits includes review and assessment of monitoring data, conducting compliance inspections, and pursuing enforcement actions if necessary. Due to limited resources, only the basic regulatory activities are performed: review of dischargers' monitoring reports, minimum necessary inspections and sampling, issuance/renewal of permits, levels 1 and 2 enforcement actions (noncompliance and violation notification), case handling, and answering inquiries from the public.

Core regulatory responsibilities also include administration of the consent decrees for full secondary treatment compliance by the City of Los Angeles and the County Sanitation Districts of Los Angeles County (CSDLAC) and a 1990 Settlement Agreement with the City of Los Angeles. Another responsibility is oversight of the approved pretreatment programs for the joint outfall system for the City of Los Angeles and the CSDLAC and oversight of the sewage collection systems.

In addition, although the permit for the Tapia Water Reclamation Plant in the Malibu Creek Watershed was renewed in 1997, there were appeals and changes which resulted in the permit being revised again in December 1999. Staff continue to spend significant effort on this permit due to contentious issues such as the summer flow prohibition, and pending nutrient and total maximum daily load limitations. The permit has most recently been renewed in 2005.

The Santa Monica Bay Watershed Management Area falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was adopted on December 13, 2001. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit in 1999. The Los Angeles County Flood Control District is the Principal Permittee. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permit can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/la_ms4_final.html.

An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system.

MONITORING AND ASSESSMENT

Portions of a regional ocean monitoring program are being implemented through the receiving water monitoring programs of the major dischargers as well as through the Bight-wide monitoring (see Region-wide Section for additional details). A watershed-wide monitoring program is currently being implemented in the Malibu Creek Watershed.

The SMBRC in 2006 developed a *Comprehensive Monitoring Program* which lays out new monitoring designs for five major habitat types within the Bay. Each includes a core motivating question, a number of related objectives, specific monitoring approaches, indicators, and data products, and sampling designs detailing number and locations of stations, sampling frequency, and measurements to be collected. The Program incorporates key monitoring efforts that extend from the outer Bay to the high tide line along the shore. While this is the scope of the Program, it is intended to complement other efforts, such as TMDLs, that link land and marine environments.

The five major habitat (or ecosystem) types covered in the Comprehensive Monitoring Program:

− Pelagic Ecosystem
− Soft Bottom Ecosystem
− Hard Bottom Ecosystem
− Rocky and Sandy Intertidal
− Wetlands

The new Comprehensive Monitoring Program also includes an implementation plan with a detailed schedule, cost estimates for individual Program elements, and recommendations on the Program's management structure, including data management and assessment strategies.

In 2005, the SMBRC conducted an assessment of information needs for protection of the Bay's habitats and living resources. A new inventory of existing information on the Bay's habitats and living resources was developed as part of this assessment effort. In 2007, the Bay Restoration Commission formed a Marine Protected Area (MPA) Technical Advisory Committee to facilitate filling gaps in data that are critical in the upcoming State process for establishing MPAs in Southern California. The Commission's MPA TAC (MTAC) has worked on identifying key habitat areas and species of concern, updating the existing information inventory, identifying key data gaps, and overseeing research and monitoring projects. To date, key data gaps identified by the MTAC include

- Completion of seafloor mapping and development of GIS-based habitat mapping and information system
- Study of larval and juvenile fish dispersal rate
- Comprehensive assessment of subtidal habitats and communities
- Comprehensive assessment of intertidal habitats and communities
- Assessment of marine mammal and seabird communities
- Reconnaissance of deep reef habitats
- Study of the impacts of resource extraction on fish and invertebrate populations
- Socioeconomic impacts of ecosystem health - funded by the SMBRC's Habitats Assessment Trust Fund Study of socioeconomic impacts and assessment of subtidal habitats are currently underway.

The adoption of the Marina del Rey Harbor back basins toxics TMDL included a requirement that the five responsible parties (Los Angeles County Department of Public Works, Los Angeles County Department of Beaches and Harbors, the City of Los Angeles, Culver City, and the California Department of Transportation) do a sediment characterization study of the entire marina.

Because it is not practical to continuously monitor every stream/storm drain, the monitoring approach adopted by the municipal storm water permit is to rely on sampling of a set of mass loading stations in combination with a set of land use stations. Data collected through sampling of these stations will then be used to calibrate models that produce mass loading estimates for a specific watershed/subwatershed. The USACE has worked with UCLA to collect storm water samples in Ballona Creek to calculate relative contributions of pollutant loadings from each tributary and major land use types. SCCWRP also has on-going efforts to investigate the loading and impacts of storm water runoff throughout the Southern California region, including creeks in the Santa Monica Mountains.

Besides information provided by these existing efforts, there are still information gaps that hinder the fulfillment of the identified monitoring objectives, including:

- A project that develops methodology for and conducts status and trend analysis using stormwater monitoring data collected under the municipal NPDES permit.
- A study that uses more frequent monitoring during different periods of a storm to generate a "pollutograph." This information will greatly improve the accuracy of pollutant loading estimates generated by modeling efforts.
- A project that resolves the issue of consistency in detection limits used by different dischargers. The Regional Board needs recommendations and rationale on the proper detection limits for each measured constituent to estimate and make comparisons of loadings from various sources (point and nonpoint sources).
- The study and application of molecular markers for storm water runoff. The marker can be used to identify the area of storm water influence and therefore aid further study if the runoff impacts in receiving water sediments.
- Toxicity Identification Evaluations to identify the sources of storm water/urban runoff toxicity.
- A study of the effectiveness of structural BMPs that are implemented using Proposition A grant money funds. Since many pollution control devices are new and considered to be pilots in the Region, the review panel for the Proposition A funds recommended that the regional Board should take on the responsibility to both monitor the progress in implementing these projects and to evaluate the effectiveness of installed devices for regional applicability.
- A study of the effectiveness of non-structural BMPs (e.g. public outreach) implemented under the municipal storm water permit. The information will be useful for developing future storm water pollution control strategies.
- Development of practical sanitation survey tools.

These projects would require either additional staff time or need to receive funding from various grant sources.

There are also a number of ongoing volunteer monitoring efforts underway in the WMA. They include storm event sampling at over 30 Bay storm drains coordinated by the Santa Monica BayKeeper, gutter patrol monitoring in inland neighborhoods and monitoring of Malibu Lagoon and the lower Creek for water quality and biological parameters coordinated by Heal the Bay, water quality and biological monitoring and surveys of Malibu Lagoon, as well as Topanga Creek, coordinated by the Resource Conservation District of the Santa Monica Mountains, monitoring of the upper Malibu Creek Watershed, and coliform monitoring of the surf zone off of Malibu coordinated by the Malibu Chapter of the Surfrider Foundation.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project considers the Ballona Wetlands Restoration Planning a high priority on the current workplan and is underway. The State Coastal Conservancy in partnership with the California Department of Fish and Game and State Lands Commission is developing a restoration plan for Ballona Wetlands. More information about this work may be found at http://www.scc.ca.gov/Ballona/index.html. A US Army Corps-funded Ecosystem Restoration Feasibility Study is also being conducted in coordination with the Coastal Conservancy work. More information about this study may be found at http://www.spl.usace.army.mil/cms/index.php?option=com_content&task=view&id=64&Itemid=31.

Other projects in the WMA listed on the Wetlands Recovery Project's workplan include:

- The Topanga Creek Restoration Program listed as a high priority,
- Las Flores Creek Restoration,
- The Malibu Lagoon Habitat Enhancement Program which is ongoing,
- The Upper Malibu Creek Feasibility Study (Rindge Dam) which is ongoing,
- Cold Creek Riparian Acquisitions, Part 2,
- La Sierra Riparian Acquisitions,
- Nicholas Canyon Watershed Acquisition, and
- Solstice Creek Steelhead Access Implementation which is ongoing

Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

The Santa Monica Mountains Conservancy is a state agency created by the Legislature in 1979 charged with primary responsibility for acquiring property with statewide and regional significance, and making those properties accessible to the general public. The Conservancy manages parkland in the Santa Monica Mountains, Santa Susana Mountains, the Simi Hills, the Santa Clarita Woodlands, the Whittier-Puente Hills, the Sierra Pelona, the Los Angeles River Greenway, the Rio Hondo, the Verdugo Mountains, the San Gabriel Mountains, and the San Rafael Hills. The agency's goals are to: 1) implement the Santa Monica Mountains Comprehensive Plan, 2) implement the Rim of the Valley Trails Corridor Master Plan, 3) implement the Los Angeles County River Master Plan, 4) further cooperation with local governments in the region to secure open space and parkland, and 5) expand education, public access, and resource stewardship components in a manner that best serves the public, protects habitat, and provides recreational opportunities. More information on this agency's goals may be found at http://www.smmc.ca.gov.

SMBRC Proposition 12 Grant Program: The *Safe Neighborhood Parks, Clean Water, Clean Air, and Coastal Protection Bond Act (Proposition 12*), passed in March 2000, provides a total of $25 million to projects that clean up or rehabilitate the resources of Santa Monica Bay. It was the first significant source of state funding to carry out the goals of the 1995 Santa Monica Bay Restoration Plan. By late 2007, forty projects, totaling approximate $19 million, representing the first phase of the bond money support, had been awarded funding under this grant program. The projects included a wide array of actions that address pollution prevention, habitat restoration, as well as critical research and educational needs of the watershed. Many of the projects address information and action needs identified in this document.

SMBRC Proposition 50 Grant Program*:* The *Water Quality, Supply and Safe Drinking Water Projects, Coastal Wetlands Purchase and Protection Act (Proposition 50)* passed in November 2002, provides a total of $20 million for projects that control pollutant loading to Santa Monica Bay and restore habitats in the Bay watershed. It was the second significant source of state funding to carry out the goals of the Bay Restoration Plan. By late 2007, approximately $18 million had been awarded to implement sixteen pollution control and habitat restoration capital outlay projects.

NONPOINT SOURCE PROGRAM

Nonpoint source pollution to the ocean (greater Santa Monica Bay) includes urban runoff, aerial fallout, spills, sediment resuspension, oil seeps, vessel traffic, and advection. Strategies for dealing with urban and storm runoff were discussed under the Core Regulatory section. In addition, a priority over the last five years has been to divert dry weather flows from all problematic storm drains to the sewer system. As of September 2007, more than twenty dry-weather diversion projects have been funded and completed through Proposition A, Proposition 12, Proposition 40, and Proposition 50 grant funds awarded by the Santa Monica Bay Restoration Commission and/or the SWRCB under the State Clean Beach Initiative (CBI). Recent attention and new funding from the State CBI program has been shifted to upgrade the existing diversion projects to make them work year-round (diverting first flush and non-storm runoff during the wet season), identify and control sources of contamination from municipal Piers, and implement measures to improve water circulation in enclosed beach areas. More information on the CBI may be found at http://www.waterboards.ca.gov/cwphome/beaches/index.html.

Strategies have been developed and efforts are underway to address aerial fallout, sediment resuspension, septic systems, marinas, and vessel traffic.

Malibu Creek is identified as Critical Coastal Area (CCA) #60 in the State Water Resources Control Board's and California Coastal Commission's Critical Coastal Area Draft Strategic Plan. It has been identified as such since it flows into a Marine Protected Area and is an impaired water body. The major efforts listed to implement NPS management measures include: work by the Malibu Creek Watershed Advisory Council, various efforts to manage septic systems near Surfrider Beach, projects to capture and treat runoff from Malibu Creek and storm drains in the area, the Assessment of Water Quality and Loadings From Natural Landscapes project being conducted by SCCWRP, and implementation of the Santa Monica bay Restoration Plan.

Topanga Canyon Creek is identified as CCA #61 in the Draft Strategic Plan since it flows into a Marine Protected Area and is an impaired water body. The major efforts listed to implement NPS management measures include: work by the Malibu Creek Watershed Advisory Council (the small Topanga watershed is adjacent to the much larger Malibu watershed), various efforts to manage septic systems, participation with the Topanga Watershed Committee, implementation of the watershed management plan, and continuance of creek monitoring.

Santa Monica Canyon is identified as CCA #62 in the Draft Strategic Plan; it is an impaired water body that flows into a Marine Protected Area. Santa Monica Canyon is formed by the confluence of three major watersheds. Approached from the shoreline it extends upstream for a couple of miles to include lower Rustic Canyon and lower Sullivan Canyon, both entering tangentially from the northwest and ends at the entrance to Mandeville Canyon which extends six miles farther north to the crest of the Santa Monica Mountain. The major efforts listed to implement NPS management measures include: work by the Malibu Creek Watershed Advisory Council; dry weather diversions ate Will Rogers State Beach; and participation with the North Santa Monica Bay Water Quality Improvement Project.

Ballona Creek is identified as CCA #68 in the Draft Strategic Plan; it is an impaired water body that flows into a Marine Protected Area. The major efforts listed to implement NPS management measures include: work by the Ballona Wetlands Foundation to preserve and protect the Ballona Wetlands ecosystem through research, educational programs and activities; activities at the Friends of Ballona Wetlands Education/Ecology Center; construction of the Ballona Creek Stormwater Trash Capture System; work undertaken by the nonprofit Ballona Creek Renaissance; implementation of the Santa Monica Bay Restoration Plan; posting of creek pollution warning signs; a metals source study; various TMDLs; implementation of the Ballona Creek Watershed Management Plan; and use of Clean Beaches Initiative funds to implement the Santa Monica Bay Restoration Plan.

Aerial Fallout: Funded by USEPA , the SMBRC, and the Los Angeles County Department of Public Works, researchers at UCLA and SCCWRP completed a three-phase study in 2005on air transport/deposition of toxic contaminants to the Bay. The study sought to establish what the total annual pollutant load from air deposition is to both Santa Monica Bay and the Bay watershed, assess how large the load is compared to other sources, and determine how the loads varies spatially and temporally. The Regional Board can use this information to evaluate the effectiveness of air pollution control measures. The study's findings indicate that:

- Aerial deposition is a significant contributor to the overall pollutant load to the Bay for trace metals such as lead, chromium, and zinc, and less so for copper and nickel. The atmospheric portion of inputs for the five metals varied from 13 – 99% of the total trace metal inputs to Santa Monica Bay considering both atmospheric and non-atmospheric sources.
- On an annual basis, daily dry deposition of metals on Santa Monica Bay and its watershed far exceeds the amount deposited during rain events. Also, chronic daily dry deposition is far greater than deposition occurring during Santa Ana conditions when large volumes of polluted air blows from inland out to sea. Daily quantities of metals deposited during Santa Ana and rainfall events are comparable to the chronic daily deposition, however, since rainfall and Santa Anas are infrequent events, they are not significant factors in determining the total deposition load.
- Most of the mass of metals deposited by dry deposition on Santa Monica Bay and its watershed originates as relatively large aerosols from area sources (off-highway vehicles such as construction equipment and small businesses) in the Santa Monica Bay watershed.

The study's implications for management of nonpoint source pollution are several and include:

- Daily chronic dry deposition of metals must be a significant nonpoint source in establishing TMDLs for Santa Monica Bay.
- Reductions of nonpoint source inputs may require coupling between air quality and water quality regulatory actions and policies.

Sediment Resuspension: Currently, there is no study specifically planned to examine sediment resuspension as a source of pollutant loading to the Bay. However, the USEPA Superfund investigation on the Palos Verdes Shelf evaluated the feasibility of capping DDT-contaminated sediments as a remediation measure. USEPA conducted a pilot project in September 2000 to evaluate cap placement methods and cap stability at three test cells on the Palos Verdes Shelf. Based on the results of this pilot capping project as well as other technical studies, USEPA recently (2007) developed and released a remedial investigation (RI) report which characterizes the PV Shelf Study Area, compiles and evaluates information on the nature and extent of DDT and PCB contamination, and discusses the long-term transport and fate of the contaminants. Additionally, the RI assesses the risks to human health and the environment from the effluent-affected sediments. EPA will use the information and analysis provided by the RI report to develop, evaluate, and select appropriate response alternatives in the coming years.

Meanwhile, since 2002, EPA has implemented an institutional control program to address the significant human health risks associated with consumption of fish, particularly white croaker, contaminated by exposure to DDT and PCBs in the sediment. The institutional controls (IC) program has three components: (1) public outreach and education, (2) fish monitoring, and (3) enforcement.

As part of the IC Program, EPA and the Montrose Settlements Restoration Program (natural resources trustees) in 2006 completed a comprehensive sampling and analysis chemical levels in fish caught off the coast of Los Angeles and Orange Counties.

Also as part of the IC Program, a Fish Contamination and Education Collaborative (FCEC) has been established under the IC program. The FCEC is composed of federal and state governments, local health departments, community-based organizations and other local institutions. The FCEC has been assisting EPA to conduct and coordinate efforts to educate the most affected population through outreach at fishing piers, community-gathering, and through media as well as outreach and inspection at fish markets and restaurants.

Marinas and Vessel Traffic: Boating wastes (vessel traffic) are potentially a significant source of loadings into the Bay as well as into harbors of pathogens, trash, and some heavy metals. Launched in 1996, the SMBRC has implemented a comprehensive boater education program for the southern California counties. Their program addresses non-point source pollution generated from boat maintenance and activities. This includes sewage, used motor oil, trash and debris, fuel, heavy metals and cleaning agents. One of the SMBRC's focuses is to promote clean marinas. Their Clean Marina 319(h) grant, awarded by the SWRCB, will further help educate boaters, facilitate clean-out practices, and promote recognition of successes.

CWA Section 319(h)-funded Activities: A 319(h)-funded nonpoint source control strategy being undertaken in the Malibu Creek Watershed is evaluation of BMPs for horse stables and continuation of volunteer Stream Team monitoring by Heal the Bay. The Santa Monica BayKeeper also received 319(h) grant funds in 2001 to continue a citizen monitoring program involving storm drains flowing into Santa Monica Bay and to add in additional monitoring of Ballona Creek.

We continue to support as a high priority for 319(h) program funding in FY2002/03 projects to restore wetlands in Malibu, Topanga, and Trancas Lagoons.

Proposition 13-funded Activities: The Southern California Coastal Water Research Project (SCCWRP) received Proposition 13 funding (Coastal Subaccount) in 2001 for two projects affecting Santa Monica Bay. One is "Implementation and Evaluation of BMPs for Improving Coastal Water Quality." This is a multi-regional project which will conduct enhanced BMP effectiveness monitoring through use of more relevant indicators such as toxicity removal and reduction of pesticides and biologically-available metals. Samples will be collected during storm events. The other funded project is "Implementation of Coliform TMDL for Santa Monica Bay Beaches Using Standard Methods and Rapid Indicator Detection

Techniques." AB411 requires weekly bacterial indicator monitoring and posting of beaches with chronic contamination. AB538 requires source identification at beaches with storm drains that have chronic contamination. This project will identify sources of fecal contamination to characterize the presence of human versus animal contamination.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

Core regulatory activities will focus on permit compliance, monitoring report review, and enforcement as needed. Work continues on lower Malibu Creek issues as well as on the watershed-wide monitoring program. Periodic updates of the State of the Watershed Report will occur.

Regarding resources needed to continue oversight of the Los Angeles County storm water permit (regulatory-based BMP management), regulatory personnel will be revising the annual program report format, auditing the permittees, evaluating the revised model programs, and reviewing reports and alternate programs submitted by permittees. The eighteen municipal program audits must be completed and matched with BMPs selected to address the pollutants of concern to facilitate development of TMDLs. The Caltrans storm water management program BMPs must be matched with pollutants of concern to facilitate TMDLs impacted by transportation land use. In addition, SWPPPs for all industrial storm water facilities in the WMA must be reviewed and BMPs matched with pollutants of concern to facilitate TMDL development.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

Issuing waste discharge requirements for all existing multi-family and commercial establishments in northern Santa Monica Bay watersheds not currently under permit (with any necessary followup work), as recommended by the Santa Monica Bay Restoration Commission septic systems task force, will entail requiring **an additional 2 – 4 PYs per year for at least the next five years**.

There are a number of activities that need to be conducted over the next few years such as:

- Collect baseline information on biological conditions of subtidal rocky reef habitats in the Region, including ASBS.
- Update information on seafood consumption rates by anglers in the Santa Monica Bay region.
- Analyze the link between contaminants in fish and biological impacts to shore birds, sea birds, and marine mammals.
- Study the potential causes and sources of harmful algal bloom (HABs)
- Assess the loading and potential impacts of emerging contaminants (pharmaceuticals)
- Continued involvement in updates to the baseline State of the Watershed Report, focusing on filling data gaps and evaluating cumulative impacts as monitoring data become available from dischargers.
- Regional Board ambient monitoring, and evaluation of monitoring data from the municipal storm water program.
- An important issue to address at some point in the future is the need to protect the populations of threatened and endangered species in the Bay which include the California least tern, Belding's savannah sparrow, western snowy plover, California red-legged frog, California brown pelican, El Segundo blue butterfly, steelhead trout, and tidewater goby. Depending on the level of existing efforts, the needs for each species range from monitoring and assessing current conditions, to developing or implementing strategies for population recovery.
- In the Malibu Creek Watershed, a number of long-term projects are being considered or are in progress which the Regional Board will be involved with to some extent. The Department of Parks and Recreation and the City of Malibu are investigating development of a plan to reduce unseasonal breaching of the lagoon. Also, the Rindge Dam Task Force is investigating the possibility and alternative ways to remove the dam in order to facilitate access to the upper watershed by steelhead trout. There is no projected end date for this project. Additionally, the POTW which discharges to Malibu Creek is under a discharge prohibition starting each April 15 through November 15 of each year, except during times of plant upset, storm events, or the existence of minimal streamflow conditions that require flow augmentation in Malibu Creek to sustain endangered species. In the long-run, this discharge prohibition may have many other implications on water quality and quantity in the Creek and Lagoon.
- Develop a strategy for regulating septic systems in the Malibu area.
- A priority planning issue is to define water quality standards for nutrients in Malibu Lagoon and Creek.
- Develop inventory and establish monitoring stations for invasive exotic and sensitive plant species in riparian areas of northern Santa Monica Bay watershed.
- Develop strategy to control/eradicate invasive plant and animal species such as Arundo, crayfish, and mudsnails.
- Conduct the technical background work needed to understand local hydrology and develop regional curves for local streams
- Develop water budget for Santa Monica Bay watershed starting with Ballona Creek
- We will also continue our involvement with stakeholder activities and the pursuit of funding options, especially those involving implementation of nonpoint source measures (coordinate grant activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.
- Comments on watershed issues in CEQA documents (for the highest priority projects) will continue to be prepared; however, there is currently no funding for this program.
- Implement biological monitoring in priority watersheds (e.g. Malibu, Topanga).
- As a followup to the aerial deposition study recently completed:
  - Pinpoint sources of aerial deposition in the watershed
  - Study the deposition of other pollutants of concern (nutrients, pesticides, mercury)

- Determine how aerial deposition is transformed into urban runoff, and how much of it is transformed into runoff

Potential Long-term Activities

A wetlands management issue that will continue to impact core regulatory activities in Malibu Creek is the listing of the creek as critical habitat for the endangered steelhead trout. Water quantity will continue to play as critical a role as water quality in the issue.

We will continue to develop strategies for the implementation of priority actions identified under the Santa Monica Bay Restoration Plan, including protection of the Ballona Wetlands, as well as additional actions targeted by the SMBRC's Governing Board for action. We will also integrate these into the Watershed Council's Plan and implementation activities. Additional issues may include: 1) conduct or review studies to evaluate and refine (if necessary) the designated beneficial uses for certain waterbodies, 2) consider the establishment of wet weather criteria in some areas, 3) integrate water supply and quality issues with local land use planning and management, and 4) institute better coordination of multi-agency reviews of environmental impacts for flood control and development projects, including the consideration of regional mitigation programs.

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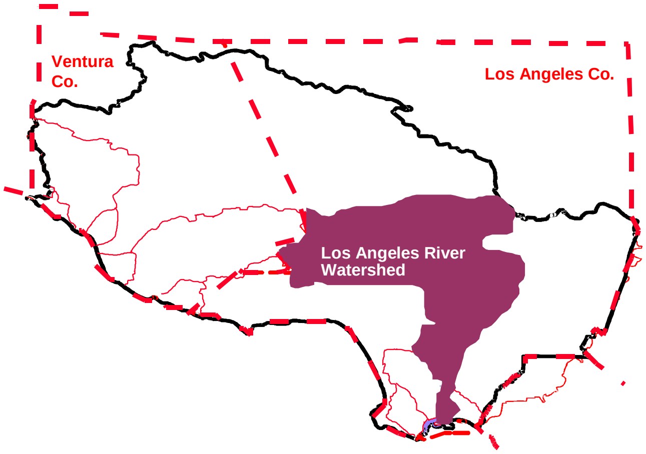
2.3 LOS ANGELES RIVER WATERSHED

This watershed will be targeted in FY2009/10.

Overview of Watershed

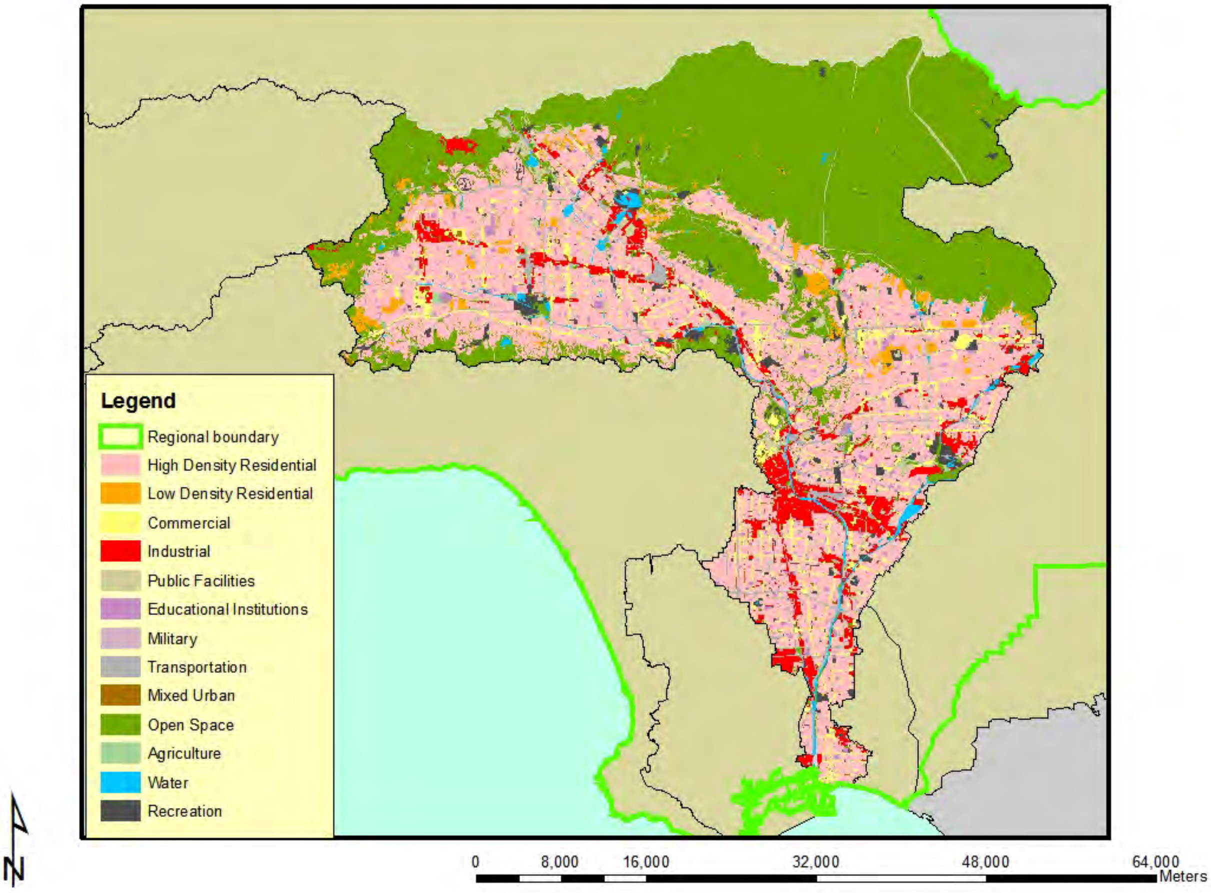


Size of watershed: 824 square miles

Length of river: 55 miles

The Los Angeles (LA) River Watershed is one of the largest in the Region. It is also one of the most diverse in terms of land use patterns. Approximately 324 square miles of the watershed are covered by forest or open space land including the area near the headwaters which originate in the Santa Monica, Santa Susana, and San Gabriel Mountains. The rest of the watershed is highly developed.

The river flows through the San Fernando Valley past heavily developed residential and commercial areas. From the Arroyo Seco, north of downtown Los Angeles, to the confluence with the Rio Hondo, the river flows through industrial and commercial areas and is bordered by railyards, freeways, and major commercial and government buildings. From the Rio Hondo to the Pacific Ocean, the river flows through industrial, residential, and commercial areas, including major refineries and petroleum products storage facilities, major freeways, rail lines, and rail yards serving the Ports of Los Angeles and Long Beach. Land use can be seen in the figure below.



Land Use in the Los Angeles River Watershed

Major tributaries to the river in the San Fernando Valley are the Pacoima Wash, Tujunga Wash (both drain portions of the Angeles National Forest in the San Gabriel Mountains), Burbank Western Channel and Verdugo Wash (both drain the Verdugo Mountains). Due to major flood events at the beginning of the century, by the 1950's most of the river was lined with concrete. In the San Fernando Valley, there is a section of the river with a soft bottom at the Sepulveda Flood Control Basin. The Basin is a 2,150-acre open space upstream of the Sepulveda Dam designed to collect flood waters during major storms. Because the area is periodically inundated, it remains in a semi-natural condition and supports a variety of low-intensity uses as well as supplying habitat. At the eastern end of the San Fernando Valley, the river bends around the Hollywood Hills and flows through Griffith and Elysian Parks, in an area known as the Glendale Narrows. Since the water table was too high to allow laying of concrete, the river in this area has a rocky, unlined bottom with concrete-lined or rip-rap sides. This stretch of the river is fed by natural springs and supports stands of willows, sycamores, and cottonwoods. The many trails and paths along the river in this area are heavily used by the public for hiking, horseback riding, and bird watching.

South of the Glendale Narrows, the river is contained in a concrete-lined channel down to Willow Street in Long Beach. The main tributaries to the river in this stretch are the Arroyo Seco (which drains areas of Pasadena and portions of the Angeles National Forest in the San Gabriel Mountains), the Rio Hondo, and Compton Creek. Compton Creek supports a wetland habitat just before its confluence with the Los Angeles River. The river is hydraulically connected to the San Gabriel River Watershed by the Rio

Hondo through the Whittier Narrows Reservoir. Flows from the San Gabriel River and Rio Hondo merge at this reservoir during larger flood events, thus flows from the San Gabriel River Watershed may impact the LA River. Most of the water in the Rio Hondo is used for groundwater recharge during dry weather seasons. The San Gabriel River drains approximately 689 square miles, which includes the eastern San Gabriel Mountains and portions of the Chino, San Jose, and Puente Hills.

Beneficial Uses in watershed:

Estuary	*Above estuary*
Industrial service supply	Groundwater recharge
Contact & noncontact water recreation	Contact & noncontact water recreation
Navigation	Warmwater habitat
Commercial & sportfishing	Wetlands Habitat
Protection of rare & endangered species	Protection of rare & endangered species
Wildlife habitat	Wildlife habitat
Marine habitat	
Migration of aquatic organisms	
Spawning	
Estuarine habitat	

The LA River tidal prism/estuary begins in Long Beach at Willow Street and runs approximately three miles before joining with Queensway Bay located between the Port of Long Beach and the city of Long Beach. The channel has a soft bottom in this reach with concrete-lined sides. Queensway Bay is heavily water recreation-oriented; however, major pollutant inputs are likely more related to flows from the LA River which carries the largest storm flow of any river in southern California.

Also part of the watershed are a number of lakes including Peck Road Park, Belvedere Park, Hollenbeck Park, Lincoln Park, and Echo Park Lakes as well as Lake Calabasas. These lakes are heavily used for recreational purposes.

Four basins in the San Fernando Valley area contain substantial deep groundwater reserves and are recharged mainly through runoff and infiltration although the increase in impermeable surfaces has decreased infiltration. Groundwater basins in the San Gabriel Valley are not separated into distinct aquifers other than near the Whittier Narrows. Active recharge occurs in some of these areas through facilities operated by Los Angeles County. Spreading grounds recharge two basins in the coastal plain of Los Angeles west of the downtown area.

Permitted discharges:

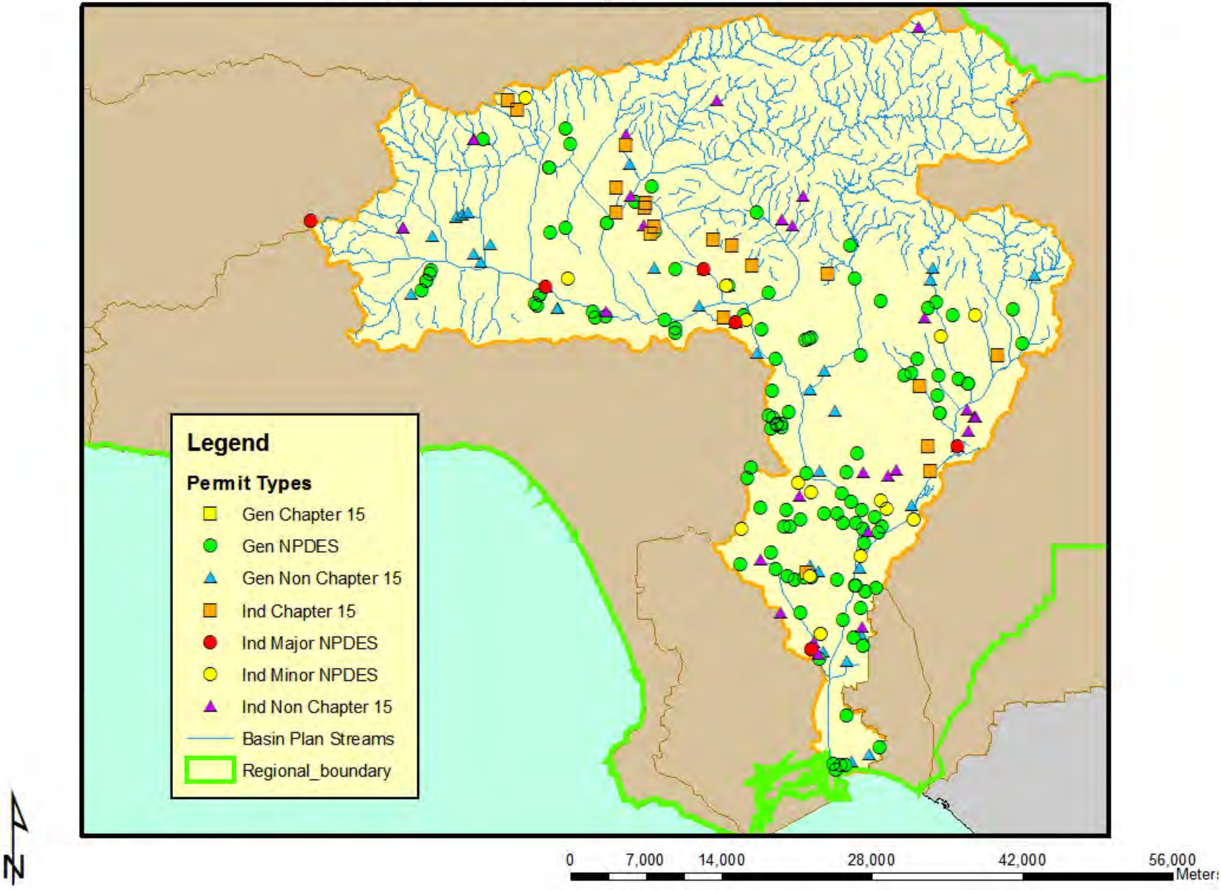
- 134 NPDES discharges including: six major NPDES dischargers (four POTWs); 15 minor individual permits; 113 dischargers covered by general permits
- Minor permits cover miscellaneous wastes such as ground water dewatering, recreational lake overflow, swimming pool wastes, and ground water seepage. Other permits are for discharge of treated contaminated ground water, noncontact cooling water, and storm water
- Two municipal storm water permits
- 1,336 dischargers covered under the industrial storm water permit
- 759 dischargers covered under the construction storm water permit

Water Quality Problems and Issues

Pollutants from dense clusters of residential, industrial, and other urban activities have impaired water quality in the middle and lower watershed. Added to this complex mixture of pollutant sources (in particular, pollutants associated with urban and stormwater runoff), is the high number of point source permits. Excessive nutrients (and their effects) and coliform are widespread problems in the watershed as well as excessive metals. Water column toxicity was found at a number of sites sampled by SWAMP in 2005.

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

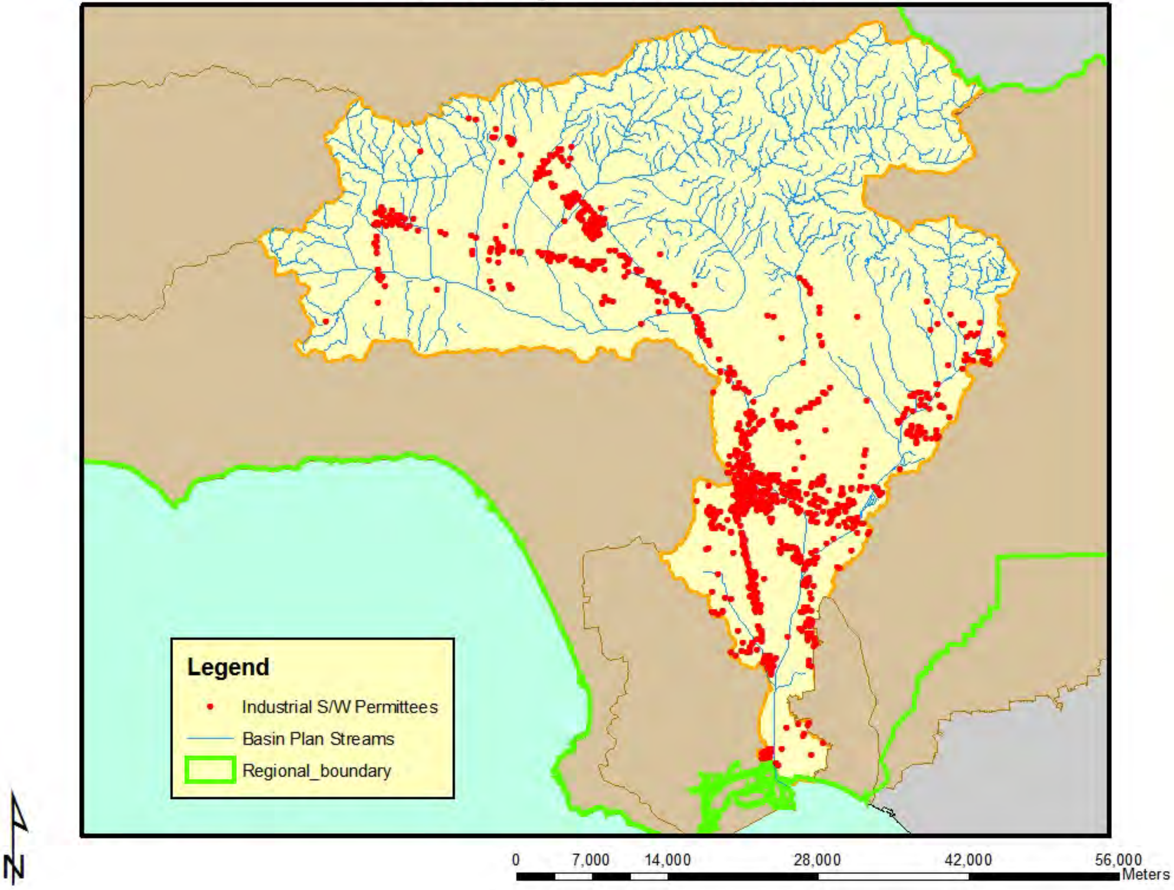
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Los Angeles River Watershed



A majority of the 134 NPDES discharges go directly to the Los Angeles River. Burbank Western Channel receives three discharges, Compton Creek receives twelve, and Rio Hondo receives fourteen.

Of the 1,365 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers occur in the cities of Los Angeles (many within the community of Sun Valley), Vernon, South Gate, Long Beach, Compton, and Commerce. Wholesale trade-durable goods, fabricated metal products, trucking & warehousing, and chemicals & allied products are a large component of these businesses based on their Standard Industrial Classification (SIC) codes. This watershed has about twice the number of industrial stormwater dischargers as does the San Gabriel River Watershed and the most in this region. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

Locations of Dischargers Covered by General Industrial Stormwater Permit in the Los Angeles River Watershed



There are a total of 759 construction sites enrolled under the general construction storm water permit in this watershed, the most in the Region. The larger sites are in the upper watershed (which includes the San Fernando Valley) and the construction in this watershed is fairly evenly divided between commercial and residential. About one-third of the sites are five acres or larger in size with the largest sites being up to 700 acres.

IMPAIRMENTS: The majority of the LA River Watershed is considered impaired due to a variety of point and nonpoint sources. The 2006 303(d) list implicates pH, ammonia, a number of metals, coliform, trash, scum, algae, oil, chlorpyrifos as well as other pesticides, and volatile organics for a total of 111 individual impairments (reach/constituent combinations). Some of these constituents are of concern throughout the length of the river while others are of concern only in certain reaches. Impairment may be due to water column exceedances, excessive sediment levels of pollutants, or bioaccumulation of pollutants. The beneficial uses threatened or impaired by degraded water quality are aquatic life, recreation, groundwater recharge, and municipal water supply. The table below shows the complete list of impairments:

Water Quality Limited Segment Name	Pollutant
Aliso Canyon Wash	Copper Fecal Coliform Selenium[1]
Arroyo Seco Reach 1 (LA River to West Holly Ave.)	Coliform Bacteria Trash
Arroyo Seco Reach 2 (Figueroa St. to Riverside Dr.)	Coliform Bacteria Trash
Bell Creek	Coliform Bacteria
Burbank Western Channel	Cyanide Trash Copper[1]
Compton Creek	Coliform Bacteria Trash Copper[1] Lead[1] pH[2]
Dry Canyon Creek	Fecal Coliform Fecal Coliform Selenium, Total[1]
Echo Park Lake	Algae Ammonia Copper Eutrophic Lead Odor PCBs (Polychlorinated biphenyls) (tissue) pH Trash
Lake Calabasas	Ammonia DDT (tissue) Eutrophic Odor Organic Enrichment/Low Dissolved Oxygen pH
Legg Lake	Ammonia Copper Lead Odor pH Trash
Lincoln Park Lake	Ammonia Eutrophic Lead

	Odor Organic Enrichment/Low Dissolved Oxygen Trash
Los Angeles River Estuary (Queensway Bay)	Chlordane (sediment) DDT (sediment) Lead (sediment) PCBs (Polychlorinated biphenyls) (sediment) Sediment Toxicity Trash Zinc (sediment)
Los Angeles River Reach 1 (Estuary to Carson Street)	Coliform Bacteria Cyanide Diazinon Trash Ammonia[2] Copper, Dissolved[1] Lead[1] Nutrients (Algae)[2] pH[2] Zinc, Dissolved[1]
Los Angeles River Reach 2 (Carson to Figueroa Street)	Coliform Bacteria Oil Trash Ammonia[2] Lead[1] Nutrients (Algae)[2]
Los Angeles River Reach 3 (Figueroa St. to Riverside Dr.)	Trash Ammonia[2] Nutrients (Algae)[2]
Los Angeles River Reach 4 (Sepulveda Dr. to Sepulveda Dam)	Coliform Bacteria Trash Ammonia[2] Lead[1] Nutrients (Algae)[2]
Los Angeles River Reach 5 (within Sepulveda Basin)	Oil Trash Ammonia[2] Nutrients (Algae)[2]
Los Angeles River Reach 6 (Above Sepulveda Flood Control Basin)	1,1-Dichloroethane (1,1-DCE)/Vinylidene chloride Coliform Bacteria Tetrachloroethylene/PCE Trichloroethylene/TCE

McCoy Canyon Creek	Fecal Coliform Nitrate Nitrogen, Nitrate Selenium, Total[1]
Monrovia Canyon Creek	Lead[1]
Peck Road Park Lake	Chlordane (tissue) DDT (tissue) Lead Odor Organic Enrichment/Low Dissolved Oxygen Trash
Rio Hondo Reach 1 (Confl. LA River to Snt Ana Fwy)	Coliform Bacteria Trash Copper[1] Lead[1] pH[2] Zinc[1]
Rio Hondo Reach 2 (At Spreading Grounds)	Coliform Bacteria
Tujunga Wash (LA River to Hansen Dam)	Coliform Bacteria Trash Ammonia[2] Copper[1]
Verdugo Wash Reach 1 (LA River to Verdugo Rd.)	Coliform Bacteria Trash
Verdugo Wash Reach 2 (Above Verdugo Road)	Coliform Bacteria Trash

1Los Angeles River and Tributaries Metals TMDL, 2005
2Los Angeles River Nutrients TMDL, 2004

CURRENTLY SCHEDULED TMDLS:

- historic pesticides-FY07/08
- coliform-FY07/08

Ground water resources in the watershed are also impacted. Impacts, both real and threatened, include those from hundreds of cases of known leaking underground storage tanks that have contaminated soil and/or ground water with petroleum hydrocarbons and volatile organic compounds. There are also a number of cases of refineries/tank farms that have contaminated soil and/or ground water. Seawater intrusion (chloride) is of concern in other areas of the watershed which has necessitated wellhead treatment, shutdown, or blending. Finally, a number of wells have been shut down due to nitrate contamination with septic systems as a likely source.

Potential sources of pollution:

- POTWs
- Industrial discharges
- septic systems
- landfills
- Nonpoint sources (horse stables, golf courses)
- Illegal trash dumping
- Cross-contamination between surface and groundwater

ISSUES: The major issues of concern in the watershed include: 1) protection and enhancement of fish and wildlife habitat, 2) removal of exotic vegetation, 3) enhancement of recreational areas, 4) attaining a balance between water reclamation and minimum flows to support habitat, 5) management of storm water quality, 6) assessment of other nonpoint sources including horse stables, golf courses, and septic systems, 7) pollution from contaminated ground water, 8) groundwater recharge with reclaimed water, 9) contamination of ground water by volatile organic compounds, 10) leakage of MTBE from underground storage tanks, 11) groundwater contamination with heavy metals, particularly hexavalent chromium, and 12) contaminated sediments within the LA River estuary.. Some of these issues are only indirectly related to water quality but are those identified by stakeholder groups.

Stakeholder Groups

Los Angeles and San Gabriel Rivers Watershed Council The group was formed in 1995 following a large watershed conference held in the area which served as a springboard. The Council has a board of directors and became incorporated as a nonprofit organization in 1996. The group is tracking watershed activities, but has primarily focused on flood control issues in the Los Angeles River as well as opportunities to create greenbelts and restore habitat. The Council's goal is to help facilitate a process to preserve, restore, and enhance all aspects of the two watersheds. The Council has published a document entitled “Beneficial Uses of the Los Angeles and San Gabriel Rivers” which summarizes a great deal of information about the joint watershed. The Council has changed its meeting format and now conducts a quarterly watershed symposium. More information about this group may be found at their website http://www.lasgrwc.org/.

Friends of the Los Angeles River The Friends of the LA River is a nonprofit organization formed in 1986 in support of Los Angeles River restoration activities. More information about the organization may be found at http://www.folar.org/.

The River Project This group is a nonprofit organization dedicated to planning for natural resource protection, conservation and enhancement in Los Angeles County. The group has received CalFed funding to develop a watershed management plan for the Tujunga Watershed, a subwatershed of the Los Angeles River. More information about the organization may be found at http://www.theriverproject.org/ and about the Tujunga Wash project at http://www.tujungawash.org/.

Past Significant Activities

WATERSHED MANAGEMENT

The Los Angeles and San Gabriel Rivers Watershed Council was awarded Proposition 13 grant funds from the State Water Resources Control Board to prepare a **Compton Creek Watershed Management Plan**. Compton Creek is a tributary to the lower Los Angeles River. A steering committee and a community action team developed the Plan which can be found at http://www.lasgrwc.org/ComptonCreek.htm. An implementation plan recently developed entitled "Realizing Change in the Compton Creek Watershed" can also be found on the webpage.

The San Gabriel Valley Council of Governments (SGVCOG), in partnership with the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC), was awarded Proposition 13 grant funds from the State Water Resources Control Board to prepare a **Rio Hondo Watershed Management Plan**. The Rio Hondo is a major subwatershed draining to the Los Angeles River. Once the Plan is completed in late 2004, it is anticipated that the RMC will adopt it as part of their Rivers and Tributaries Greenway Plan. A webpage for the watershed management planning process is at http://www.rmc.ca.gov/rio_hondo/rh_index.html. The public review draft of the Watershed Plan can also be obtained at the website.

Information about the Arroyo Seco, a major tributary to the Los Angeles River, may be found at the Arroyo Seco Foundation's website http://www.arroyoseco.org/. The nonprofit group Northeast Trees completed development of a Proposition 13-funded watershed plan for the Arroyo Seco Subwatershed in 2006. It is available for download at http://www.waterboards.ca.gov/losangeles/html/programs/funding/ArroyoSeco%20WMRP.pdf.

Staff were involved in the watershed plan-related stakeholder meetings and assisted in the development of them; watershed management plans were expected to address strategies to reduce point and nonpoint source pollutants as well as other issues deemed necessary.

MONITORING AND ASSESSMENT

This watershed was one of those focused on for SWAMP monitoring in FY04/05. Monitoring included a total of 15 randomized stations (bioassessment, water column toxicity and conventional water column chemistry) and 7 targeted stations at the confluence points of major tributaries (adding trace metals and trace organics from the water column to the previously mentioned indicators).

Additional information on flow requirements for sensitive habitats, including the area in the concreted lower river utilized by shorebirds, was collected in collaboration with the US Bureau of Reclamation and the City's Department of Water and Power.

NONPOINT SOURCE PROGRAM

A 319(h) project by the Friends of the Los Angeles River ended in 2002. The project involved volunteer monitoring of the river for physical and chemical parameters and surveys of the natural bottom portions of the river.

The City of Los Angeles Department of Public Works and Stormwater Management Division received a Proposition 13 grant in 2001 to install a low-flow diversion and treatment system for the 8th Street drainage area leading into the river. The most severe bacterial pollution along the entire river has been found at this storm drain. All dry weather flow was diverted to the sewer system. Trash and other solid pollutants are captured both during diversion and non-diversion periods.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Los Angeles River Watershed.

CORE REGULATORY

Continuing core regulatory activities that have been integrated into the watershed management approach include (but are not limited to) renewal/revision of NPDES permits including those covered under Regional Board general permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue. Because of the large number of permits, renewal of permits in this watershed during its first cycle was spread over two years. Due to limited resources, only the basic regulatory activities are performed: review of dischargers' monitoring reports, minimum necessary inspections and sampling, issuance/renewal of permits, levels 1 and 2 enforcement actions (noncompliance and violation notification), case handling, and answering inquiries from the public.

The Los Angeles River Watershed falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was and adopted on December 13, 2001. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit in 1999. The Los Angeles County Flood Control District is the Principal Permittee. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permit can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/Stormwater/stormwater.html.

An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.
The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system. Other standards also apply; additional information on the SUSMP may be

found on the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/susmp/susmp_details.html.

Regulation of groundwater protection activities is intended to eventually become integrated into the watershed management approach while land disposal activities will likely remain separate. Accomplishment of core regulatory activities are a high priority that is currently funded; however, funds do not tend to go far enough to encompass extensive enforcement and response to complaints; however, enforcement is a high priority.

WATERSHED MANAGEMENT

The City of Los Angeles, US Army Corps of Engineers, and multiple partners have developed a Los Angeles River Revitalization Master Plan which is available for review and download at http://www.lariver.org. A Programmatic Environmental Impact Report/Statement is also available.

MONITORING AND ASSESSMENT

As part of a long-term integrated resource planning process, the City of Los Angeles has been conducting enhanced monitoring in the river. A watershed-wide monitoring program is in development that would integrate discharger receiving water monitoring with monitoring conducted by other entities to meet specific goals developed by a stakeholder group.

NONPOINT SOURCE PROGRAM

The major nonpoint source-generated pollutants found throughout the watershed that have contributed to its impairments are lead, coliform, and oil, while chlorpyrifos is implicated in the upper watershed. These pollutants are common components of dry weather urban runoff and wet weather storm runoff. In many ways, the "point source" municipal stormwater permit for LA County will be a major tool in nonpoint source pollution elimination. Permittees are responsible for development and implementation of storm water management plans, for plans to eliminate non-storm water discharges (dry weather urban runoff), and must apply best management practices to prevent storm water pollution.

Proposition 13 funds were awarded to the Los Angeles and San Gabriel Rivers Watershed Council to evaluate the effectiveness of infiltration BMPs on water quality at various depths as urban runoff infiltrates into the groundwater supply. Sampling under this contract is ongoing.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project considers acquisition of various parcels along the lower Los Angeles River in the city of Long Beach a priority in their workplan. Development of a wetlands restoration preliminary plan for the DeForest Park and Dominguez Gap areas in the lower river is another priority. Being listed on the workplan is not a guarantee of funding however. More information on Wetland Recovery Project's workplan may be found at http://www.scwrp.org.

The San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC) is an independent State agency within the Resources Agency. State law established the Conservancy in 1999. Its jurisdiction includes the San Gabriel River and its tributaries, the Lower Los Angeles River and its tributaries, and the San Gabriel Mountains. Puente Hills, and San Jose Hills. It was established to preserve open space and habitats in order to provide for low-impact recreation and educational uses, wildlife and habitat restoration and protection, and watershed improvements within its jurisdiction. It is currently involved with beginning work on an open space plan for the area. Propositions 12 and 40 have directed funds to the Conservancy. More information about the RMC's workplan may be found at http://www.rmc.ca.gov/.

The Santa Monica Mountains Conservancy (SMMC) is a state agency created by the Legislature in 1979 charged with primary responsibility for acquiring property with statewide and regional significance, and making those properties accessible to the general public. The Conservancy manages parkland in the Santa Monica Mountains, Santa Susana Mountains, the Simi Hills, the Santa Clarita Woodlands, the Whittier-Puente Hills, the Sierra Pelona, the Los Angeles River Greenway, the Rio Hondo, the Verdugo Mountains, the San Gabriel Mountains, and the San Rafael Hills. The agency's goals are to: 1) implement the Santa Monica Mountains Comprehensive Plan, 2) implement the Rim of the Valley Trails Corridor Master Plan, 3) implement the Los Angeles County River Master Plan, 4) further cooperation with local governments in the region to secure open space and parkland, and 5) expand education, public access, and resource stewardship components in a manner that best serves the public, protects habitat, and provides recreational opportunities. More information about SMMC activities may be found at http://smmc.ca.gov/.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

Following renewal of the watershed's permits, core regulatory activities will focus on permit compliance, monitoring report review, and enforcement as needed. Members of the watershed team will be involved with periodic updates of the State of the Watershed Report. Additionally, there will be on-going interaction with stakeholders and followup on goals established during the permit renewal phase. Pending completion of a final TMDL we will pursue agreement on pollutant loadings that can be implemented through future NPDES permits, the municipal stormwater permit, and through other nonpoint source control measures.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

Our efforts to involve stakeholders also shall include exploration of funding options (especially for implementation of nonpoint source measures) and continuation of other outreach activities, such as presentations, meetings, and participation in environmental events.

Also, efforts are underway to address problems with urban runoff (through the storm water municipal and industrial NPDES permits) and septic systems. Future activities should focus on horse corrals and golf courses, parks or other green areas. Activities proposed include outreach to implement BMPs. Tier I activities also should include monitoring and assessment to determine if Tier 2 or Tier 3 activities are needed to ensure successful implementation of BMPs and reduction of nitrogen and coliform loadings.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures (coordinate 205(j) and 319(h) activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

Potential Long-term Activities

In the long-term, Basin Planning activities will include continued participation in both internal and external watershed planning efforts and further incorporation of watershed management and principles and watershed-specific priorities (such as more refined regional procedures for conducting use attainability analyses and site-specific objective development) into the next update of the Basin Plan. More detailed analysis regarding certain beneficial uses needs to be done (species inhabiting/using the river, potential for aquatic life in the river, future water supply needs/diversions, ground water recharge areas). We will continue to pursue funding for Basin Planning programs. Comments on watershed issues in CEQA documents (for the highest priority projects) will continue to be prepared; however, there is currently no funding for this program.

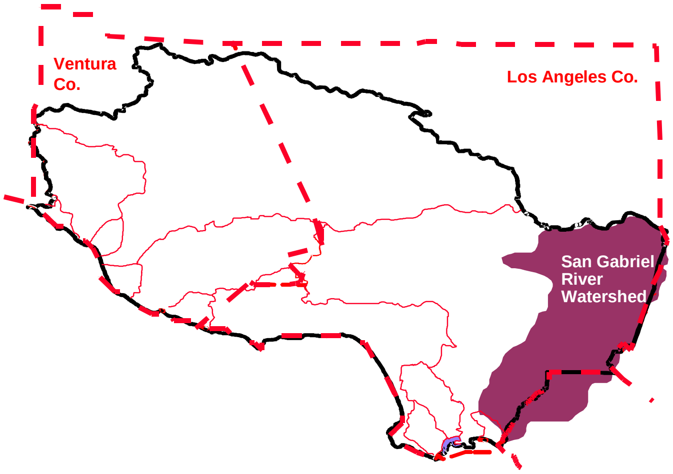
Other issues include:

- Balancing maintenance of habitat in the river with flood control needs
- Evaluation of areas in the river for restoration purposes
- Evaluating critical habitat areas
- Evaluating the most protective (while providing flood control) long-term plans for vegetation/sediment removal under the 401certification program
- Evaluate and implement low flow diversions where appropriate
- Assist in greenway developments along the river
- Evaluate estuarine habitats and water quality
- Implementing biological monitoring

2.4 SAN GABRIEL RIVER WATERSHED

This watershed will be targeted in FY2010/2011.

Overview of Watershed



Size of watershed: 689 sq. mi.

The San Gabriel River receives drainage from a large area of eastern Los Angeles County; its headwaters originate in the San Gabriel Mountains. The watershed consists of extensive areas of undisturbed riparian and woodland habitats in its upper reaches. Much of the watershed of the West Fork and East Fork of the river is set aside as a wilderness area; other areas in the upper watershed are subject to heavy recreational use. The upper watershed also contains a series of flood control dams. Further downstream, towards the middle of the watershed, are large spreading grounds utilized for groundwater recharge. The watershed is hydraulically connected to the Los Angeles River through the Whittier Narrows Reservoir (normally only during high storm flows). The lower part of the river flows through a concrete-lined channel in a heavily urbanized portion of the county before becoming an soft bottom channel once again near the ocean in the city of Long Beach. Large electrical power poles line the river along the channelized portion; nurseries, small stable areas, and storage facilities are located in these areas.

Part of the Coyote Creek Subwatershed is in Orange County and is under the authority of the Santa Ana Regional Water Quality Control Board.

Beneficial Uses designated in the watershed:

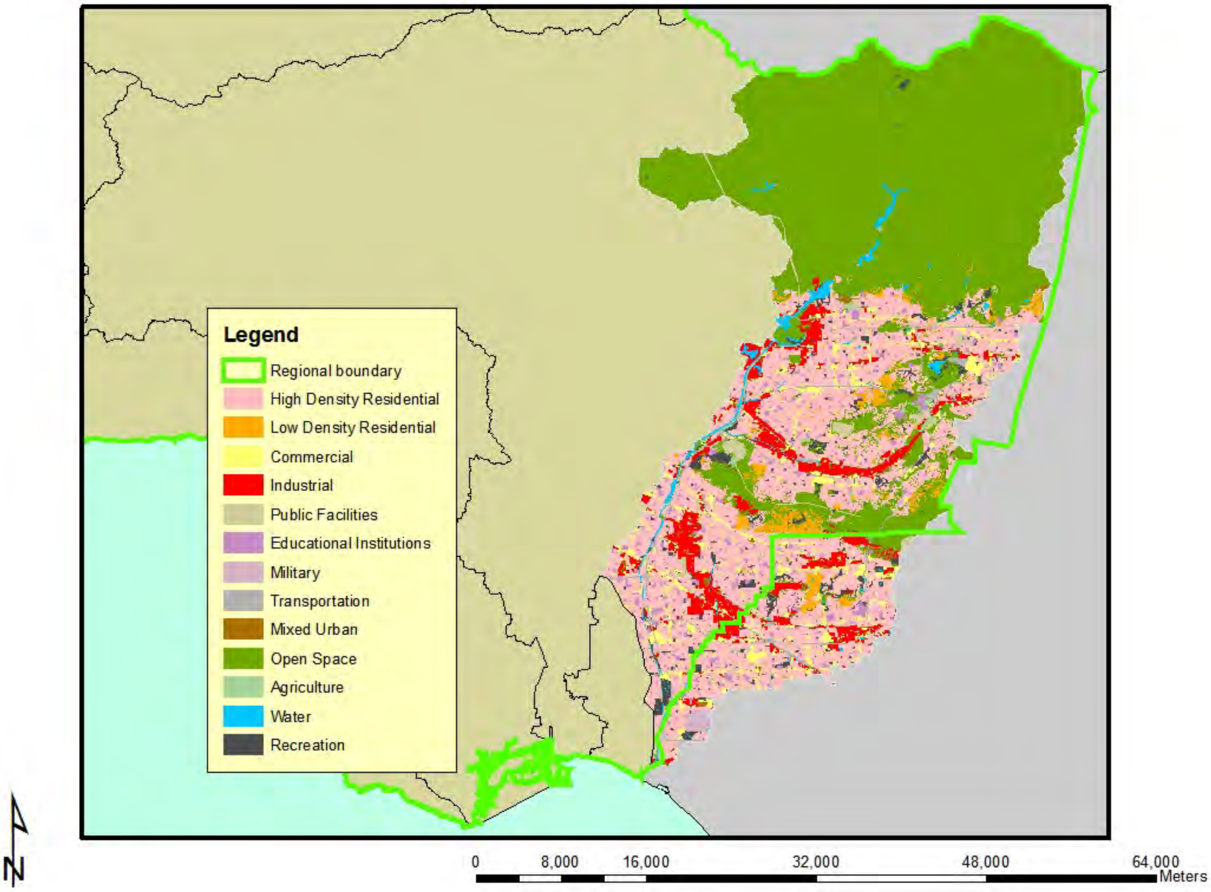
Estuary	*Above Estuary*
Contact & noncontact water recreation	Contact & noncontact water recreation
Industrial service supply	Industrial service supply
Protection of rare & endangered species	Protection of rare & endangered species
Wildlife habitat	Wildlife habitat
Spawning	Spawning
Marine habitat	Warm- & coldwater habitat
Estuarine habitat	Municipal water supply
Navigation	Groundwater recharge
Commercial & sportfishing	Industrial process supply
Migratory	Agricultural supply

Water Quality Problems and Issues

Pollutants from dense clusters of residential and commercial activities have impaired water quality in the middle and lower watershed. Tertiary effluent from several sewage treatment plants enters the river in its middle reaches (which is partially channelized) while two power generating stations discharge cooling water into the river's estuary. The watershed is also covered under two municipal storm water NPDES permits. Several landfills are also located in the watershed.

Land use in the watershed is diverse and ranges from predominantly open space in the upper watershed to urban land uses in the middle and lower parts of the watershed as seen in the following figure.

Land Use in the San Gabriel River Watershed



Several reservoirs, which exist primarily for flood control purposes, are located in the upper part of the watershed. Frequent removal of accumulated sediments is necessary to maintain the flood control capacity of these reservoirs. Some of the removal methods previously used have had water quality impacts. Continued need for such maintenance could cause longer-term impacts.

Significant Issues:

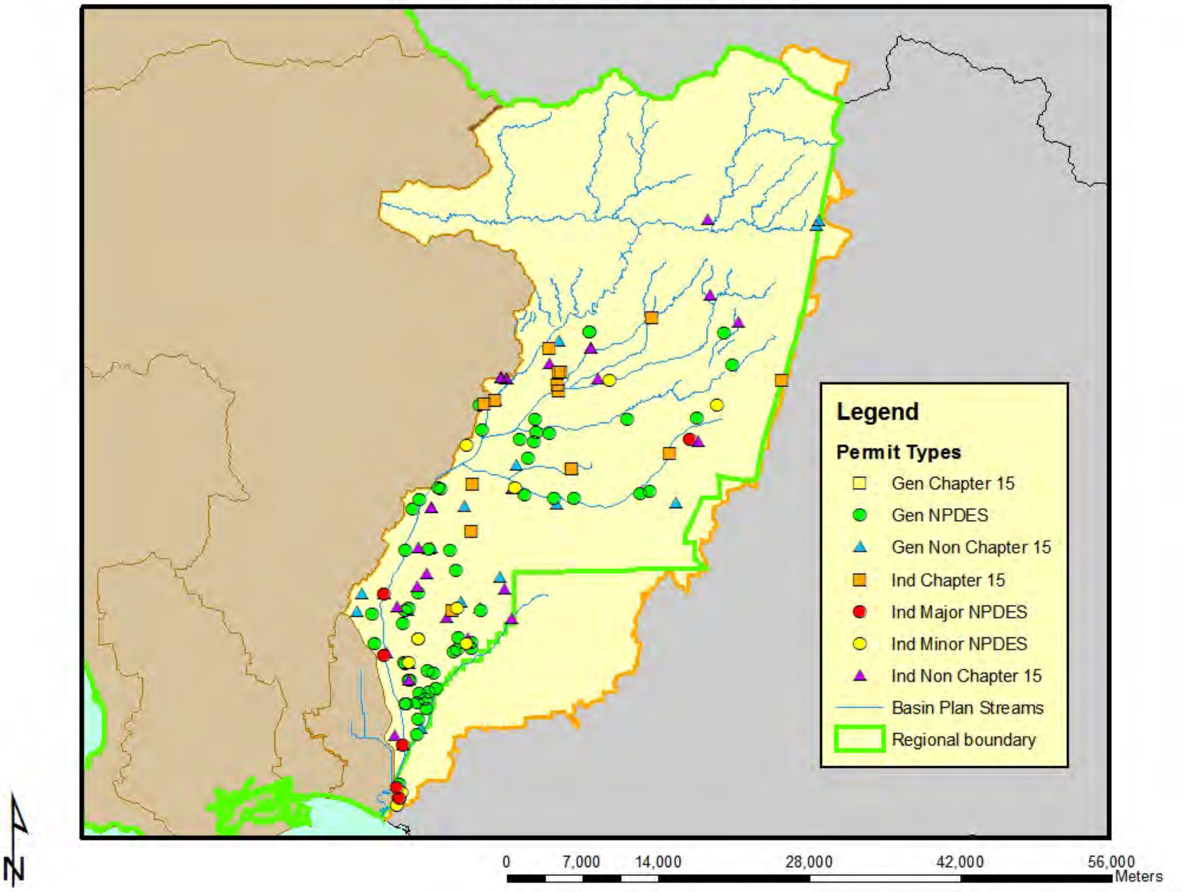
- Sluicing of reservoirs
- Protection of groundwater recharge areas
- Trash in upper watershed
- Mining/stream, modifications
- Ambient toxicity
- Urban and storm water runoff quality
- Nonpoint source loadings from nurseries and horse stables

Permitted discharges:

- 74 NPDES discharges including: six major NPDES dischargers (four POTWs), 10 minor permits, 57 discharges covered under general permits
- 2 municipal storm water permits
- 606 dischargers covered under the industrial storm water permit
- 446 dischargers covered under the construction storm water permit

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

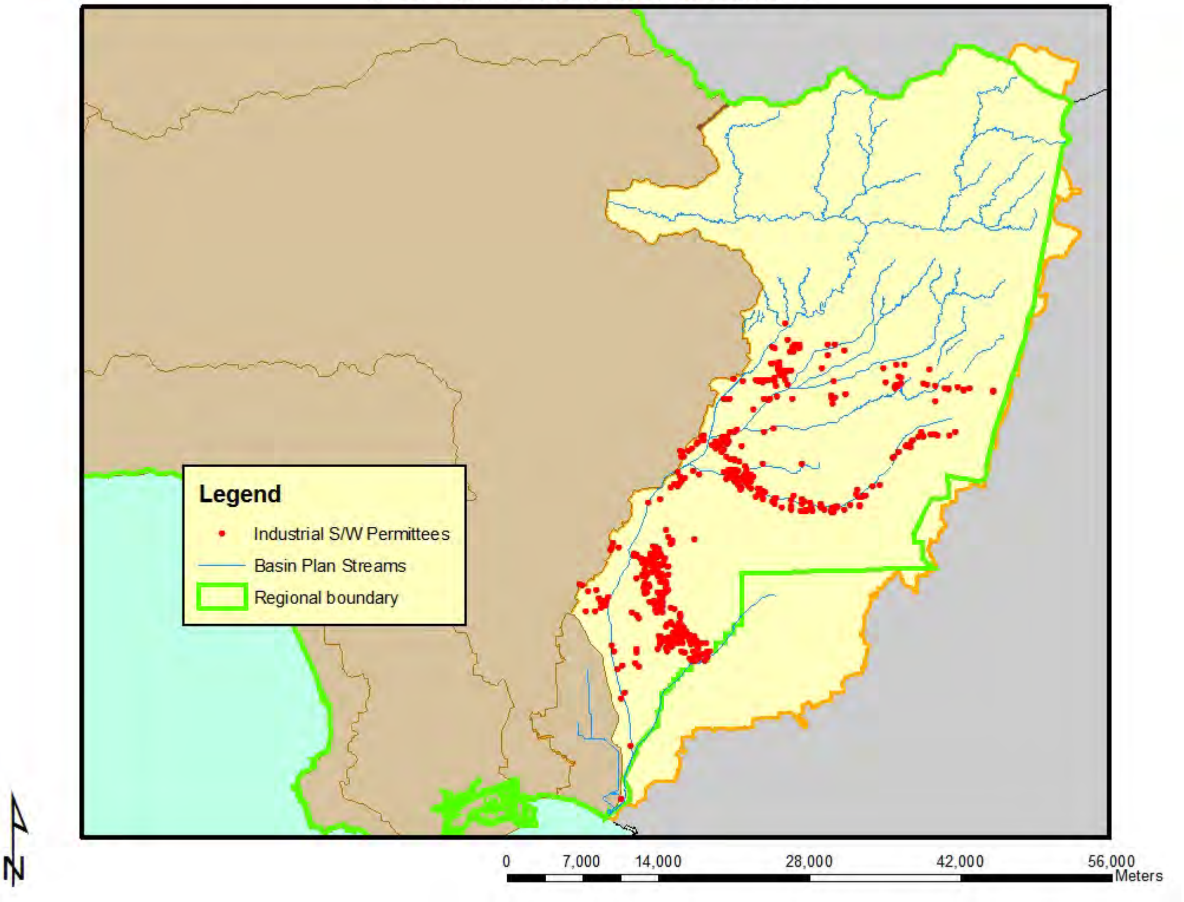
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the San Gabriel River Watershed



A majority of the 74 NPDES permittees in the watershed discharge directly to the San Gabriel River (29). Twenty-four discharge to Coyote Creek and twelve discharge to San Jose Creek.

Of the 570 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers occur in the cities of Industry, Irwindale, Pomona, and Santa Fe Springs. Fabricated metal products, trucking & warehousing, chemicals and allied products, and rubber and miscellaneous plastic products are a large component of these businesses based on their Standard Industrial Classification (SIC) codes. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

Locations of Dischargers Covered by General Industrial Stormwater Permit in the San Gabriel River Watershed



There are 446 construction sites enrolled under the general construction storm water permit. There are slightly more commercial than residential sites with somewhat less industrial sites. A similar number of sites are found in both the upper (San Gabriel Valley) and lower watershed (coastal plain). About one-half of the sites are five acres or larger in size; sites are up to about 500 acres in size.

IMPAIRMENTS: The upper reaches of the river (in the Angeles National Forest) are heavily used for recreational purposes and have been impacted from trash, debris, and habitat destruction. Various reaches of the river are on the 2006 303(d) list due to nitrogen and its effects, trash, PCBs and pesticides, metals, and coliform for a total of 39 impairments (reach/constituent combinations). The table below shows the complete list of impairments:

Water Quality Limited Segment Name	Pollutant
Coyote Creek	Coliform Bacteria Copper, Dissolved Diazinon Lead pH Toxicity

	Zinc Ammonia[1]
Crystal Lake	Organic Enrichment/Low Dissolved Oxygen
El Dorado Lakes	Algae Ammonia Copper Eutrophic Lead Mercury (tissue) pH
Puddingstone Reservoir	Chlordane (tissue) DDT (tissue) Mercury (tissue) Organic Enrichment/Low Dissolved Oxygen PCBs (tissue)
San Gabriel River Estuary	Copper
San Gabriel River Reach 1 (Estuary to Firestone)	Coliform Bacteria pH
San Gabriel River Reach 2 (Firestone to Whittier Narrows Dam	Coliform Bacteria Lead
San Gabriel River, East Fork	Trash[2]
San Jose Creek Reach 1 (SG Confluence to Temple St.)	Coliform Bacteria Selenium Toxicity Ammonia[1]
San Jose Creek Reach 2 (Temple to I-10 at White Ave.)	Coliform Bacteria
Santa Fe Dam Park Lake	Copper Lead pH
Sawpit Creek	Bis(2ethylhexyl)phthalate/DEHP Fecal Coliform
Walnut Creek Wash (Drains from Puddingstone Res)	pH Toxicity

[1] Enforceable Programs
[2] San Gabriel East Fork Trash TMDL, 2000

CURRENTLY SCHEDULED TMDLS:

- toxicity-FY06/07
- nitrogen-FY07/08

Stakeholder Groups

Los Angeles and San Gabriel Rivers Watershed Council: This nonprofit organization was formed in 1995 following a large watershed conference held in the area which served as a springboard for other efforts. The Council has a board of directors and became incorporated as a nonprofit organization in 1996. The group is tracking watershed activities, as well as opportunities to create greenbelts and restore habitat. The Council's goal is to help facilitate a process to preserve, restore, and enhance all aspects of the two watersheds. More information on this group may be found on their website http://www.lasgrwc.org/. Development of a watershed management plan for the Coyote Creek Subwatershed led to the formation of a Coyote Creek Watershed Council but that group did not have a venue to continue meeting separately after the plan was completed and agreed to be involved instead with the Los Angeles and San Gabriel Rivers Watershed Council.

Amigos de los Rios is a nonprofit organization working with cities and residents to renew urban neighborhoods. A current project being worked on is the Emerald Necklace, a vision for a 17 mile loop of parks and greenways connecting 10 cities and nearly 500,000 residents along the Río Hondo and San Gabriel Rivers. More information about the organization may be found at http://www.amigosdelosrios.org/.

Past Significant Activities

WATERSHED MANAGEMENT

A “State of the Watershed” report was prepared by Regional Board staff in 2000. The report describes the watershed, with its many diversion structures and recharge areas, and summarizes available water quality data in a manner easily understood by the layperson. The report can be downloaded by accessing the Regional Board’s website at http://www.waterboards.ca.gov/losangeles and clicking on “Watersheds” on the left side-bar which leads to a clickable map of the region’s watersheds for information specific to each one.

In 1999, the Los Angeles County Board of Supervisors directed the Department of Public Works (in cooperation with the County Departments of Parks and Recreation and Regional Planning) to prepare a San Gabriel River Master Plan which has since been adopted by the County Board of Supervisors. The National Park Service through its Rivers, Trails, and Conservation Assistance Program assisted in the development effort. All river stakeholders were invited to participate. The intent was to develop a consensus-based document that will recognize and address River issues and concerns of the stakeholders. It includes areas within existing rights of way from Morris Dam in the San Gabriel Mountains to the River's outlet in Seal Beach. The Master Plan identifies project opportunities for: enhancements for recreation, open space, and habitat areas; restoration; preservation of the River's natural resources; maintaining flood protection and existing water rights. The Master Plan effort will continue to be coordinated with the activities of the San Gabriel and Lower Los Angeles Rivers and Mountain

Conservancy. Documents relating to the Master Plan may be obtained at http://www.sangabrielriver.com/.

MONITORING AND ASSESSMENT

SWAMP monitoring was conducted in FY 04/05. The San Gabriel River Watershed monitoring was conducted as a collaborative effort between SWAMP and several local stakeholder groups (SWAMP funding paid for approximately half of the monitoring effort). A total of 30 randomized stations were sampled once during the summer 2005 for bioassessment, water column toxicity and water column chemistry (including trace metals) to provide for an overall watershed-wide assessment of water quality conditions. A total of 15 targeted sites were sampled for the same indicators to characterize conditions in areas of special interest, including the upper, middle and lower portions of the watershed and the major tributaries of the system. SWAMP monitoring also included bioaccumulation sampling (fish tissue) at 3 monitoring locations within the San Gabriel Watershed during 2005 (San Gabriel River Estuary, Puddingstone Reservoir and Legg Lake).

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has funded planning projects in the watershed, development of the El Dorado Wetlands Restoration Plan and development of the Coyote Creek Watershed Plan.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the San Gabriel River

CORE REGULATORY

Continuing core regulatory activities that will be integrated into the watershed management approach include (but are not limited to) necessary renewal/revision of NPDES permits. There are six major dischargers, 18 significant or minor dischargers under individual permits, as well as 55 dischargers currently covered under general permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue. All of the County Sanitation Districts’ permits for their inland POTWs (which comprise most of the flow in the middle to lower river) are being renewed this year. Due to limited resources, only the basic regulatory activities are performed: review of dischargers' monitoring reports, minimum necessary inspections and sampling, issuance/ renewal of permits, levels 1 and 2 enforcement actions (noncompliance and violation notification), case handling, and answering inquiries from the public.

The San Gabriel River Watershed falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was adopted on December 13, 2001. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit in 1999. The Los Angeles County Flood Control District is the Principal Permittee. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public

Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permit can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/sw_municipal.html. An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system. Other standards also apply; additional information on the SUSMP may be found on the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/la_ms4_final.html.

The watershed also falls partly within the City of Long Beach which was issued a municipal storm water permit in 1999.

NONPOINT SOURCE PROGRAM

The Regional Board encourages pollution prevention and source control; the Propositions 40 and 50, SRF, and 319(h) grants are tools to provide funds for these types of projects. Implementation of TMDLs for bacteria, nitrogen, and trash, as well as, preservation/restoration of high value habitat areas in support of the waters' beneficial uses are high priorities for the current grant programs.

MONITORING AND ASSESSMENT

The 2000 State of the Watershed Report identified numerous inconsistencies or duplications in sampling effort occurring within the watershed. Consequently, a requirement was put into the County Sanitation Districts of Los Angeles County's monitoring and reporting program for their POTWs discharging in the watershed to work with the Los Angeles and San Gabriel Rivers Watershed Council to develop a watershed-wide monitoring plan to be implemented by the watershed's dischargers and other stakeholders. A San Gabriel River Watershed Monitoring Work Group was formed as a result and its members developed and are implementing a watershed-wide monitoring program. Work Group members include representatives from the County Sanitation Districts of Los Angeles County, the Los Angeles County Department of Public Works, City of Downey, Los Angeles City Department of Water and Power, the Los Angeles and Santa Ana Regional Boards, County of Orange, the Rivers and Mountains Conservancy, the San Gabriel Mountains Regional Conservancy, the Los Angeles and San Gabriel Rivers

Watershed Council, and the Southern California Coastal Water Research Project. The monitoring program integrates as much as possible with existing monitoring; it was integrated with the FY04/05 SWAMP monitoring which took place in the Los Angeles/ San Gabriel Hydrologic Unit. The monitoring approach includes use of random sites in order to assess overall watershed health as well as directed sites at high habitat value areas and at the base of subwatersheds.

In support of TMDL work, focused monitoring has occurred for a variety of constituents and modeling of pollutant loading is ongoing. The need for a tidal prism mixing study to resolve issues concerning the fate of freshwater effluent in the estuary had previously been noted.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WATERSHED MANAGEMENT

The San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC) has produced a **Guiding Principles Watershed and Open Space Plan** which may be obtained at http://www.rmc.ca.gov/. Meeting notices for the Conservancy's Board are also on the website. The Conservancy is an independent State agency within the Resources Agency of the State of California established by state law in 1999. Its jurisdiction includes the San Gabriel River and its tributaries, the Lower Los Angeles River and its tributaries, and the San Gabriel Mountains, Puente Hills, and San Jose Hills. It was established to preserve urban open space and habitats in order to provide for low-impact recreation and educational uses, wildlife and habitat restoration and protection, and watershed improvements within its jurisdiction. Implementation of the Open Space Plan is occurring partly through award of pass-through grant funds.

The County of Orange, in coordination with the County of Los Angeles and multiple stakeholders in both counties, completed a watershed management plan for Coyote Creek, a subwatershed of the San Gabriel River which straddles two counties and two Regional Board jurisdictions. The creek enters the San Gabriel River near the ocean; the subwatershed area covers a densely populated area of southeastern Los Angeles County and northern Orange County. Information on the subwatershed may be found at http://www.ocwatersheds.com/watersheds/coyotecreek.asp .

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

We will maintain involvement with stakeholder activities and assist them in pursuing funding options, as well as, other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

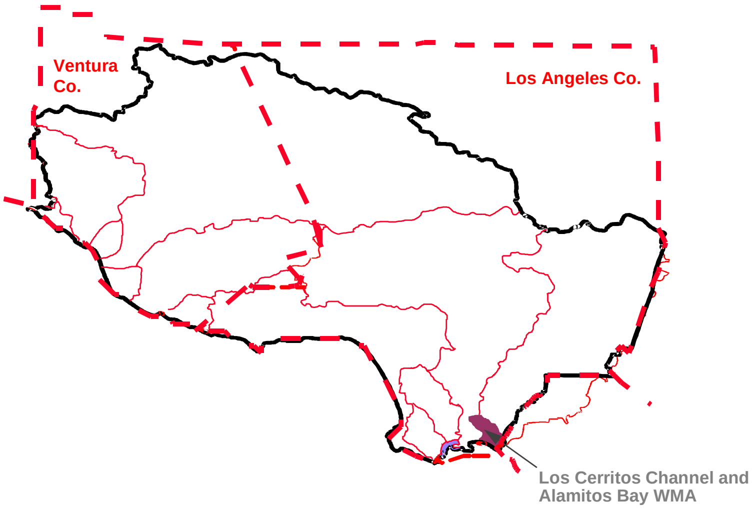
Potential Long-term Activities

- Development of coordinated watershed monitoring program
- Hydrologic study of the estuary to evaluate mixing dynamics and effects on water quality and beneficial uses
- Evaluation of fish tissue from fish in the lower river and estuary
- Evaluation of toxicity impacts in the estuary
- Evaluation of habitats in the middle/lower river
- Evaluation of impacts from reservoir cleaning on water quality, particularly fisheries-related
- Evaluation of mining on instream beneficial uses
- Evaluation of impacts of reclaimed water on river/groundwater
- Evaluation of success of trash TMDL efforts in upper river
- Evaluation of impacts from industrial stormwater in the watershed
- Consideration of TMDL-related issues
- Implementation of biological monitoring

2.5 LOS CERRITOS CHANNEL AND ALAMITOS BAY WMA

This watershed will be targeted in FY2010/2011.

Overview of WMA



Los Cerritos Channel, Tidal Prism, and Wetlands: The Los Cerritos Channel is concrete-lined above the tidal prism and drains a relatively small area of east Long Beach, albeit a densely urbanized one. The channel's tidal prism starts at Anaheim Road and connects with Alamitos Bay through the Marine Stadium; the wetlands connects to the Channel a short distance from the lower end of the Channel. The wetlands, and portion of the channel near the wetlands, is an overwintering site for a great diversity of birds (up to 50 species) despite its small size. An endangered bird species, the Belding's Savannah Sparrow, may nest there and an area adjacent to the wetlands is a historic least tern colony site. One small marina is located in the channel which is also used by rowing teams and is a popular fishing area.

Alamitos Bay: Alamitos Bay is composed of the Marine Stadium, a recreation facility built in 1932 and used for boating, water skiing, and jet skiing; Long Beach Marina, which contains five smaller basins for recreational craft and a boatyard; a variety of public and private berths; and the Bay proper which includes several small canals, a bathing beach, and several popular clamming areas. A small bathing lagoon, Colorado Lagoon in Long Beach, has a tidal connection with the Bay and a small wildlife pond, Sims Pond, also has a tidal connection. The latter is heavily used by overwintering migratory birds.

Beneficial uses designated in the watershed:

Estuary (marina, wetlands, bay)	*Above Estuary*
Contact & noncontact water recreation	Wildlife habitat
Industrial service supply	
Navigation	*Intermittent uses:*
Commercial & sportfishing	Noncontact water recreation
Estuarine habitat	
Marine habitat	Warmwater habitat
Wildlife habitat	
Preservation of rare & endangered species	
Migration of aquatic organisms	
Spawning habitat	
Shellfish harvesting	
Wetlands habitat	

Water Quality Problems and Issues

Significant Issues:

- Loss of wetlands habitat in Los Cerritos area
- Impacts from antifouling paint in marinas
- Urban and storm water runoff impacts on isolated water bodies
- Loss of tidal exchange

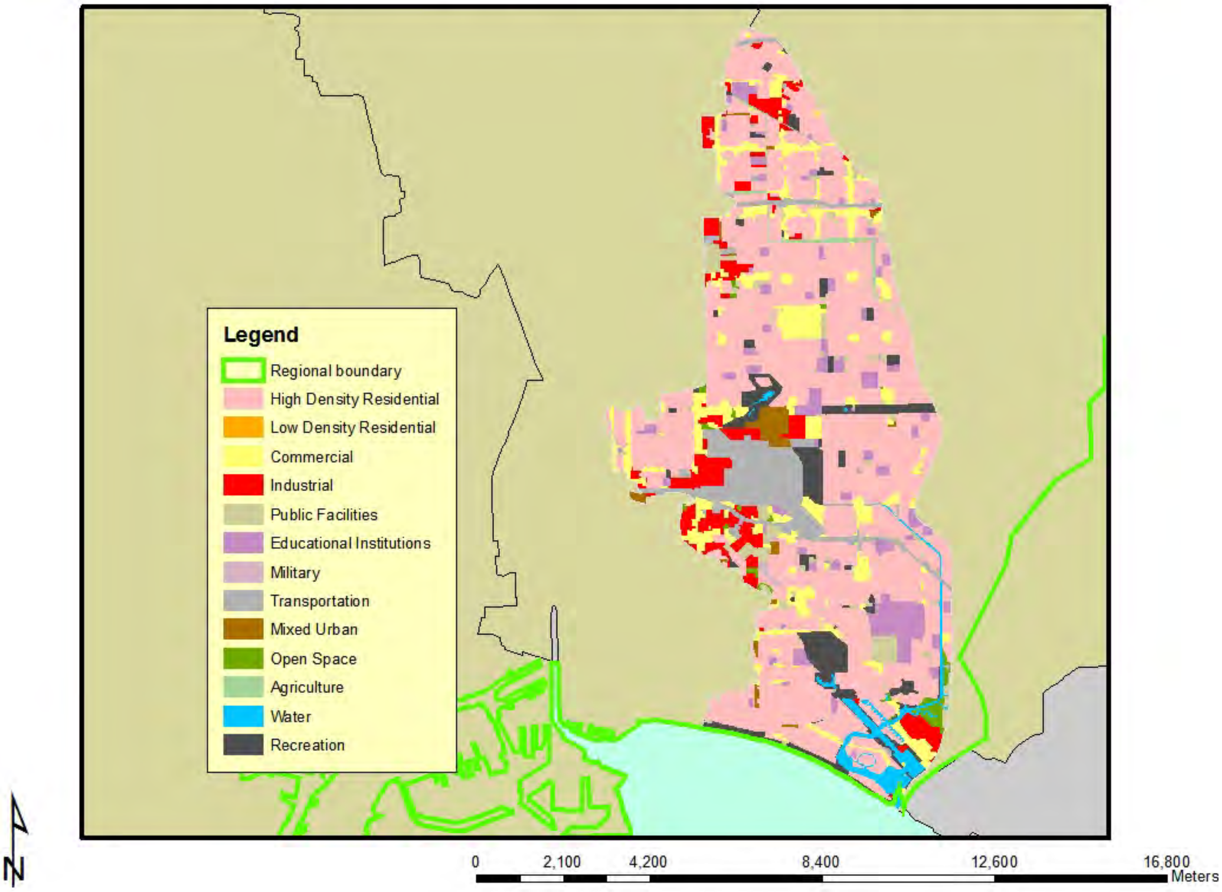
A considerable amount of leaching of boat paint likely occurs in the Bay, particularly in the marina. Nonpoint source runoff from storm drains is also a likely source of problems.

Permitted discharges:

- 14 NPDES discharges: two minor and twelve under general permits
- 2 municipal storm water permits
- 36 dischargers covered under the industrial storm water permit
- 31 dischargers covered under a construction storm water permit

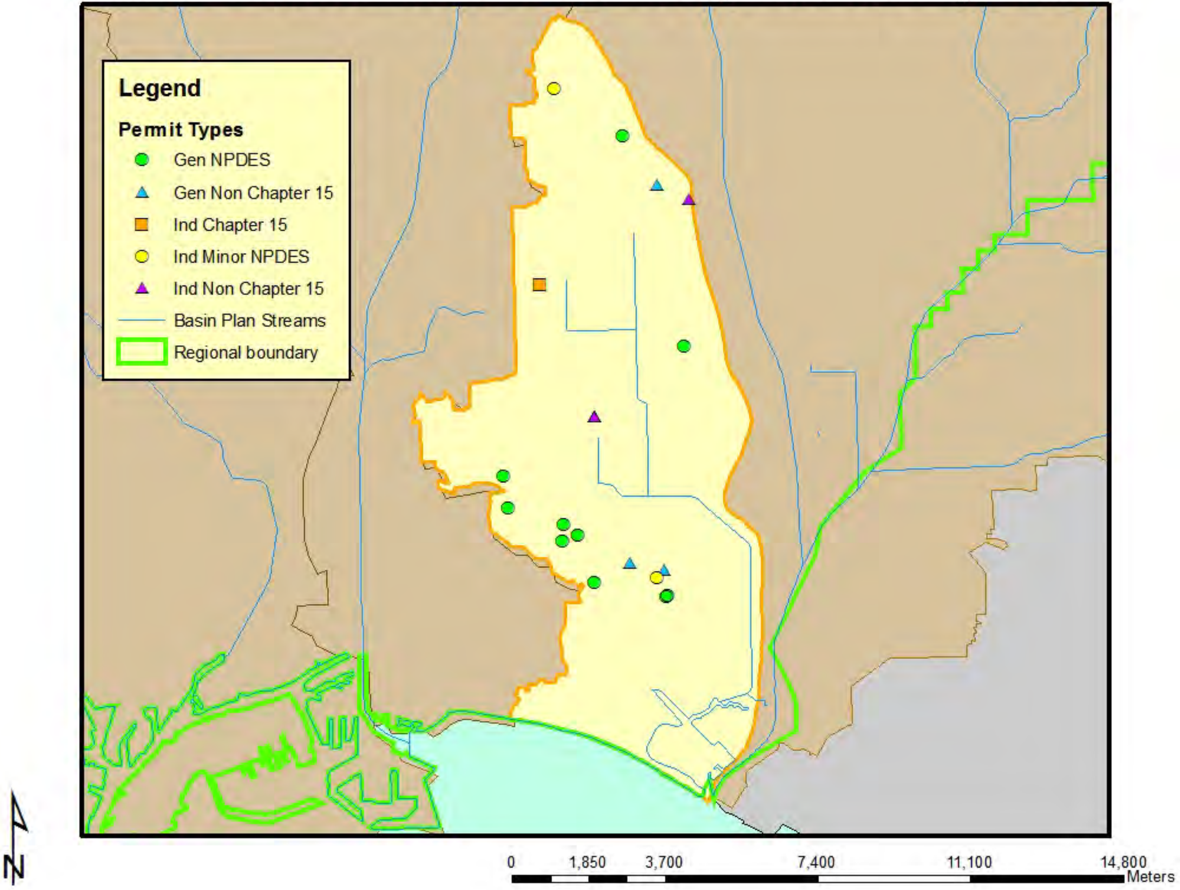
A majority of land use in the WMA is high density residential as seen in the follow figure.

Land Use in the Los Cerritos and Alamitos Bay Watershed Management Area



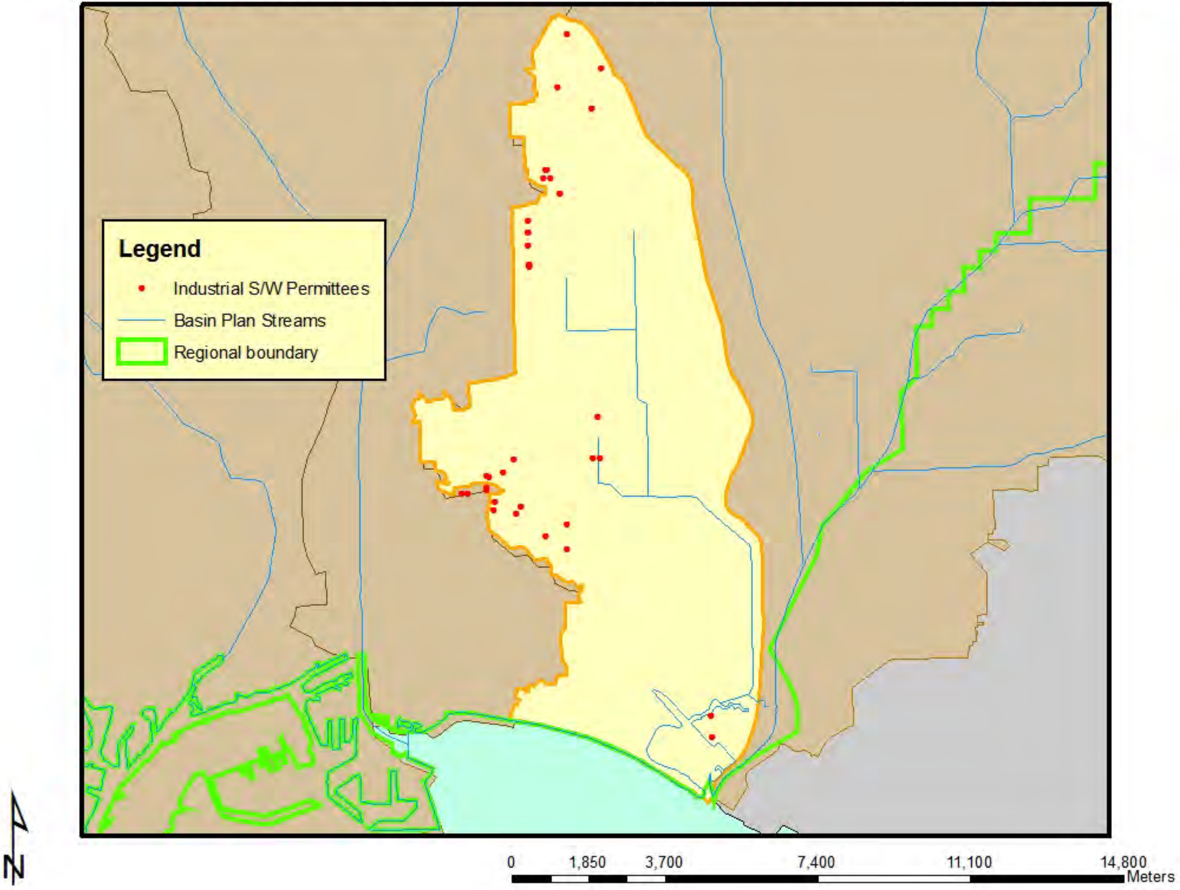
The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Los Cerritos Channel - Alamitos Bay Watershed Management Area



Most of the 14 NPDES permittees in the watershed discharge to Los Cerritos Channel; the rest discharge to Alamitos Bay.

Of the 37 dischargers enrolled under the general industrial storm water permit in the watershed, the majority occur in the cities of Long Beach. Many of these businesses are involved with trucking and warehousing, transportation equipment, and fabricated metal products based on their Standard Industrial Classification (SIC) codes. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.



Locations of Dischargers Covered by General Industrial Stormwater Permit in the Los Cerritos Channel - Alamitos Bay Watershed Management Area

There are 31 construction sites enrolled under the general construction storm water permit. Sites are fairly evenly divided between commercial, residential, and industrial sites. About one-half of them occur on sites that are five acres or greater. Sites range up to 200 acres in size.

IMPAIRMENTS: Beneficial uses in the wetlands area are considered fully supported while those in the channel are not. Beneficial uses in the Bay are, for the most part, considered fully supported although Long Beach Marina is considered a site of concern due to elevated sediment concentrations of metals. The table below shows the impairments from the 2006 303(d) list:

Water Quality Limited Segment Name	**Pollutant**
Alamitos Bay (4 segments: Shore float; 1st & Bayshore; 2nd St Bridge & Bay shore; 56th Place - bayside)	Indicator bacteria
Colorado Lagoon	Chlordane (tissue & sediment) DDT (tissue) Dieldrin (tissue) Lead (sediment)

	PAHs (sediment) PCBs (tissue) Sediment Toxicity Zinc (sediment)
Colorado Lagoon (3 segments: north, center, south)	Indicator bacteria
Long Beach City Beaches (13 segments: 3rd Place; 5th; 10th; 16th; 36th; 54th; 55th; 62nd; 72nd; Coronado Ave; Granada Ave; Molina Ave; Prospect Ave)	Indicator bacteria
Los Cerritos Channel	Ammonia Bis(2ethylhexyl)phthalate/DEHP Chlordane (sediment) Coliform Bacteria Copper Lead Trash Zinc

CURRENTLY SCHEDULED TMDLS:

- Colorado Lagoon toxics-FY07/08

Stakeholder Groups

This watershed area is within the purview of the *Los Angeles and San Gabriel Rivers Watershed Council*. The Los Cerritos WMA is located between the Los Angeles and San Gabriel Rivers and drains to the same general area as the San Gabriel River. There is also a minor hydraulic connection between the lower San Gabriel River and Los Cerritos Channel due to the location of a power plant intake with the Long Beach Marina; the discharge from this facility is into the San Gabriel River estuary.

Other stakeholder groups include the *Los Cerritos Wetlands Task Force* at http://www.loscerritos.org/ and *Friends of Colorado Lagoon* at http://www.coloradolagoon.org/.

Past Significant Activities

MONITORING AND ASSESSMENT

This watershed was a focus for SWAMP monitoring in FY03/04. Waterbodies monitored included Los Cerritos Channel and Wetlands (four stations), Sims Pond (one station) and Colorado Lagoon (one station).

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has funded a planning project in the WMA, the Colorado Lagoon Restoration Project.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Los Cerritos Channel and Alamitos Bay.

CORE REGULATORY

Continuing core regulatory activities that will be integrated into the watershed management approach include (but are not limited to) necessary renewal/revision of NPDES permits. There eight significant or minor dischargers under individual permits as well as seven dischargers currently covered under general permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue.

The Los Cerritos Channel and Alamitos Bay WMA falls partly within Los Angeles County which was issued a renewed municipal storm water permit in December 2001. There are 87 co-permittees covered under this permit including 85 cities, the County of Los Angeles, and the California Department of Transportation. Work on the permit will involve review of monitoring reports, evaluation of the storm water program's effectiveness, coordination with other watershed efforts, and modification of the permit as necessary. The watershed falls mostly within the City of Long Beach which was issued a municipal storm water permit in 1999.

An important requirement of both storm water municipal permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and Numerical Design Standards for Best Management Practices (BMPs) which were adopted in 2000. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality concerns in addition to flood protection and that pollutants carried by storm water are retained and not delivered to waterways.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrates or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system. Other standards also apply; additional information on the SUSMP may be found on the Regional Board website http://www.waterboards.ca.gov/losangeles.

NONPOINT SOURCE PROGRAM

The Regional Board encourages pollution prevention and source control; the Propositions 40 and 50, SRF, and 319(h) grants are tools to provide funds for these types of projects. Implementation of TMDLs for bacteria, nitrogen, and trash, as well as, preservation/restoration of high value habitat areas in support of the waters' beneficial uses are high priorities for the current grant programs.

A feasibility study for restoration of Colorado Lagoon was funded by the Coastal Conservancy. The lagoon is a tidal water body connected to Alamitos Bay via a box culvert. The lagoon is heavily utilized for recreational activities; it is in a natural low point of the watershed and thus receives a considerable amount of urban runoff and has impaired water quality. The purpose of the Colorado Lagoon Restoration Feasibility Study is to evaluate and recommend feasible opportunities to restore the marine ecosystem and support safe recreation while improving water and sediment quality and managing storm water in the lagoon. The City of Long Beach was awarded Clean Beaches Initiative funds from the State Water Resources Control Board to begin implementation of water quality improvement actions described in the feasibility study. More information on the study may be found at http://www.longbeach.gov/news/displaynews.asp?NewsID=561.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has identified acquisition of various properties in the Los Cerritos Wetlands area as a high priority project in their current workplan. Development of a conceptual restoration plan for the wetlands is also a high priority. Another high priority project in the watershed management area is restoration of Colorado Lagoon. Being listed on the workplan is not a guarantee of funding however. More information may be found at http://www.scwrp.org.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities and TMDLs in this area.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures (coordinate 205(j) and 319(h) activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

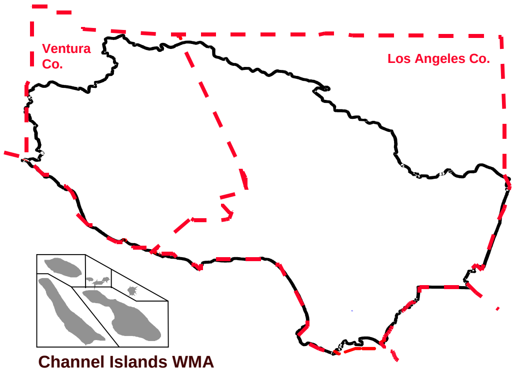
Potential Long-term Activities

- Evaluation of existing conditions/beneficial uses
- Consideration of TMDL-related issues
- Implementation of biological monitoring

2.6 THE CHANNEL ISLANDS WMA

This watershed will be targeted in FY2010/2011.

Overview of WMA



Beneficial Uses of Island Watercourses

Municipal supply
Groundwater recharge
Contact & noncontact water recreation
Warmwater habitat
Wildlife habitat
Preservation of rare & endangered species

The Channel Islands within the Region's boundaries are: Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente Islands. Anacapa and Santa Barbara Islands are part of the Channel Islands National Park. The waters within six nautical miles of Anacapa and Santa Barbara Islands are designated a national marine sanctuary. The ocean waters adjacent to the islands (not the entire circumference of Santa Catalina however) were designated Areas of Special Biological Significance by the state of California. The west side of San Nicolas supports a large gull rookery and elephant seal breeding area. The U.S. Navy has facilities on San Nicolas (and a desalination plant) and San Clemente Islands with a small package treatment plant on the latter. San Clemente Island is the primary maritime training area for the U.S. Department of the Navy Pacific Fleet, U.S. Navy SEALs, and the U.S. Marine Corps. The city of Avalon is located on Santa Catalina Island and also has a small treatment plant.

The Channel Islands WMA

- Five islands
- Areas offshore of islands designated as Areas of Special Biological Significance
- High quality marine and rocky intertidal habitat
- Heavy use by marine mammals and endangered species
- No impairments

Water Quality Problems and Issues

Water quality in the vicinity of the islands is generally good. There are some potential threats from naval facilities and small treatment plants; however, there is only one area (Avalon Beach) with an impairment listing, for bacteria on the 2006 303(d) list.

Permitted discharges:

- 6 NPDES discharges including one POTW (major discharge) on Catalina Island
- Four minor NPDES discharges
- 4 dischargers covered under an industrial storm water permit
- 1 discharger covered under a construction storm water permit

Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity. Most of the NPDES dischargers (five of the total six) are located on Catalina Island including the one major discharge, a POTW.

There are four dischargers enrolled under the general industrial storm water permit, all on Santa Catalina Island. One discharger is enrolled under the general construction storm water permit, on San Clemente Island.

Stakeholder Group

There is no formal stakeholder group organized for the islands although activities on the non-military islands are often reported on at the Wetlands Recovery Project's Ventura County Task Force meetings.

Current Activities

CORE REGULATORY

Continuing core regulatory activities that will be integrated into the watershed management approach include (but are not limited to) necessary renewal/revision of NPDES permits. There is one major discharger (sewage treatment plant on Santa Catalina Island) and four significant or minor dischargers under individual permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue.

Due to limited resources, only the basic regulatory activities are performed: review of dischargers' monitoring reports, minimum necessary inspections and sampling, issuance/renewal of permits, levels 1 and 2 enforcement actions (noncompliance and violation notification), case handling, and answering inquiries from the public.

NONPOINT SOURCE PROGRAM

Santa Barbara and Anacapa Islands are identified as Critical Coastal Area (CCA) #56 in the State Water Resources Control Board's and California Coastal Commission's Critical Coastal Area Draft Strategic Plan. The islands were identified as such since the watersheds on the islands flow into an ASBS, which is a State Water Quality Protection Area. The draft strategic plan lists the major effort to implement NPS management measures as a water quality needs assessment completed in 2005.

San Nicolas Island and Begg Rock are identified as CCA #57 in the CCA Draft Strategic Plan. San Nicolas Island was identified as such since its watershed flows into an ASBS, which is a State Water

Quality Protection Area. The draft strategic plan lists that there are no major efforts currently to implement NPS management measures.
Northwest Santa Catalina Island is identified as CCA #63 in the CCA Draft Strategic Plan. This watershed flows into the Northwest Santa Catalina Island ASBS. This is the largest of the four ASBSs off Catalina Island, with 20.9 miles of coastline. Two marine protected areas are located just outside the boundaries of this ASBS: the Catalina Marine Science Center State Marine Reserve, and the Farnsworth Bank State Marine Conservation Area. In addition, a special invertebrate take closure area is located between Lion Head and Arrow Pt. The draft strategic plan lists the major effort to implement NPS management measures as stewardship of the Catalina Island Conservancy.

Western Santa Catalina Island is identified as CCA #64 in the CCA Draft Strategic Plan due to the watershed's flow into an ASBS. The draft strategic plan lists the major effort to implement NPS management measures as stewardship of the Catalina Island Conservancy.

CCA #65 is Farnsworth Bank, an ASBS with 37 acres of submerged marine habitat but no coastline and so no flows from land. The draft strategic plan lists the major effort to implement NPS management measures as stewardship of the Catalina Island Conservancy.

CCA #66 is Southeast Santa Catalina Island; flows from its watershed enter an ASBS. The draft strategic plan lists the major effort to implement NPS management measures as stewardship of the Catalina Island Conservancy.

CCA #67 is San Clemente Island; flows from its watershed enter an ASBS. The draft strategic plan lists the major efforts to implement NPS management measures: services provided by the Navy Public Works Center; establishment of the Navy Environmental Leadership Program; and preparation of the San Clemente Island Integrated Natural Resources Management Plan.

A draft final San Clemente Island Integrated Natural Resources Management Plan (INRMP) for San Clemente Island has been prepared by he U.S. Navy. The Island is home to a variety of unique and rare biological resources both on the land and in the adjacent waters. The INRMP will establish priorities for the next 5 years by which the Island provides necessary military training opportunities, while sustaining and enhancing the natural resources found there.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

MONITORING AND ASSESSMENT

No SWAMP monitoring of the Channel Islands Watershed coastal waters has occurred as this area has been sampled by the Bight-wide comprehensive monitoring projects conducted in 1994, 1998 and 2003; Bight 2008 is currently in the planning stages.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

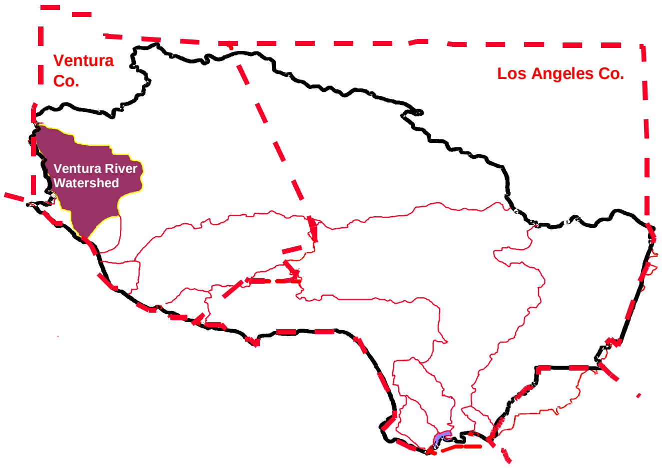
A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

We will maintain involvement with island activities and pursue funding options, especially those involving implementation of nonpoint source measures (coordinate 205(j) and 319(h) activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

2.7 VENTURA RIVER WATERSHED

This watershed will be targeted in FY2011/2012.

Overview of Watershed



The Ventura River and its tributaries drain a coastal watershed in western Ventura County. The watershed covers a fan-shaped area of 235 square miles, which is situated within the western Transverse Ranges (the only major east-west mountain ranges in the continental U.S.). From the upper slopes of the Transverse Ranges, the surface water system in the Ventura River watershed generally flows in a southerly direction to an estuary, located at the mouth of the Ventura River. Groundwater basins composed of alluvial aquifers deposited along the surface water system, are highly interconnected with the surface water system and are quickly recharged or depleted, according to surface flow conditions. Topography in the watershed is rugged and as a result, the surface waters that drain the watershed have very steep gradients, ranging from 40 feet per mile at the mouth to 150 feet per mile at the headwaters.

Precipitation varies widely in the watershed. Most occurs as rainfall during just a few storms, between November and March. Summer and fall months are typically dry. Although snow occurs at higher elevations, melting snowpack does not sustain significant runoff in warmer months. The erratic weather pattern, coupled with the steep gradients throughout most of the watershed, result in high flow velocities with most runoff reaching the ocean.

Beneficial Uses in Watershed:

Estuary	*Above Estuary*
Navigation	Municipal supply
Commercial & sportfishing	Industrial service supply
Estuarine habitat	Industrial process supply
Marine habitat	Agricultural supply
Contact & noncontact water recreation	Contact & noncontact water recreation
Warmwater habitat	Warmwater habitat
Wildlife habitat	Wildlife habitat
Preservation of rare & endangered species	Preservation of rare & endangered species
Migratory & spawning habitat	Migratory & spawning habitat
Wetlands habitat	Wetlands habitat
Shellfish harvesting	Coldwater habitat
	Groundwater recharge
	Freshwater replenishment

Water Quality Problems and Issues

The majority of water quality problems involve eutrophication (excessive nutrients and effects), especially in the estuary/lagoon. A large storm drain enters the river near the estuary and homeless persons live in and frequent the river bed. Sediment in the estuary, however, appears relatively uncontaminated and in laboratory tests conducted through the Bay Protection and Toxic Cleanup Program, little sediment toxicity was found. In some subwatersheds, high TDS concentrations impair the use of water for agriculture. The watershed's water quality problems are, for the most part, nonpoint source-related. There have also been incidents of releases of toxic materials into storm drains entering the lower river.

The Ventura River Watershed

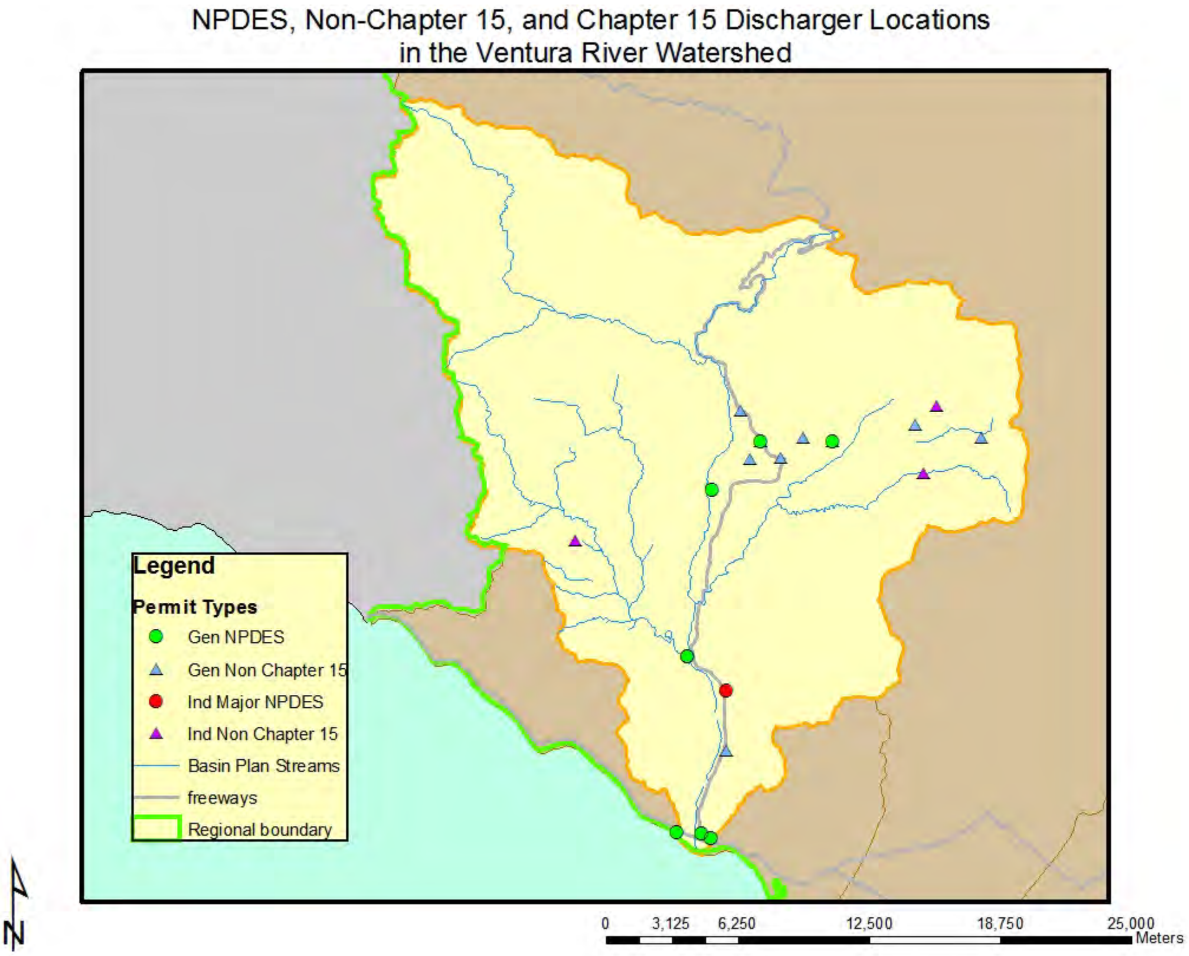
- Eutrophication concerns, especially in lagoon
- Some bioaccumulation of DDT and metals
- TDS concerns in some subwatersheds
- Impediments to steelhead trout migration (but much high quality habitat)
- More nonpoint source rather than

There is only one major discharger, a small POTW (3.0 MGD) in the middle reach of the Ventura River. For much of the year, the facility's effluent can make up two-thirds of the total river flow.

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

Permitted discharges:

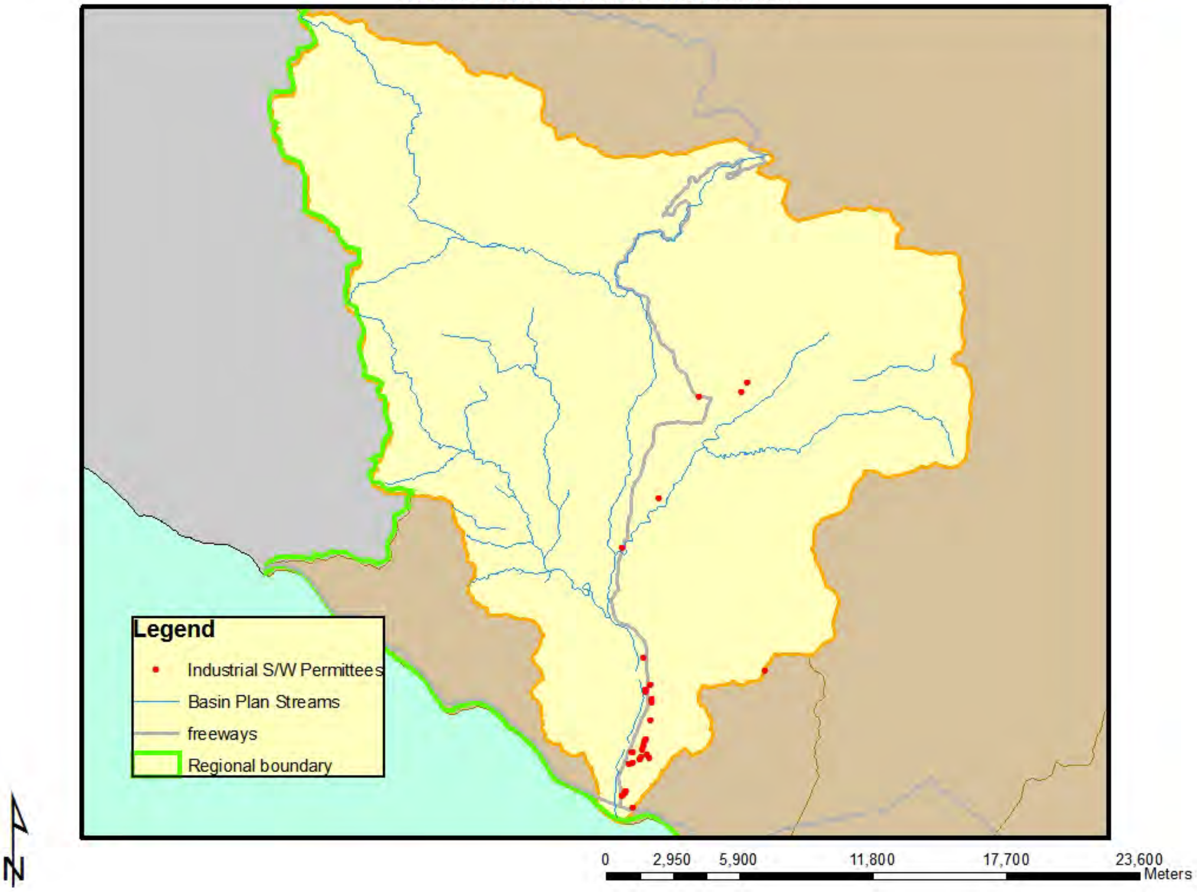
- 9 NPDES discharges: one major (POTW) and eight discharges covered by general permits
- 37 dischargers covered under the industrial storm water permit
- 33 dischargers covered under the construction storm water permit


NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Ventura River Watershed

Most of the nine NPDES permittees in the watershed discharge to the main river.

Of the 36 dischargers enrolled under the general industrial storm water permit in the watershed, the majority are in the city of Ventura. Wholesale trade-durable goods, trucking and warehousing, and food and kindred products (including wineries) are most prominently represented based on their Standard Industrial Classification (SIC) codes. Most of the facilities are under ten acres in size. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

Locations of Dischargers Covered by General Industrial Stormwater Permit in the Ventura River Watershed

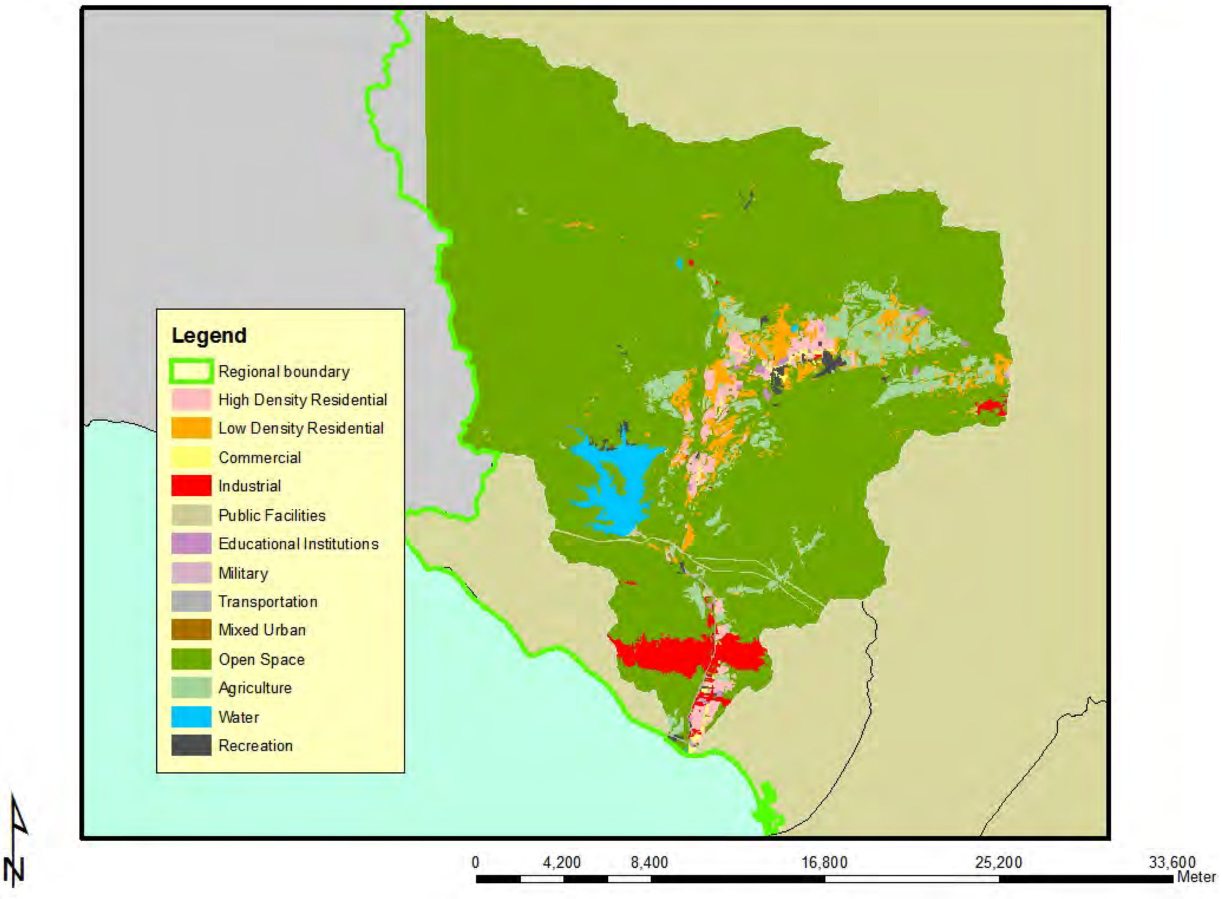


About one-half of the 33 dischargers under the general construction storm water permit are on residential sites; most of the sites are 5 acres or greater in size and range up to 100 acres.

Water diversions, dams, and groundwater pumping also are thought to limit surface water resources needed to support a high quality fishery. Reduced water supplies affect water quality and thus beneficial uses, particularly with regards to the endangered steelhead trout (steelhead trout are known to utilize the River and some of its tributaries historically supported annual steelhead runs of 5000 – 6000 adults). Removal of the Matilija Dam in the upper watershed is a high priority.

Land use is the watershed is predominantly open space with a mix of residential, agriculture and industrial along the mainstem of the river as shown in the following figure.

Land Use in the Ventura River Watershed



The table below shows the water quality impairments from the 2006 303(d) list:

Water Quality Limited Segment Name	Pollutant
Canada Larga (Ventura River Watershed)	Fecal Coliform Low Dissolved Oxygen
Matilija Creek Reach 1 (Jct. With N. Fork to Reservoir)	Fish Barriers (Fish Passage)
Matilija Creek Reach 2 (Above Reservoir)	Fish Barriers (Fish Passage)
Matilija Reservoir	Fish Barriers (Fish Passage)
San Antonio Creek (Tributary to Ventura River Reach 4)	Nitrogen
Ventura River Estuary	Algae Eutrophic Total Coliform Trash
Ventura River Reach 1 and 2 (Estuary to Weldon Canyon)	Algae
Ventura River Reach 3 (Weldon Canyon to Confl. w/ Coyote Cr)	Pumping Water Diversion

Ventura River Reach 4 (Coyote Creek to Camino Cielo Rd)	Pumping Water Diversion

Stakeholder Groups

Ventura River Watershed Council The group originally was formed to aid the Trust for Public Land in development of a lower river parkway. It has become a formal part of the Integrated Regional Water Management Plan (IRWMP) process as one of three watershed groups in the Ventura County water management area.

Ventura River Steelhead Restoration and Recovery Plan Group A Plan was developed in response to the listing of steelhead trout as an endangered species by the National Marine Fisheries Service (NMFS) in August 1997. The plan was developed 1) to identify measures to mitigate impacts of ongoing operations and maintenance activities, 2) to identify future projects and, 3) identify and evaluate opportunities to promote recovery and restoration of the steelhead trout in the watershed. One staff person will continue to remain involved with the group, as needed.

Ventura River Habitat Conservation Plan (HCP) Group: The group, mostly comprised of resource agencies, cities, and water districts, began meeting in 2000. The cities and water districts involved all operate and maintain facilities that may affect sensitive resources or their habitats in the river. In order to comply with the Endangered Species Act they are engaging in consultation with the National marine Fisheries Service and US Fish and Wildlife Service and are in the process of developing a HCP that, with monitoring program and implementation agreements, would serve as the basis for an Incidental Take Permit.

Matilija Dam Steering and Executive Committees: The USACE, Ventura County Flood Control District, US Bureau of Reclamation, and other agencies and entities began convening in 2000 to begin discussions on the possible removal of Matilija Dam as part of an ecosystem restoration. An USACE and VCFCD sponsored ecosystem restoration feasibility study was completed in summer 2004 and a favored alternative will be further pursued. More information may be found at http://www.matilijadam.org/.

Matilija Coalition: The Coalition is a local group committed to removal of Matilija Dam and subsequent ecosystem restoration. More information about the group may be found at http://www.matilija-coalition.org/ .

Significant Past Activities

In August 1997, the National Marine Fisheries Service (NMFS) listed the steelhead trout in Southern California as endangered under the Federal Endangered Species Act (ESA). The listing means that any project or action that may affect steelhead trout or their habitats will require consultation with NMFS to obtain an incidental take permit. In order to prepare for the listing and deal with possible regulatory requirements as a result of the listing, the Casitas Municipal Water District, City of Ventura, Ventura County Flood Control District, and seven other local public and private agencies collaborated and developed the **Ventura River Steelhead Restoration and Recovery Plan** in December 1997 (see above). The plan also contains large amount of background information on the watershed such as hydrology, biology, steelhead habitat conditions, and the operations and maintenance of water wastewater, solid waste, transportation and flood control facilities of the sponsoring agencies. The regulatory activities by the Regional Water Quality Control Board in the watershed were briefly reviewed in the plan.

Regional Board staff produced a *State of the Watershed Report* for the Ventura River in 2002. This document is available on the Regional Board's website.

No SWAMP monitoring of the Ventura River Watershed occurred as existing monitoring efforts adequately characterized conditions.

The Wetlands Recovery Project funded two planning projects in the watershed, the Matilija Dam Evaluation Project and the Matilija Dam Removal Feasibility Study..

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Ventura River Watershed.

CORE REGULATORY

Continuing core regulatory activities include compliance inspections, reviewing of monitoring reports, response to complaints, and enforcement actions as needed. Key regulatory staff will continue to remain involved in the Ventura River Watershed Team for purposes of coordinating watershed activities in-house and working on any needed State of the Watershed Report updates.

Additionally, most urban areas in Ventura County, including this watershed, are implementing Best Management Practices (BMPs) under the Municipal Storm Water Permit (revised in 2000). The "Discharger" consists of the co-permittees Ventura County Flood Control District, the County of Ventura, and the Cities of Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, San Buenaventura, Santa Paula, Simi Valley, and Thousand Oaks. The Discharger is required to implement the Ventura Countywide Stormwater Quality Urban Impact Mitigation Plan (SQUIMP), which requires the implementation of BMPs to reduce the discharge of pollutants in storm water from new development and significant redevelopment. Other requirements of the Municipal Storm Water Permit include a public education program, an educational site inspection program for industrial and commercial facilities, program for construction sites, public agency activities, and a storm water monitoring program.

The storm water monitoring program has consisted of land-use based monitoring, receiving water and mass emission station monitoring, and bioassessment. The Discharger also participates in regional monitoring activities, such as the Storm Water Monitoring Coalition, organized by the Southern California Coastal Water Research Project. Furthermore, the Discharger participates in the development and implementation of volunteer monitoring programs in the Ventura Coastal watersheds.

The Ventura River receives municipal storm drain discharges from the City of Ojai, City of San Buenaventura (part), and unincorporated Ventura County (part).

Currently under consideration are agreements with sister agencies in regulatory-based encouragement of Best Management Practices. Most notably is the use of a GIS layer for pesticides application available from the Department of Pesticide Regulation (DPR). Reduction of pesticides identified as contaminants of concern for a watershed might be addressed through a Management Agency Agreement (MAA) with the DPR, or through waiving adoption of waste discharge requirements on an individual basis using information gathered in databases provided by the Ventura County Agricultural Commission office.

MONITORING AND ASSESSMENT

A receiving water monitoring program is implemented by the Ojai Valley Sanitary District, supplemented by ambient or special monitoring conducted by Regional Board staff. The monitoring supports compliance evaluation, nonpoint source identification, and potential TMDL development. In conjunction with the receiving water monitoring, land-use based monitoring is done as part of the Ventura County Municipal Storm Water Program as well as bioassessment. The County's work is integrated and coordinated with citizen monitoring being conducted by the Ventura River Stream Team.

The Ventura County Environmental Health Department conducts weekly coastline bacteriological monitoring for total and fecal coliform and enterococcus at a number of stations along the Ventura County coast. There are two stations in the immediate vicinity of the Ventura River, one upcoast and one downcoast. Monitoring results are at posted at http://www.ventura.org/env_hlth/ocean.htm.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has listed the Matilija Dam Removal Engineering and Design project and acquisitions for the Ventura River Parkway as high priority projects on the current workplan. The Ventura River Arundo Removal Project is also listed on the workplan. Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

NONPOINT SOURCE PROGRAM

A priority issue is continued work to determine the scope of water quality impacts from agricultural runoff in the Region. Some agricultural activities occur in the Ventura River Watershed. Development of solutions to any impacts is also a high priority and will be a major concern of the nonpoint source program and, by extension, watershed groups which will be addressing this as well as other problems.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WATERSHED MANAGEMENT

The Ventura County Watershed Protection District received a Proposition 50 IRWMP implementation grant of $25 million which includes as one project development of a watershed protection plan and formation of a stakeholder group.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

Near-term **Basin Planning** issues include addressing impacts from hydromodification and pumping, particularly in steelhead trout restoration and dam removal efforts, and developing nutrient standards for the lagoon.

Potential Long-term Activities

Grant funding to help support this largely natural watershed's natural resources will be an important component of any long-term restoration and preservation process.

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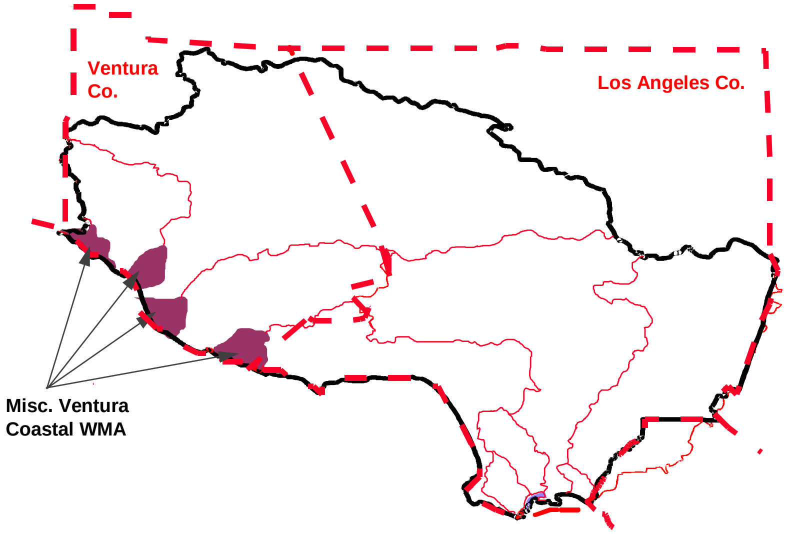
2.8 *MISCELLANEOUS VENTURA COASTAL WMA*

This Watershed Management Area will be targeted in FY2011/2012.

Overview of WMA

The WMA is composed of four separate coastal drainage areas located between the Regional boundary, the Ventura River, Santa Clara River, and Calleguas Creek Watersheds, as well as, the Santa Monica Bay WMA. The drainage areas are typified by either small coastal streams, wetlands, or marinas/urban centers.



Channel Islands Harbor: Channels Islands Harbor is located south of the Santa Clara River and is in the immediate vicinity of considerable residential development and some agricultural land. The Southern California Edison inlet canal to the Ormond Beach Generating Station is located at the north end of the harbor. The harbor is home to many recreational boats and two boatyards.

Port Hueneme Harbor: Port Hueneme is a medium-sized deepwater harbor located in Ventura County, north of Mugu Lagoon. Part of it was operated by a U.S. Navy Construction Battalion until very recently while the rest of the harbor serves as a commercial port operated by the Oxnard Harbor District. The construction of a majority of the harbor was completed in 1975. The commercial side generally serves ocean-going cargo vessels and oil supply boats; the latter serve the oil platforms in the Santa Barbara Channel. Two endangered bird species may use the harbor, the California Brown Pelican and the California Least Tern.

Ventura Marina: Ventura Marina is a small craft harbor located between the mouths of the Ventura and Santa Clara Rivers. It is home to numerous small boats and two boatyards. The "Ventura Keys" area of the marina is a residential area situated along three canals. The marina is surrounded by agricultural land and a large unlined ditch drains into the Keys area. Since the marina is between the mouths of two rivers which discharge large sediment loads from their relatively undeveloped watersheds, the marina has a constant problem with keeping the entrance channel open.

McGrath Lake: McGrath Lake is a small brackish waterbody located just south of the Santa Clara River. The lake is located partially on State Parks land and partially on privately-owned oilfields in current production. A number of agricultural ditches drain into the lake. A state beach is located off the coastal side of the lake. The habitat around the lake is considered to be quite unique and it is utilized by a large number of overwintering migratory birds.

Beneficial Uses in WMA

Channel Islands Harbor
- Industrial service supply
- Contact & noncontact water recreation
- Navigation
- Commercial & sportfishing
- Marine habitat
- Wildlife habitat

Port Hueneme Harbor
- Process water supply
- Contact & noncontact water recreation
- Navigation
- Commercial & sportfishing
- Marine Habitat
- Wildlife habitat

Ventura Marina
- Industrial service supply
- Contact & noncontact water recreation
- Navigation
- Commercial & sportfishing
- Marine habitat
- Wildlife habitat
- Shellfish harvesting

Ormond Beach
- Industrial water supply
- Contact & noncontact water recreation
- Wildlife habitat
- Wetlands habitat
- Protection of rare & endangered species
- Navigation
- Power generation
- Commercial & sportfishing
- Marine habitat
- Shellfish harvesting

Ormond Beach Wetlands and McGrath Lake
- Estuarine habitat
- Contact & noncontact water recreation
- Wildlife habitat
- Wetlands habitat
- Protection of rare & endangered species

Open Coastline: A major feature of the coastline north of Mugu Lagoon is Ormond Beach and Ormond Beach Wetlands. There are a number of scenarios under consideration for restoration of this degraded yet valuable wetlands.

Water Quality Problems and Issues

Channel Islands Harbor: The harbor is on the 2006 303(d) list for lead and zinc. During the early to mid-1980s, the State Mussel Watch Program (SMWP) found low to intermediate levels of metals and organics except for one especially high accumulation of DDT. Sediment sampling for metals conducted by Regional Board staff in 1988 revealed slightly to moderately elevated levels. Copper at one site was nearly 50 ppm and zinc was as high as 76 ppm. Arsenic was slightly elevated (4 ppm) at a sampling site located next to a drain possibly connected to a nearby agricultural field. Under the Bay Protection and Toxic Cleanup Program (BPTCP), the harbor is listed as site of concern due to DDT and silver sediment concentrations and sediment toxicity; further monitoring is needed here.

Port Hueneme Harbor: The harbor is on the 2006 303(d) list for DDT and PCBs. The SMWP found elevated levels of these parameters. An Army Corps DEIR released in 1985 covering extension of one channel stated that water quality was good. The document also briefly discussed the port's biota which CDFG found to be "fairly healthy" and typical of southern California harbors. Sediment core samples were collected in 1985 and 1996 as part of a proposed dredge project. Relatively low levels of metals were found and no pesticides were detected. It may well be that flushing is good in the harbor and only locating a station directly next to a source will result in bioaccumulation. The BPTCP found fairly minimal levels of sediment toxicity but the harbor is considered a site of concern under the program due to accumulation of DDT, PCBs, TBT, PAHs, and zinc in mussel tissue. However, more recent monitoring conducted as part of dredging projects have found much lower concentrations of many pollutants, at least in sediment.

The harbors
- One deepwater harbor and two small-craft marinas
- Accumulation of metals, PCBs, and historic pesticides in sediment and tissue
- Support considerable marine life

The wetlands and coast
- Historic pesticide contamination
- Loss of quality habitat
- Impacts from oil spills
- Use by endangered species

Ventura Marina: The marina (the Keys area) is on the 2006 303(d) list for coliform problems. The City of Ventura monitors six stations within the Keys and the nearby Arundell Barranca (open drain carrying mostly agricultural runoff) for coliform on a regular basis. There are currently ongoing discussions concerning the possibility of re-rerouting the barranca away from the marina. The SMWP has found moderately elevated levels of metals, DDT, and chlordane in the marina from sampling conducted in the late 1980s; however, it is not listed as a site of concern under the BPTCP.

McGrath Lake: The lake is on the 2006 303(d) list for several legacy pesticides. The BPTCP found varying amounts of sediment toxicity and sediment levels of many pesticides were very high; the lake is listed as a toxic hot spot due to sediment concentrations of DDT, chlordane, dieldrin, toxaphene and endosulfan above sediment quality guidelines. A major crude oil spill into the lake occurred in late 1993 and runoff from nearby agricultural fields is ongoing. A characterization study revealed the large extent to which the sediment is contaminated; however, since the likelihood of cleanup is currently low, planning for habitat restoration is proceeding on its own track.

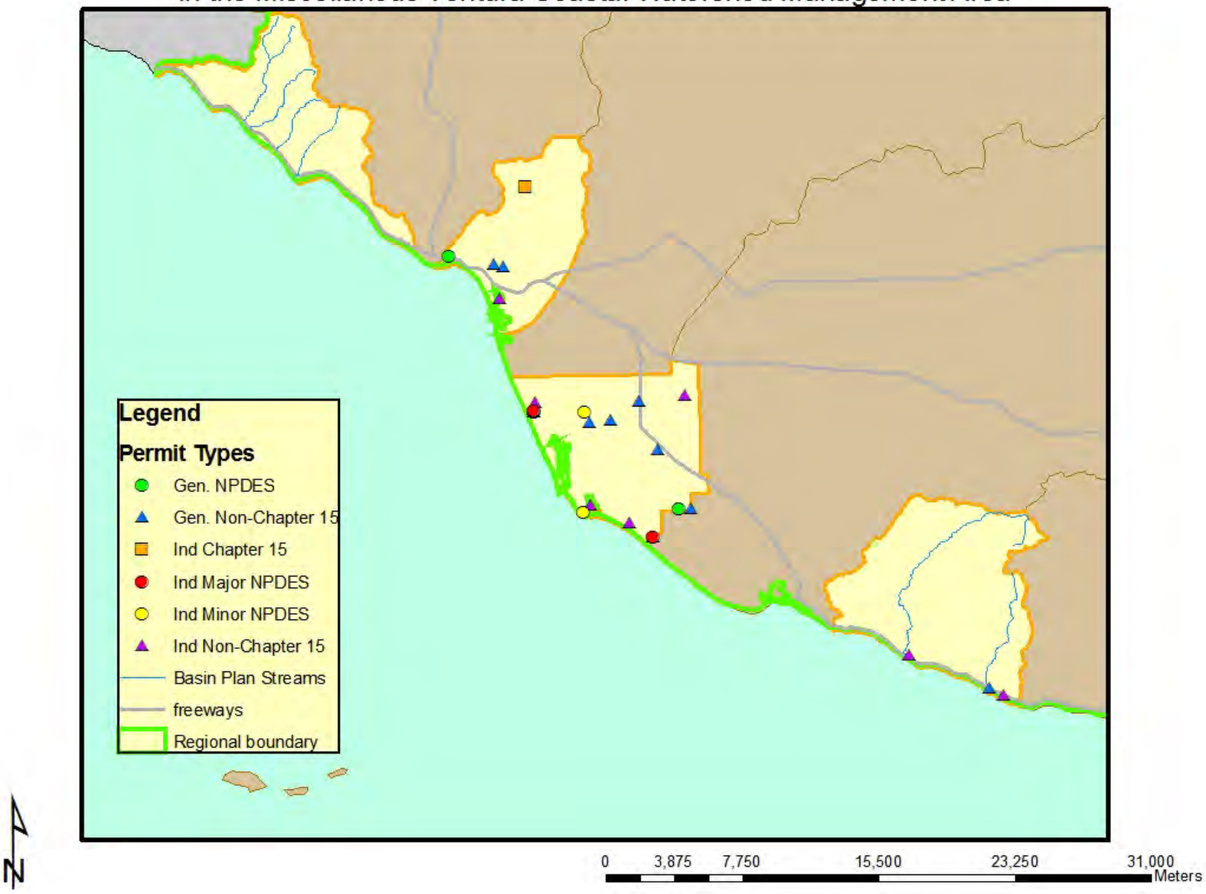
Permitted discharges:

- 17 NPDES discharges including three major discharges (one POTW and one generating stations), 6 minor discharges, and 8 covered by general NPDES permits
- 82 dischargers covered under the industrial storm water permit
- 91 dischargers covered under the construction storm water permit

Open Coastline: Little is known of water quality in the Ormond Beach area. The Oxnard Treatment Plant discharges secondary effluent to the ocean off of Oxnard. The facility is currently investigating approaches to remove upstream brine dischargers in order to move toward water reclamation. Part of the reclaimed water is proposed for use in a seawater intrusion barrier project to protect the Oxnard Plain ground water basin. The ocean immediately off of the coast was part of Bight ’03, Bight ’98 and the 1994 Southern California Bight Pilot Project. The Ormond Beach Wetlands is being characterized as part of a wetlands restoration planning process being led by the Coastal Conservancy. New samples of water and soil have been collected and data from previous sampling efforts (mostly in relation to a scrap metal facility nearby, Halaco) are being assessed for data gaps.

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

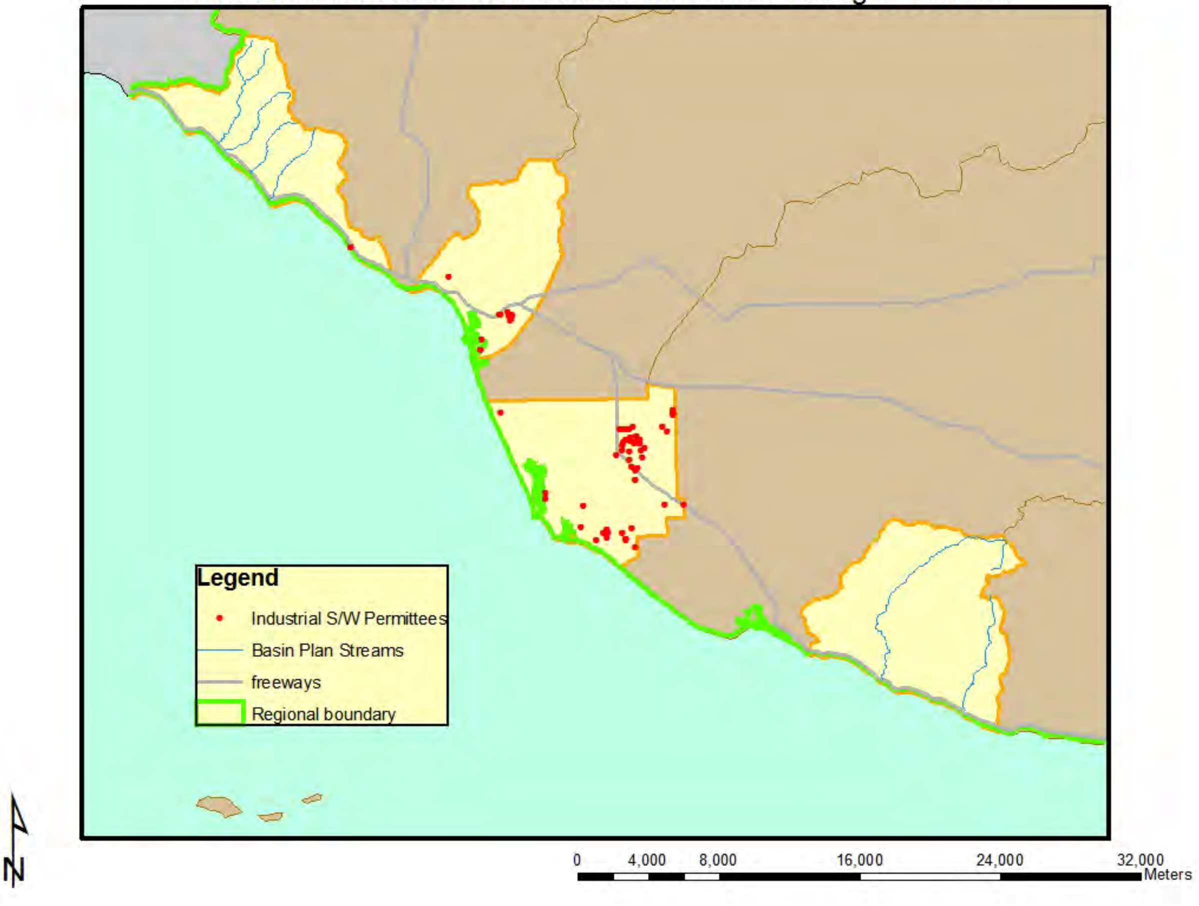
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Miscellanous Ventura Coastal Watershed Management Area



Most of the 17 NPDES permittees in the watershed management area discharge to coastal streams; there two major NPDES discharges, a POTW and a generating station, to the ocean.

Of the 67 dischargers enrolled under the general industrial storm water permit in the watershed, the majority occur in the city of Oxnard. Many of these businesses are involved with trucking and warehousing, local and interurban passenger transit, food and kindred products, and oil and gas extraction according to their Standard Industrial Classification (SIC) codes. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

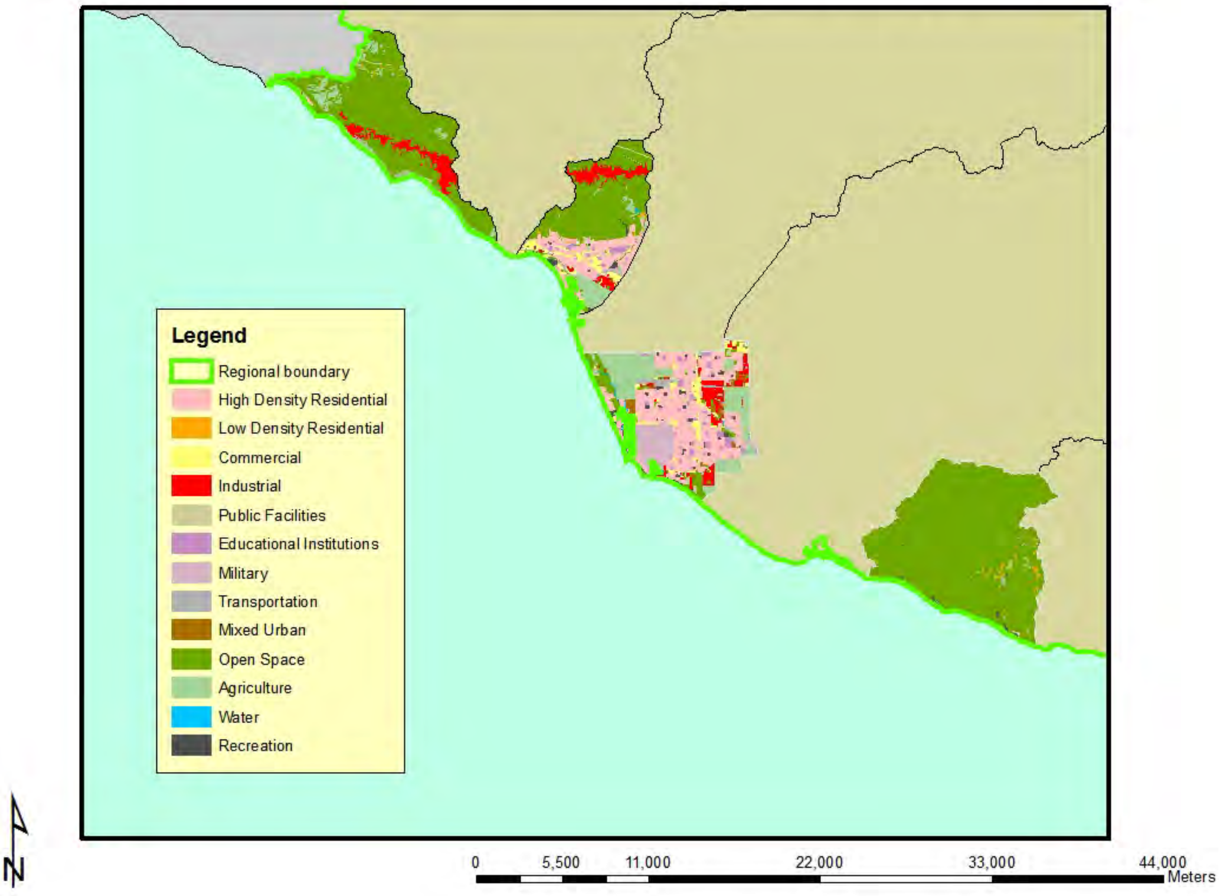
Locations of Dischargers Covered by General Industrial Stormwater Permit in the Miscellanous Ventura Coastal Watershed Management Area



There are 91 construction sites enrolled under the general construction storm water permit on a mix of residential, industrial, and commercial sites primarily in the Oxnard area. About one-half of the sites are five acres or larger in size on up to about 100 acres.

Land use in the four parts of this WMA trends heavily to either open space or urban uses as shown in the figure below.

Land Use in the Miscellaneous Ventura Coastal Watershed Management Area



The table below lists the 2006 303(d) list of water quality impairments:.

Water Quality Limited Segment Name	Pollutant
Channel Islands Harbor	Lead (sediment) Zinc (sediment)
Channel Islands Harbor Beach	Indicator bacteria
Hobie Beach (Channel Islands Harbor)	Indicator bacteria
McGrath Beach	Coliform Bacteria
McGrath Lake	Chlordane (sediment) DDT (sediment) Dieldrin (sediment) Fecal Coliform PCBs Sediment Toxicity
Ormond Beach (3 segments: J St; Oxnard Drain; Arnold Rd)	Indicator bacteria
Peninsula Beach (Area affected is beach area north of South Jetty)	Indicator bacteria

Port Hueneme Harbor (Back Basins)	DDT (tissue) PCBs
Port Hueneme Pier	PCBs
Rincon Beach (Area affected is 50 and 150 yards south of mouth of Rincon Creek, and at the end of the footpath)	Indicator bacteria
San Buenaventura Beach (4 segments/drains: Kalorama; San Jon Rd; Dover Ln; Weymouth)	Indicator bacteria
Ventura Harbor: Ventura Keys	Coliform Bacteria
Ventura Marina Jetties	DDT PCBs

CURRENTLY SCHEDULED TMDLS

- pesticides (Ventura Marina)-FY08/09
- coliform (Ventura Marina)-FY08/09

Stakeholder Group

Ormond Beach Task Force Ormond Beach is part of the Miscellaneous Ventura Coastal WMA; the area includes a somewhat degraded wetlands a large part of which has recently been acquired by the State for protection and restoration planning which has begun. The Task Force was formed in 1993 and currently meets monthly to address issues and projects which may affect the beach and wetlands.

Past Significant Activities

NONPOINT SOURCE

A recently concluded project funded by CWA Section 319(h) funds involved demonstrated advanced treatment processes of nutrients and pathogens utilizing septic systems.

MONITORING AND ASSESSMENT

SWAMP: SWAMP monitoring of the Miscellaneous Ventura Coastal Watershed Management Area occurred during FY 2005/2006. Monitoring sites included 4 sampling stations in Port Hueneme, 4 sampling stations in Ventura Marina/Ventura Keys and 5 sampling stations in Channel Islands Harbor/Mandalay Bay (benthic infaunal community, sediment chemistry, sediment toxicity), as well as a total of 17 sampling stations within coastal streams (bioassessment, water column toxicity, water column chemistry). No SWAMP monitoring of the coastal waters of the watershed management area occurred as this area has been sampled by the Bight-wide comprehensive monitoring projects conducted in 1994, 1998 and 2003.

McGrath Lake: A Consent Decree established a settlement with the responsible party in a 1993 crude oil spill. The settlement created a Trustee Council (California Department of Fish and Game, U.S. Fish and Wildlife Service, and California Department of Parks and Recreation) to determine how to spend $1.315 million targeted for natural resource restoration.

The Trustee Council formally requested assistance from the Regional Board to perform a study to characterize the water quality and sediments within the lake, as well as sources of contaminant inputs to the lake. The main objectives of the study were to determine whether it would be necessary or beneficial to dredge the lake to remove contaminated sediments, and whether it would be beneficial to spend funds on habitat improvement projects in and around the lake, given the ongoing potential contaminant inputs and uncontrolled water management activities. The Regional Board funded the characterization study (contributing $100,000) using some of the money the Board received from the oil spill settlement.

A preliminary study was conducted in August 1998 to aid in selection of sampling sites for the characterization study. The characterization study was conducted in October 1998 and included:

1) water quality measurements at several locations in the lake (temperature, dissolved oxygen, pH, and nutrient data)
2) surficial sediment samples at 10 stations in the lake will be analyzed for grain size, sediment chemistry (pesticides, petroleum hydrocarbons, metals) and sediment toxicity
3) deep sediment cores at 7 stations in the lake will be subsampled for sediment chemistry analyses
4) water column measurements at one station in an agricultural drain entering the lake (pesticides, metals, and nutrients)
5) sediment chemistry (pesticides and metals) at 2 stations in agricultural drains

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has funded an acquisition project in the WMA, the Ormond Beach Edison Acquisition..

Current Activities

CORE REGULATORY

Continuing core regulatory activities that will be integrated into the watershed management approach include (but are not limited to) necessary renewal/revision of NPDES permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue.

Additionally, most urban areas in Ventura County, including this watershed, are implementing Best Management Practices (BMPs) under the Municipal Storm Water Permit (revised in 2000). The “Discharger” consists of the co-permittees Ventura County Flood Control District, the County of Ventura, and the Cities of Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, San Buenaventura, Santa Paula, Simi Valley, and Thousand Oaks. The Discharger is required to implement the Ventura Countywide Stormwater Quality Urban Impact Mitigation Plan (SQUIMP), which requires the implementation of BMPs to reduce the discharge of pollutants in storm water from new development and significant redevelopment. Other requirements of the Municipal Storm Water Permit include a public education program, an educational site inspection program for industrial and commercial facilities, program for construction sites, public agency activities, and a storm water monitoring program.

The storm water monitoring program has consisted of land-use based monitoring, receiving water and mass emission station monitoring, and bioassessment. The Discharger also participates in regional monitoring activities, such as the Storm Water Monitoring Coalition, organized by the Southern California Coastal Water Research Project. Furthermore, the Discharger participates in the development and implementation of volunteer monitoring programs in the Ventura Coastal watersheds.

The Miscellaneous Ventura Coastal WMA receives municipal storm drain discharges from the City of Oxnard (part), City of Port Hueneme, and City of San Buenaventura (part).

MONITORING AND ASSESSMENT

The monitoring needs in this WMA include staff to evaluate coastal receiving water data, sediment data analysis and interpretation, resources to integrate surface and ground water data, and resources to evaluate other information (e.g., pesticide and fertilizer use databases as well as those for grower/crop and crop timing).

McGrath Lake: The characterization study previously conducted demonstrated widespread sediment contamination throughout most of the lake, including high concentrations of several trace metals and pesticides. Due to likely long delays in adequate funding for cleanup of contaminated sediments, the Trustee has decided to proceed with restoration planning and released a draft restoration plan in summer 2004.

Shoreline: Beginning in 1999, a new law (AB411) requires public health officials in coastal counties to conduct weekly testing, between April 1 and October 31, at beaches visited annually by more than 50,000 people and at adjacent storm drains (including natural creeks, streams, and rivers, that flow during the summer. Due to the popularity of Ventura County beaches for year-round activities, the Ventura County Board of Supervisors authorized the implementation of a program that expanded the monitoring program to all 12 months of the year. Ventura County Environmental Health Department conducts weekly surf zone sampling at 52 beach locations for total and fecal coliform and enterococcus. Data will be reviewed by the Regional Board and used to assess current conditions of Ventura County beaches for future 305(b) reports. Monitoring results are at posted at http://www.ventura.org/env_hlth/ocean.htm.

Open Coastline: Our source of data for the coastal areas comes chiefly from the one POTW and two generating stations which discharge offshore as well as regional data from Bight'98 and the 1994 SCBPP. These data support compliance evaluation.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has listed additional acquisitions in the Ormond Beach Wetlands area and preparation of a restoration plan as priority projects for funding on the current workplan. Development of the restoration plan is underway. Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting

TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

NONPOINT SOURCE PROGRAM

We are encouraging application for Proposition 13 funding for use in preparation of a watershed management plan for this watershed management area.

Groundwater

The Oxnard Forebay is a prime groundwater recharge area that is impacted by nitrogen discharges, mainly from densely populated communities using septic systems, and agricultural areas. The Regional Board undertook a study of septic systems in the area during FY98/99; in August 1999 the Board adopted a Basin Plan amendment to prohibit septic systems in the Oxnard Forebay. The amendment immediately prohibits the installation of new septic systems or the expansion of existing septic systems on lot sizes of less than five acres. Discharges from septic systems on lot sizes of less than five acres must cease by January 1, 2008. This prohibition will affect up to 3,000 septic systems and ten to fifteen thousand people. The County of Ventura has applied for Small Community Grant funding to provide adequate sewage treatment on behalf of the Saticoy and El Rio communities.

Another **319(h)** project is underway which also involves septic tanks. This project involves the evaluation of several systems for nutrient removal.

A well head protection and demonstration project in the Fox Canyon Groundwater Management Area is being funded with **319(h)** monies. This project is destroying disused drinking water wells which may serve as a conduit for contamination to reach the deep water aquifer.

Currently under consideration are agreements with sister agencies in regulatory-based encouragement of Best Management Practices. Most notably is the use of a GIS layer for pesticides application available from the Department of Pesticide Regulation (DPR). Reduction of pesticides identified as contaminants of concern for a watershed might be addressed through a Management Agency Agreement (MAA) with the DPR, or through waiving adoption of waste discharge requirements on an individual basis using information gathered in databases provided by the Ventura County Agricultural Commission office.

Marinas

There are a number of marinas in this WMA, all with well-documented levels and types of pollution consistent with nonpoint sources. We have initiated enforcement actions on several commercial fishing operations to ensure compliance with state discharge requirements. We will be focusing our 319(h) priorities for the upcoming application period on a number of areas of concern in the Region including development of education and outreach programs and implementation of management measures which are intended to reduce pollution from these nonpoint sources in marinas. A particular area of concern in Port Hueneme has been management of squid wastes from fishing vessels.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

Most watershed programs look to the Regional Board as the information management agency for the collected data. To meet that need, we require additional resources related to data management and interpretation. Some of the expenditures under NPDES support the monitoring that will ultimately be used to identify and quantify nonpoint source inputs.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures as well as other outreach activities such as speeches, meetings, and participation in environmental events. With additional resources we propose conducting a number of education and outreach activities including holding regional workshops and conferences with other Regional Boards as well as experts in the field, contacting marina operators individually, and offering an incentives program.

Potential Long-term Activities

Arundell Barranca: The Regional Board staff have been approached by the City of San Buenaventura for input on a potential project to re-route the Arundell Barranca from Ventura Harbor to the Santa Clara River estuary. The proposal calls for a constructed wetlands near the estuary to treat the Barranca's water before entering the Santa Clara River. The project is proposed as a method of dealing with periodic coliform exceedances in areas of the Ventura Harbor/Ventura Keys.

Seawater Intrusion into the Oxnard Plain: The City of Oxnard is attempting to remove high TDS inputs to their treatment plant with the ultimate goal of reuse of the wastewater for a seawater intrusion barrier project in the Oxnard Plain.

Implementation of watershed-wide biological monitoring: This is a long-term goal for all of our watersheds.

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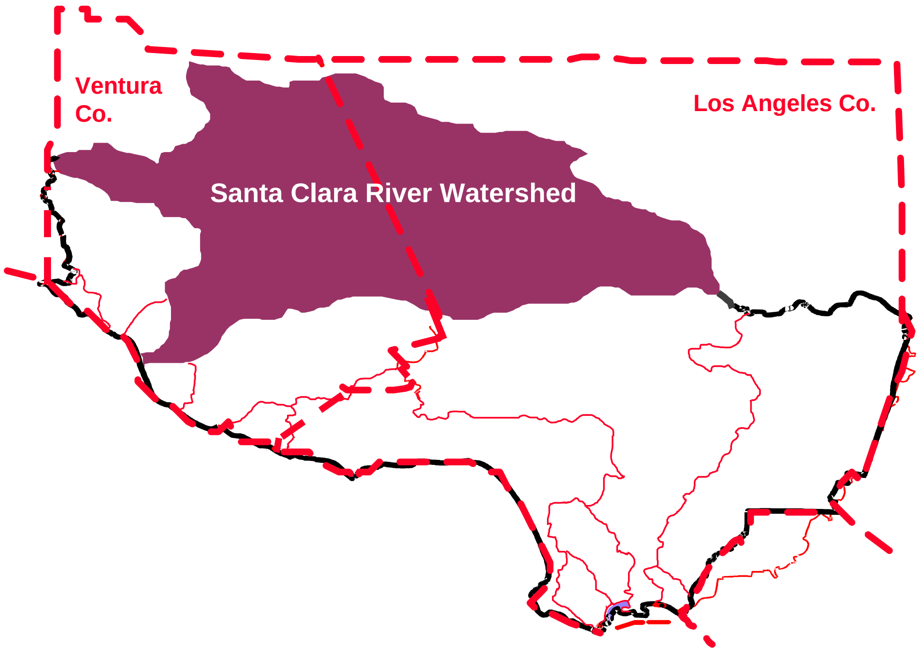
2.9 SANTA CLARA RIVER WATERSHED

This watershed will be targeted in FY2011/2012.

Overview of Watershed

Size of watershed: approximately 1,200 sq. mi.

Length of river: approximately 100 miles



The Santa Clara River is the largest river system in southern California that remains in a relatively natural state; this is a high quality natural resource for much of its length. The river originates in the northern slope of the San Gabriel Mountains in Los Angeles County, traverses Ventura County, and flows into the Pacific Ocean halfway between the cities of San Buenaventura and Oxnard.

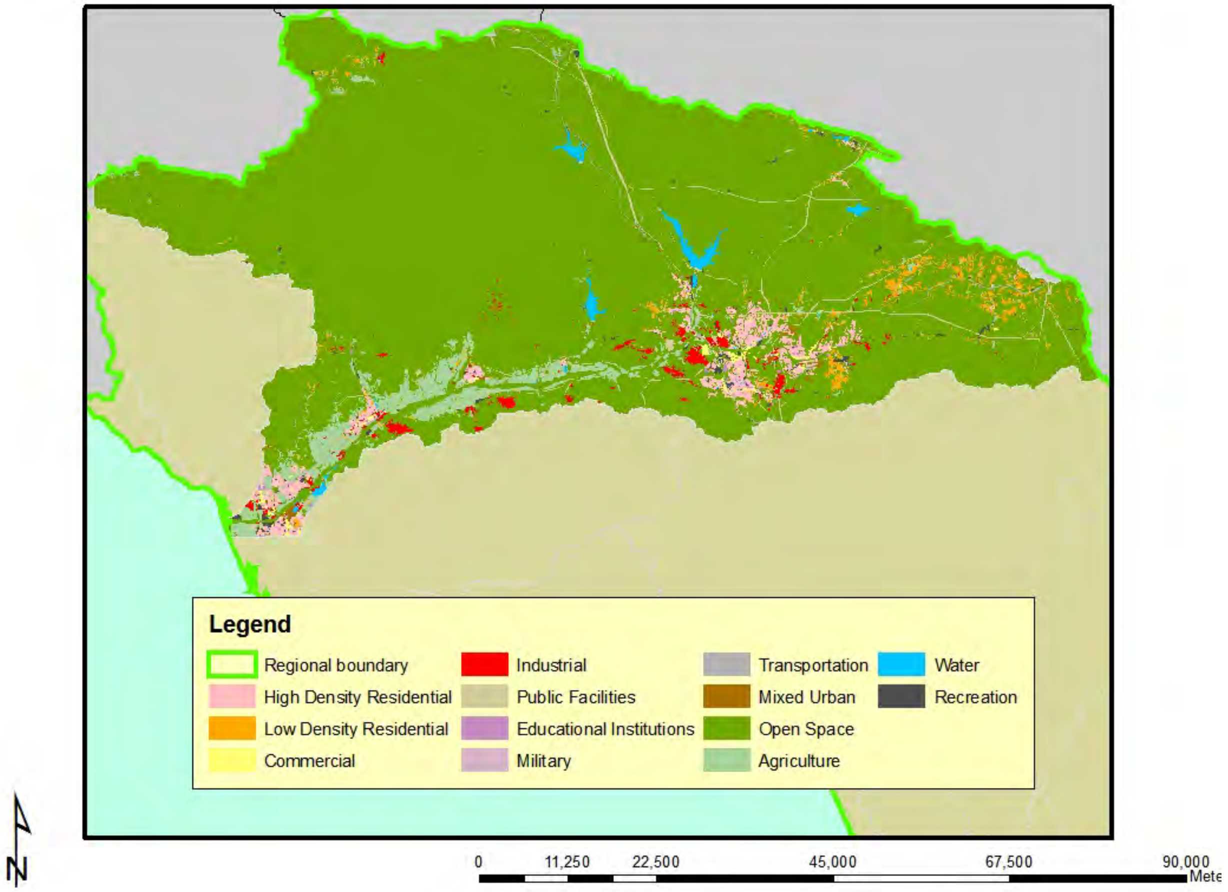
Extensive patches of high quality riparian habitat are present along the length of the river and its tributaries. The endangered fish, the unarmored stickleback, is resident in the river. One of the largest of the Santa Clara River's tributaries, Sespe Creek, is designated a wild trout stream by the state of California and supports significant spawning and rearing habitat. The Sespe Creek is also designated a wild and scenic river. Piru and Santa Paula Creeks, which are tributaries to the Santa Clara River, also support good habitats for steelhead. In addition, the river serves as an important wildlife corridor. A lagoon exists at the mouth of the river and supports a large variety of wildlife.

Beneficial Uses in watershed:

Estuary	*Above Estuary*
Contact & noncontact water recreation	Contact & noncontact water recreation
Wildlife habitat	Wildlife habitat
Preservation of rare & endangered species	Preservation of rare & endangered species
Migratory habitat	Migratory habitat
Wetlands habitat	Wetlands habitat
Spawning habitat	Municipal supply
Estuarine habitat	Industrial service supply
Marine habitat	Industrial process supply
Navigation	Agricultural supply
Commercial & sportfishing	Groundwater recharge
	Freshwater replenishment
	Warmwater habitat
	Coldwater habitat

Land use is predominately open space with the mainstem of the river residential, agriculture, and some industrial uses as shown in the following figure.

Land Use in the Santa Clara River Watershed



Water Quality Problems and Issues

Increasing loads of nitrogen and salts in supplies of ground water threaten beneficial uses including irrigation and drinking water. Other threats to water quality include increasing development in floodplain areas which has necessitated flood control measures such as channelization that results in increased runoff volumes and velocities, erosion, and loss of habitat. In many of these highly disturbed areas the exotic giant reed (*Arundo donax*) is gaining a foothold.

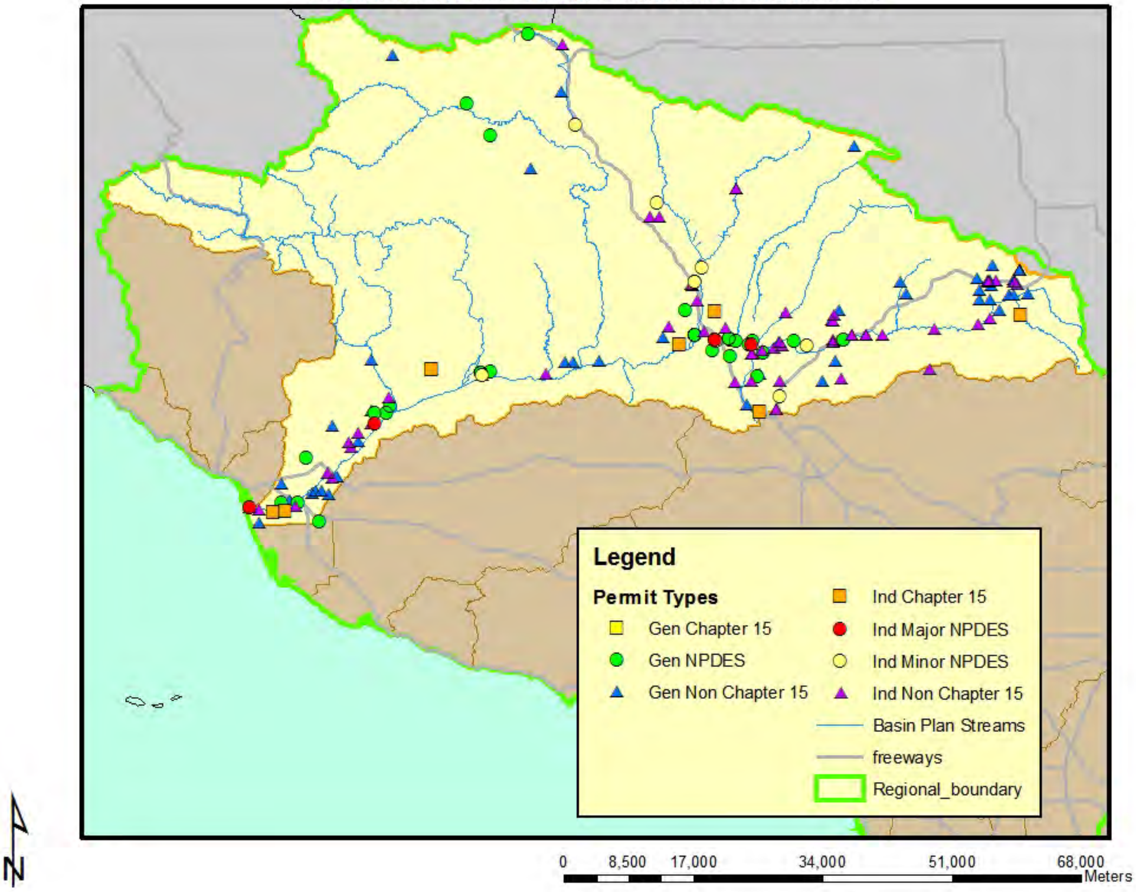
Permitted discharges:

- 60 NPDES discharges
- Four major discharges (POTWs, (one discharging to estuary, one to middle reaches, two into upper watershed)
- 8 minor NPDES discharges
- 48 discharges covered under general permits
- 114 dischargers covered under the industrial storm water permit
- 367 dischargers covered under the construction storm water permit

While there are several small POTWs in the Ventura County portion of the watershed and two larger POTWs in the upper watershed, many of the smaller communities in the watershed remain unsewered. In particular, in the Agua Dulce area of the upper watershed, impacts on drinking water wells from septic tanks is a major concern. The community is undertaking a wellhead protection effort, with oversight by Board staff. Development pressure, particularly in the upper watershed, threatens habitat and the water quality of the river. The effects of septic system use in the Oxnard Forebay area is also of concern.

The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

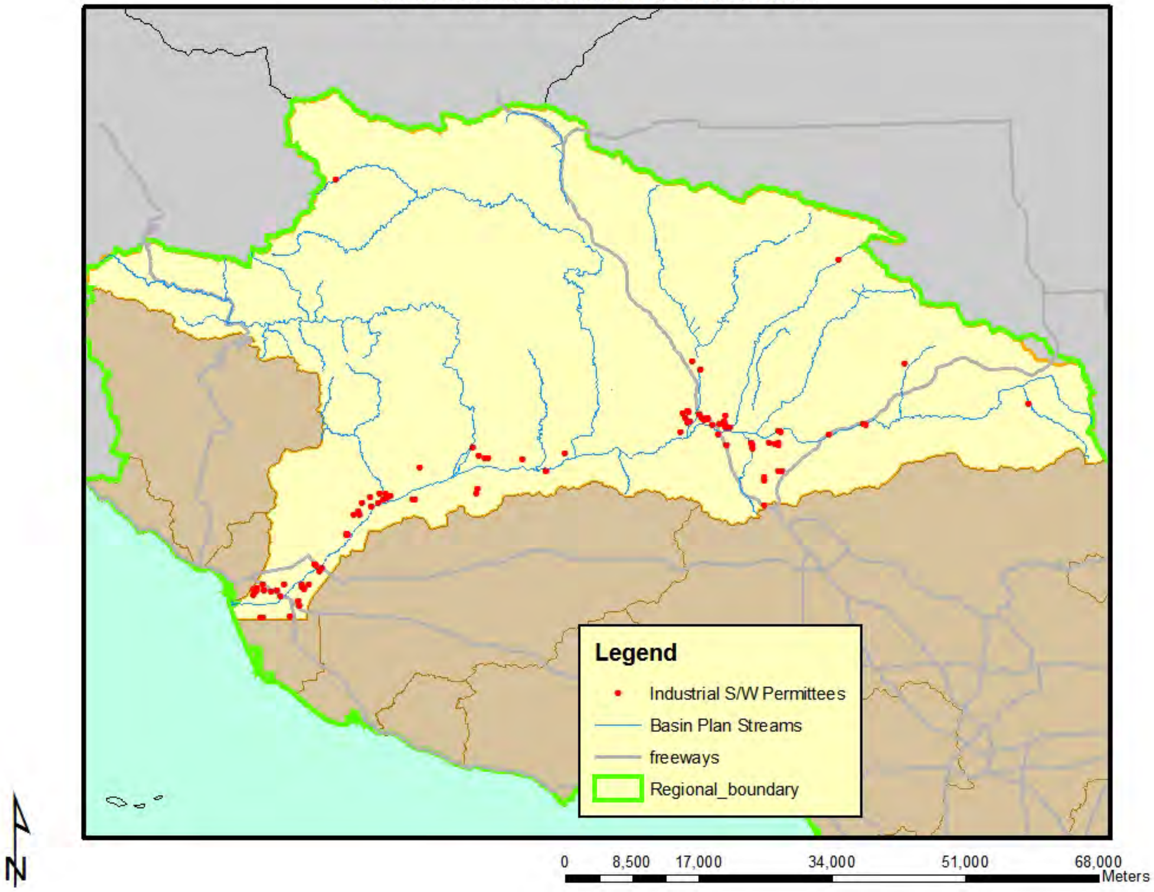
NPDES, Non-Chapter 15, and Chapter 15 Discharger
Locations in the Santa Clara River Watershed



Most of the 60 NPDES discharges are to the mainstem of the Santa Clara River while the rest discharge to various tributaries or lakes.

Of the 125 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Santa Clarita, Santa Paula and Valencia. There is a wide array of businesses represented with wholesale trade-durable goods; trucking and warehousing; stone, clay and glass products; and nonmetallic minerals, except fuels, dominating based on their Standard Industrial Classification (SIC) codes. A similar number of sites are located in the upper and lower watershed. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.

Locations of Dischargers Covered by General Industrial Stormwater Permit in the Santa Clara River Watershed



There are currently 367 sites enrolled under the general construction storm water permit; the majority of these sites are located in the upper watershed, especially within the cities of Santa Clarita and Valencia. Other clusters of construction occur in the cities of Santa Paula and Fillmore, as well as, near the coast. About one-half of the sites are residential and about two-thirds are five acres or greater in size with four sites being at least 1,000 acres.

IMPAIRMENTS: The Santa Clara River Estuary and Beach is on the 2006 303(d) list for coliform while a portion of the river upstream of the estuary is listed for ammonia and coliform. Portions of the river have chloride exceedances. Two small lakes in the watershed are also on the 303(d) list for eutrophication, trash, DO, and pH problems. Two major spills of crude oil into the river occurred in the early 1990s although recovery has been helped somewhat by winter flooding events. Natural oil seeps discharge significant amounts of oil into Santa Paula Creek.

The table below lists the 2006 303(d) impairments:

Water Quality Limited Segment Name	Pollutant
Brown Barranca/Long Canyon	Nitrate and Nitrite[1]
Elizabeth Lake	Eutrophic Organic Enrichment/Low Dissolved Oxygen pH Trash
Hopper Creek	Sulfates Total Dissolved Solids
Lake Hughes	Algae Eutrophic Fish Kills Odor Trash
Mint Canyon Creek Reach 1 (Confl to Rowler Cyn)	Nitrate and Nitrite[1]
Munz Lake	Eutrophic Trash
Piru Creek (from gauging station below Santa Felicia Dam to headwaters)	Chloride pH pH
Pole Creek (trib to Santa Clara River Reach 3)	Sulfates Total Dissolved Solids
Santa Clara River Estuary	ChemA[*] Coliform Bacteria Toxaphene
Santa Clara River Reach 1 (Estuary to Hwy 101 Bridge)	Toxicity
Santa Clara River Reach 3 (Freeman Diversion to A Street)	Total Dissolved Solids Ammonia[1] Chloride[2]
Santa Clara River Reach 5 (Blue Cut gauging station to West Pier Hwy 99 Bridge) (was named Santa Clara River Reach 7 on 2002 303(d) list)	Coliform Bacteria Chloride[3]
Santa Clara River Reach 6 (W Pier Hwy 99 to Bouquet Cyn Rd) (was named Santa Clara River Reach 8 on 2002 303(d) list)	Chlorpyrifos Coliform Bacteria

	Diazinon Toxicity Chloride[3]
Santa Clara River Reach 7 (Bouquet Canyon Rd to above Lang Gaging Station) (was named Santa Clara River Reach 9 on 2002 303(d) list)	Coliform Bacteria
Santa Clara River Reach 11 (Piru Creek, from confluence with Santa Clara River Reach 4 to gauging station below Santa Felicia Dam)	Boron Sulfates
Sespe Creek (from 500 ft below confluence with Little Sespe Cr to headwaters)	Chloride pH
Torrey Canyon Creek	Nitrate and Nitrite[1]
Wheeler Canyon/Todd Barranca	Sulfates Total Dissolved Solids Nitrate and Nitrite[1]

*ChemA refers to the sum of the chemicals aldrin, dieldrin. Chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

[1] Santa Clara River Nutrients TMDL, 2004

[2] TMDL completed by USEPA in 2003

[3] Upper Santa Clara River Chloride TMDL, 2005

Stakeholder Groups

Santa Clara River Watershed Committee The group was formed to aid with development of the IRWMP as one of three watershed groups in the Ventura County water management area.

Friends of the Santa Clara River This non-profit stakeholder group has been involved with watershed activities along the length of the river with a focus on the protection, enhancement, and management of the river's resources. More information about this group may be found at their website http://www.FSCR.org.

Santa Clarita Organization for Planning the Environment (SCOPE) This group has been involved with educating the public about planning and environmental issues, including those involving the river, particularly in the area around the Santa Clarita Valley. More information about this group may be found at their website http://www.scope.org/.

Santa Clara Estuary Work Group This group has been meeting over the past year and includes staff from the Regional Board, California Department of Fish and Game, California State Parks - Channel Coast District, and the Ventura Water Reclamation Plant. A Natural Resources Management Plan is being prepared for the State Parks land in and around the estuary and these entities are most involved with water quality and habitat issues as well as monitoring.

Significant Past Activities

Santa Clara River Enhancement and Management Plan (SCREMP) development evolved as the result of the efforts of former Ventura County Supervisor Maggie Kildee, representatives of the Ventura Office of the U.S. Fish and Wildlife Service, and grant funding provided by the State Coastal

Conservancy. As far back as 1991, it was becoming apparent that the many proposed and conflicting uses of the river were heading for problems of rather large proportions unless the agencies that regulated the river and the various stakeholders along the river agreed on a consensus plan to manage the river and its resources. The increasingly complex regulatory process along the river, involving protection of river ecology and natural processes, was becoming a more difficult environment for stakeholders wishing to stabilize banks, develop urban projects, or mine river aggregate deposits. The river is a very complex natural system and agencies had been forced to be very conservative in analysis of projects because of incomplete understanding of the river's ecological processes. The options were to keep doing business-as-usual approaches, or to work together to develop a coordinated conservation plan for the river. Therefore, in 1991, Supervisor Kildee invited all concerned parties to participate in initiating the Plan. A Project Steering Committee was formed. Since that time, funding for consulting services associated with Plan development were provided by the Coastal Conservancy, the State Wildlife Conservation Board, the U.S. Fish and Wildlife Service, the Cities of Santa Clarita and San Buenaventura, and both Ventura and Los Angeles County Flood Control Districts. In addition, a great deal of staff time and in-kind services were contributed to this planning effort. This project also formed the primary basis for nomination of the Santa Clara River as an American Heritage River which ultimately was not successful.

The Steering Committee began by identifying the river's critical issue areas. Reports were developed by subcommittees that provide background information, goals and recommendations for the river on the issue areas. A series of computer-based maps have been produced, which are currently being used in a Geographic Information Systems (GIS) overlay process to identify conflicts and opportunities and facilitate decisions regarding use of the river floodplain.

The Steering Committee initially identified nine main categories of critical resource issue areas and, over the past two years, subcommittees covering Biological Resources, Recreation, Water Resources, and Aggregate Mining have each developed reports providing background information, and goals and recommendations for their respective areas. In addition, two reports covering the History of the Santa Clara River and the Cultural Resources of the River have been published.

In April 1999, the Project Steering Committee released preliminary river-wide and reach-specific recommendations for public comment. River-wide recommendations include those involving issues such as public outreach, private property rights, water quality, water rights, saltwater intrusion, water supply, river gradient, public flood protection facilities, maintenance of design flow capacity, private flood protection, cultural resource protection, fish passage, habitat conservation priorities, biological management, control of exotics, biological mitigation, public access and recreation, recreational property acquisition, and permit streamlining.

The group has also developed draft resource-based ranking criteria for parcel acquisition. There is one such parcel acquisition, funded by the State Coastal Conservancy, currently being pursued. The proposed acquisition includes 213 acres of river bottom, river terrace, and riparian habitat. Staff will remain involved with the Plan's development and implementation. During the fall of 1999, the Project Steering Committee reviewed proposals from consultants to prepare a CEQA document for the Plan for the river.

One downside to this effort is that the study and plan were limited to the mainstem of the river, not the tributaries or other watershed areas outside of the 100-year floodplain. If additional resources can be found, the study area can be expanded throughout the watershed. This will increase the chance of successful protection of this watershed. A public review draft of the Santa Clara River Enhancement and Management Plan (SCREMP) is available http://sdgis.amec.com/scremp/index.htm.

Other important community-based efforts include Ventura County's Agriculture Policy Working Group's Agricultural Land Preservation Program, the Heritage Valley Tourism Development Program, Santa Clara River Valley Historic/Cultural Preservation Programs and the City of Santa Clarita's River Corridor Plan.

In 1990, the Regional Board adopted Resolution No. 90-004 (**Drought Policy**) which had a term of three years and provided interim relief to dischargers who experienced difficulty meeting chloride objectives because of a state-wide drought. The policy adjusted effluent limits to the lesser of 1) 250 mg/l or 2) the chloride concentration in the water supply plus 85 mg/l. In 1995, the Regional Board extended the interim limits for three years and directed staff to develop a long-term solution to deal with the impact of changing water supply, especially during droughts. In 1997, the Regional Board adopted Resolution No. 97-002 (**Chloride Policy**) which set the chloride objective at 190 mg/l except in the Calleguas Creek and Santa Clara River Watersheds where, due to the great concern for protection of agriculture, staff were directed to determine the chloride concentrations sufficient to protect agricultural beneficial uses. Chloride impairments in certain reaches of the river initially led to formation of a chloride committee to conduct a chloride TMDL. This stemmed from issues raised during development of the chloride policy for the region. Growers expressed concerned about increased chloride and effects on salt-sensitive crops, such as avocados. Staff went to the Board in December 2000 with two resolutions: one to extend the interim chloride limitation for discharges to the river until December 7, 2001; the other to amend the Basin Plan chloride objective for certain reaches in the river. The Board adopted the extension of the interim limitation at the December meeting, raised the Basin Plan objectives in Reach #3 from 80 to 100 mg/l, and determined the chloride objective for chloride in reaches #7 and #8 should remain unchanged from 100 mg/l. Reaches #3, #7, and #8 are currently 303(d)-listed for chloride. Reach #3, now with a higher objective for chloride, was still listed as impaired for chlorides in the 2002 303(d) list. The Board has directed staff to complete a chloride TMDL on Reaches #7 and #8 in a timely manner.

California State University, Fullerton, under contract with the Regional Board, completed a **GIS-based project** in the watershed during 2001 which involved verifying with Global Positioning Satellite (GPS) previous Regional Board sampling locations in the river. Digital photos and video of the locations were also taken and aerial photos were also taken. This information will augment the existing Regional Board GIS for that watershed.

UCLA was under contract with the State Board to provide data needed for establishment of **nutrient TMDLs** in several watersheds within the Region including Calleguas Creek, Santa Clara River, and Malibu Creek. By understanding the inter-relationships between water quality and habitat condition and the resulting effects that these interactions have on the biological communities of coastal watersheds, it was anticipated this research would further our understanding of the ecology of southern California watersheds. Besides providing information supporting the establishment of nutrient TMDLs for these three impaired coastal watersheds, the data collected were intended to provide insight into how these TMDLs might be complied with in the future. Three specific objectives of this project were: 1) investigate the relationships between water quality (e.g. nutrients), habitat quality, and the biological community, 2) investigate how water quality and biological communities change throughout particular target reaches representing different land uses, and 3) compare the relationships between water quality, habitat quality, and biological communities among different watersheds. The work was a continuation and extension of a Regional Environmental Monitoring and Assessment Program (R-EMAP) project in the Calleguas Creek Watershed. R-EMAP us part of a larger national effort by the USEPA to assess the condition of the nation's ecological resources.

SWAMP monitoring mostly occurred in FY 2000/2001 although due to less than average or no flows at many locations, sampling was delayed at some sites until FY 2001/2002. Samples were collected at thirty random sites plus one directed site (Blue Cut) for toxicity, bioassessment, conventional water chemistry. Six directed sites (at base of each of six main subwatersheds) were sampled for toxicity, bioassessment, conventional water chemistry, bioaccumulation, metals chemistry in water column and sediment, sediment grain size, and ELISA testing for chlorpyrifos and diazinon. One estuary station was sampled for the same parameters as the six directed sites, plus trace organic chemistry in sediment.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Santa Clara River Watershed.

CORE REGULATORY

Continuing core regulatory activities that will be integrated into the watershed management approach include (but are not limited to) necessary renewal/revision of NPDES permits and issuance of new permits. Compliance inspections, review of monitoring reports, response to complaints, and enforcement actions relative to the watershed's NPDES permits will continue.

The one POTW discharging to the estuary conducted a limited-term receiving monitoring program to investigate whether toxic constituents (to be regulated under the CA Toxics Rule) are accumulating or bioaccumulating in the estuary. More work is planned with regards to evaluating effects on the estuary.

Additionally, most urban areas in Ventura County, including this watershed, are implementing Best Management Practices (BMPs) under the Municipal Storm Water Permit (revised in 2000). The "Discharger" consists of the co-permittees Ventura County Flood Control District, the County of Ventura, and the Cities of Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, San Buenaventura, Santa Paula, Simi Valley, and Thousand Oaks. The Discharger is required to implement the Ventura Countywide Stormwater Quality Urban Impact Mitigation Plan (SQUIMP), which requires the implementation of BMPs to reduce the discharge of pollutants in storm water from new development and significant redevelopment. Other requirements of the Municipal Storm Water Permit include a public education program, an educational site inspection program for industrial and commercial facilities, program for construction sites, public agency activities, and a storm water monitoring program.

The storm water monitoring program has consisted of land-use based monitoring, receiving water and mass emission station monitoring, and bioassessment. The Discharger also participates in regional monitoring activities, such as the Storm Water Monitoring Coalition, organized by the Southern California Coastal Water Research Project. Furthermore, the Discharger participates in the development and implementation of volunteer monitoring programs in the Ventura Coastal watersheds.

The Santa Clara River receives municipal storm drain discharges from the City of Fillmore, City of Oxnard (part), City of San Buenaventura (part), City of Santa Paula, and unincorporated Ventura County (part).

MONITORING AND ASSESSMENT

The upper Santa Clara River is monitored by the County Sanitation Districts of Los Angeles County under NPDES permits for the Saugus and Valencia treatment plants. Somewhat downstream, between the towns of Piru and Saticoy, water quality in the surface and groundwater is monitored by United Water Conservation District. Mid-river receiving water data is provided by the City of Santa Paula treatment plant under an NPDES permit and occasionally by the City of Fillmore when they discharge to surface waters under an NPDES permit. Otherwise, the City of Fillmore provides groundwater data that has not yet been integrated into the watershed picture. At the river's terminus, some water quality data is available from the City of San Buenaventura under NPDES permit for discharge to ponds adjacent to the river. The monitoring supports compliance evaluation; it is not part of a program for nonpoint source identification or TMDL development. In conjunction with the receiving water monitoring, land-use based monitoring is carried out as part of the Ventura County Municipal Storm Water Program. There is a long stretch of the middle river (surrounded by private property) that has had little to no monitoring because of limited access.

Related to the SCREMP, Clean Water Act Section 205(j) grant monies were awarded to the Ventura County Watershed Protection District for development of a comprehensive river monitoring plan. While the framework for a comprehensive monitoring program is in place, more work will be needed to finalize the monitoring plan and assign monitoring site responsibilities. Additionally, an Army Corps of Engineers-sponsored watershed-wide planning effort will begin which will follow up on the intensive effort put into river corridor planning.

Ground water data are being collected by a number of agencies and should be compiled by the Fox Canyon Groundwater Management Agency. We should be acquiring some of this data over the next two years for use in our analysis of the Oxnard Plain nonpoint source contamination problems.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has listed the Hedrick Ranch Nature Area Restoration Project on the current workplan and acquisitions for the Santa Clara River Parkway as a high priority project on the workplan. Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

The Santa Monica Mountains Conservancy is a state agency created by the Legislature in 1979 charged with primary responsibility for acquiring property with statewide and regional significance, and making those properties accessible to the general public. The Conservancy manages parkland in the Santa Monica Mountains, Santa Susana Mountains, the Simi Hills, the Santa Clarita Woodlands, the Whittier-Puente Hills, the Sierra Pelona, the Los Angeles River Greenway, the Rio Hondo, the Verdugo Mountains, the San Gabriel Mountains, and the San Rafael Hills. The agency's goals are to: 1) implement the Santa Monica Mountains Comprehensive Plan, 2) implement the Rim of the Valley Trails Corridor Master Plan, 3) implement the Los Angeles County River Master Plan, 4) further cooperation with local governments in the region to secure open space and parkland, and 5) expand education, public access, and resource stewardship components in a manner that best serves the public, protects habitat, and provides recreational opportunities.

NONPOINT SOURCE PROGRAM

Agriculture

There are a number of 303(d)-listed impairments in the watershed which may be attributable in part to agricultural practices, notably salts and nitrogen related as well as movement of historic pesticides. We will be focusing our agricultural grant priorities for the upcoming application period on a number of areas of concern in the Region including development of an agricultural "strategy", education and outreach programs and implementation of management measures relative to nutrient management and erosion control.

Groundwater

The Oxnard Forebay is a prime groundwater recharge area that is impacted by nitrogen discharges, mainly from densely populated communities using septic systems, and agricultural areas. The Regional Board undertook a study of septic systems in the area during FY98/99; in August 1999 the Board adopted a Basin Plan amendment to prohibit septic systems in the Oxnard Forebay. The amendment immediately prohibits the installation of new septic systems or the expansion of existing septic systems on lot sizes of less than five acres. Discharges from septic systems on lot sizes of less than five acres must cease by January 1, 2008. This prohibition will affect up to 3,000 septic systems and ten to fifteen thousand people.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

A preliminary review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

The Regional Board will remain involved with future phases of the Santa Clara River Enhancement and Management Plan effort.

Our efforts to involve stakeholders shall also include exploration of funding options (especially for implementation of nonpoint source measures) and continuation of other outreach activities, such as speeches, meetings, and participation in environmental events. We shall continue out involvement in the watershed group's efforts to develop and implement a watershed management plan.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures as well as other outreach activities such as speeches, meetings, and participation in environmental events. With additional resources we propose conducting a number of education and outreach activities including holding regional workshops and conferences with other Regional Boards as well as experts in the field. We also propose further refining our agricultural strategy to clearly delineate our goals and objectives with regards to reducing nonpoint source pollution from this sector and potential triggers for moving through the tiers.

The complexity of this watershed system, coupled with divergent goals among upstream developers, downstream farmers, and environmental interests, necessitate that extra planning resources be allocated to this watershed. It is imperative that the Regional Board actively participate in dialogue regarding water quality issues during the near-term, to ensure proper planning and development of the long-term projects that are being proposed. Among the various approaches that will be taken by the Regional Board is more active participation in CEQA and other planning efforts in this watershed to ensure protection of this valuable water resource, especially in light of the high growth projections in the floodplains and recharge areas of this watershed.

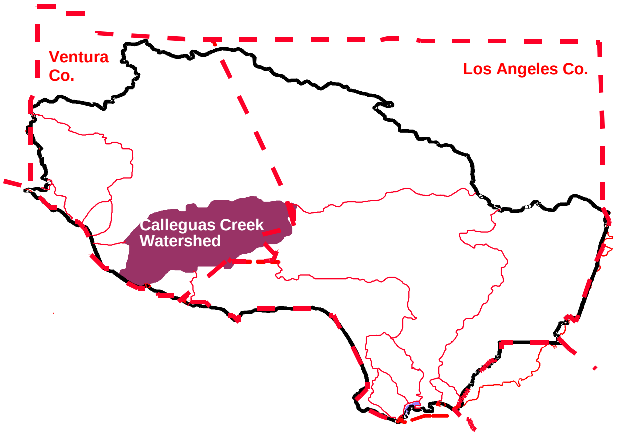
Potential Mid- to Long-term Activities

- Evaluation of potential impacts from mining in and around the river
- Evaluation of impacts from large-scale development in the upper river
- Identification of conflicts between ground water supply and water quality in lower watershed
- Identification of water quality and quantity issues for steelhead trout recovery
- Consideration of TMDL-related issues
- Implementation of watershed-wide biological monitoring which is a long-term goal for all of our watersheds

2.10 CALLEGUAS CREEK WATERSHED

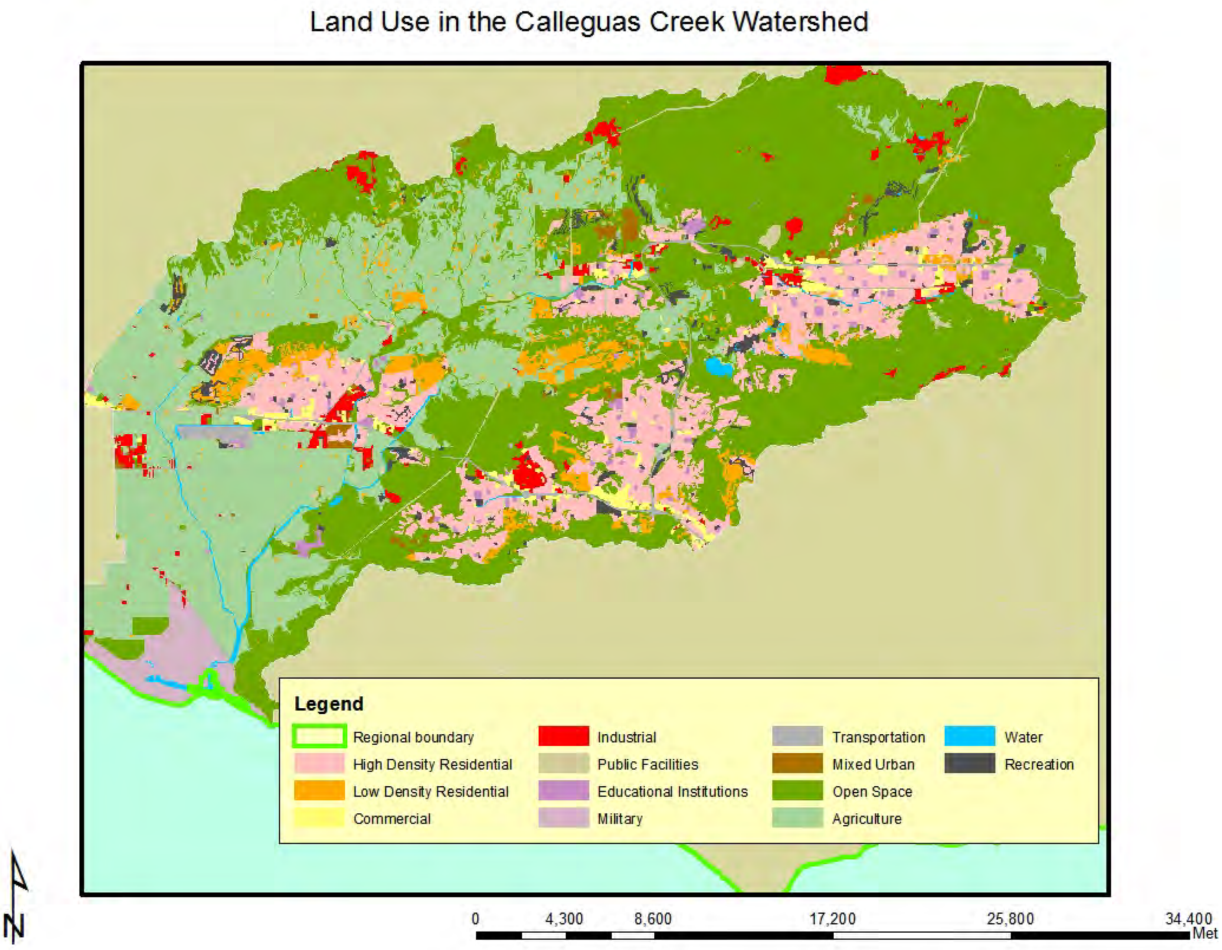
This watershed will be targeted in FY2011/2012.

Overview of Watershed



Calleguas Creek and its major tributaries, Revolon Slough, Conejo Creek, Arroyo Conejo, Arroyo Santa Rosa, and Arroyo Simi drain an area of 343 square miles in southern Ventura County and a small portion of western Los Angeles County. This watershed, which is elongated along an east-west axis, is about 30 miles long and 14 miles wide. The northern boundary of the watershed is formed by the Santa Susana Mountains, South Mountain, and Oak Ridge; the southern boundary is formed by the Simi Hills and Santa Monica Mountains.

Land uses vary throughout the watershed. Urban developments are generally restricted to the city limits of Simi Valley, Moorpark, Thousand Oaks, and Camarillo. Although some residential development has occurred along the slopes of the watershed, most upland areas are still open space; however, golf courses are becoming increasingly popular to locate in these open areas. Agricultural activities, primarily cultivation of orchards and row crops, are spread out along valleys and on the Oxnard Plain as shown in the figure below.



Mugu Lagoon, located at the mouth of the watershed, is one of the few remaining significant saltwater wetland habitats in southern California. The Point Mugu Naval Air Base is located in the immediate area and the surrounding Oxnard Plain supports a large variety of agricultural crops. These fields drain into ditches which either enter the lagoon directly or through Calleguas Creek and its tributaries. Other fields drain into tile drain systems which discharge to drains or creeks. Also in the area of the base are freshwater wetlands created on a seasonal basis to support duck hunting clubs. The lagoon borders on an Area of Special Biological Significance (ASBS) and supports a great diversity of wildlife including several endangered birds and one endangered plant species. Except for the military base, the lagoon area is relatively undeveloped.

Beneficial Uses in watershed:

Estuary	*Above Estuary*
Wildlife habitat	Wildlife habitat
Contact & noncontact water recreation	Contact & noncontact water recreation
Estuarine habitat	Industrial service supply
Marine habitat	Industrial process supply
Preservation of rare & endangered species	Preservation of rare & endangered species
Navigation	Agricultural supply
Preservation of biological habitats	Groundwater recharge
Wetlands habitat	Wetlands habitat
Migratory & spawning habitat	Freshwater replenishment
Shellfish harvesting	Warmwater habitat

Supplies of ground water are critical to agricultural operations and industry (sand and gravel mining) in this watershed. Moreover, much of the population in the watershed relies upon ground water for drinking.

Water Quality Problems and Issues

Aquatic life in both Mugu Lagoon and the inland streams of this watershed has been impacted by pollutants from nonpoint sources. DDT, PCBs, other pesticides, and some metals have been detected in both sediment and biota collected from surface waterbodies of this watershed. Additionally, ambient toxicity has been revealed in several studies from periodic toxicity testing in the watershed (ammonia from POTWs and pesticides such as diazinon and chlorpyrifos are implicated). Fish collected from Calleguas Creek and Revolon Slough exhibit skin lesions and have been found to have other histopathologic abnormalities. High levels of minerals and nitrates are common in the water column as well as in the groundwater. Sediment toxicity is also elevated in some parts of the lagoon. Reproduction is impaired in the resident endangered species, the light-footed clapper rail due to elevated levels of DDT and PCBs. Overall, this is a very impaired watershed. It appears that the sources of many of these pollutants are agricultural activities (mostly through continued disturbance and erosion of historically contaminated soils), which cover approximately 25% of the watershed along the inland valleys and coastal plain, although the nearby naval facility has also been a contributor. Other nonpoint sources include residential and urban activities, which are present over approximately 25% of the watershed. The remaining 50% of the watershed is still open space although there is a severe lack of benthic and riparian habitat.

Permitted discharges:

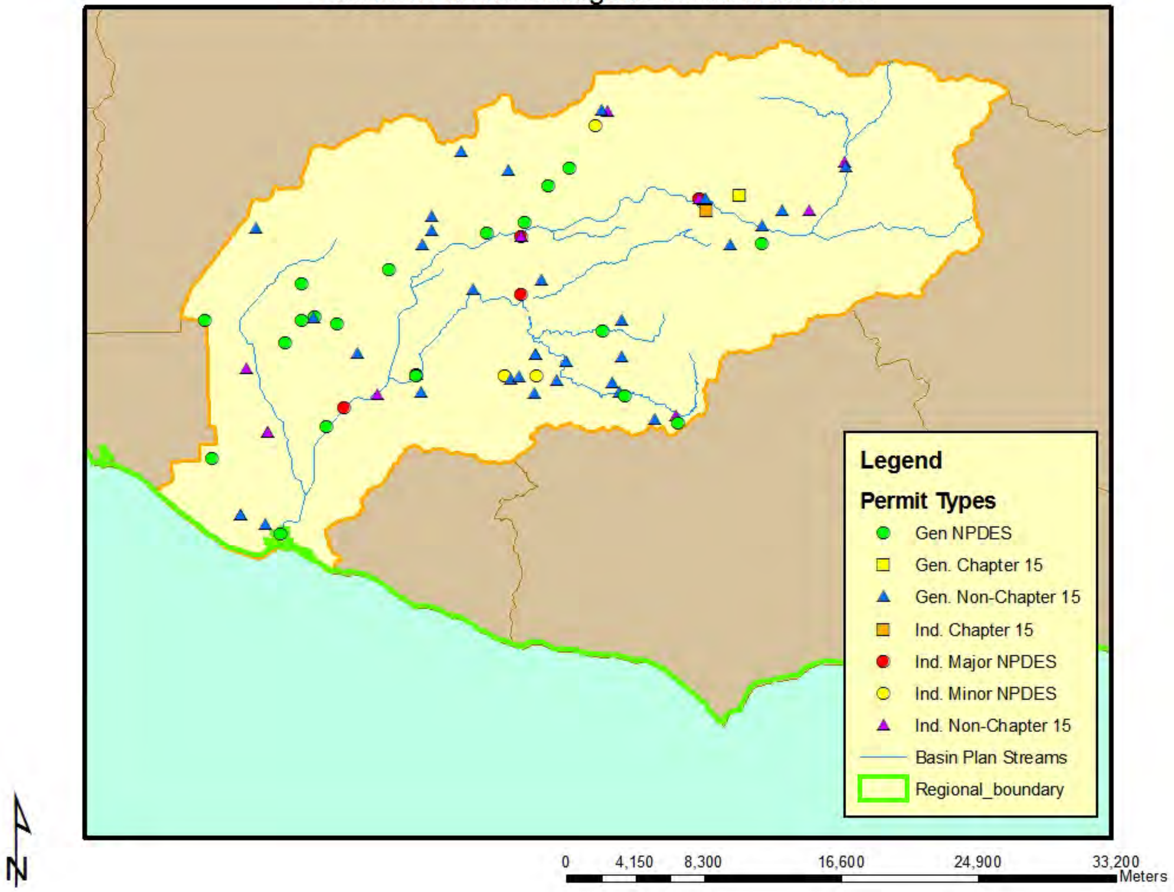
- 26 NPDES discharges; five major discharges (POTWs); three minor discharges; eighteen discharges covered by general permits
- 73 dischargers covered under the industrial storm water permit
- 292 dischargers covered under the construction storm water permit
- Municipal storm water permit

Mugu Lagoon as well as the Calleguas Creek Estuary is considered a toxic hot spot under the Bay Protection and Toxic Cleanup Program (BPTCP) due to reproductive impairment (the endangered clapper rail), exceedance of the state Office of Environmental and Health Hazard Assessment (OEHHA) advisory level for mercury in fish, and exceedance of the NAS guideline level for DDT in fish, sediment concentrations of DDT, PCB, chlordane, chlorpyrifos, sediment toxicity and degraded benthic infaunal community.

Primary issues related to POTW discharges include ammonia toxicity and high mineral content (i.e., salinity), the latter, in part, due to imported water supplies.

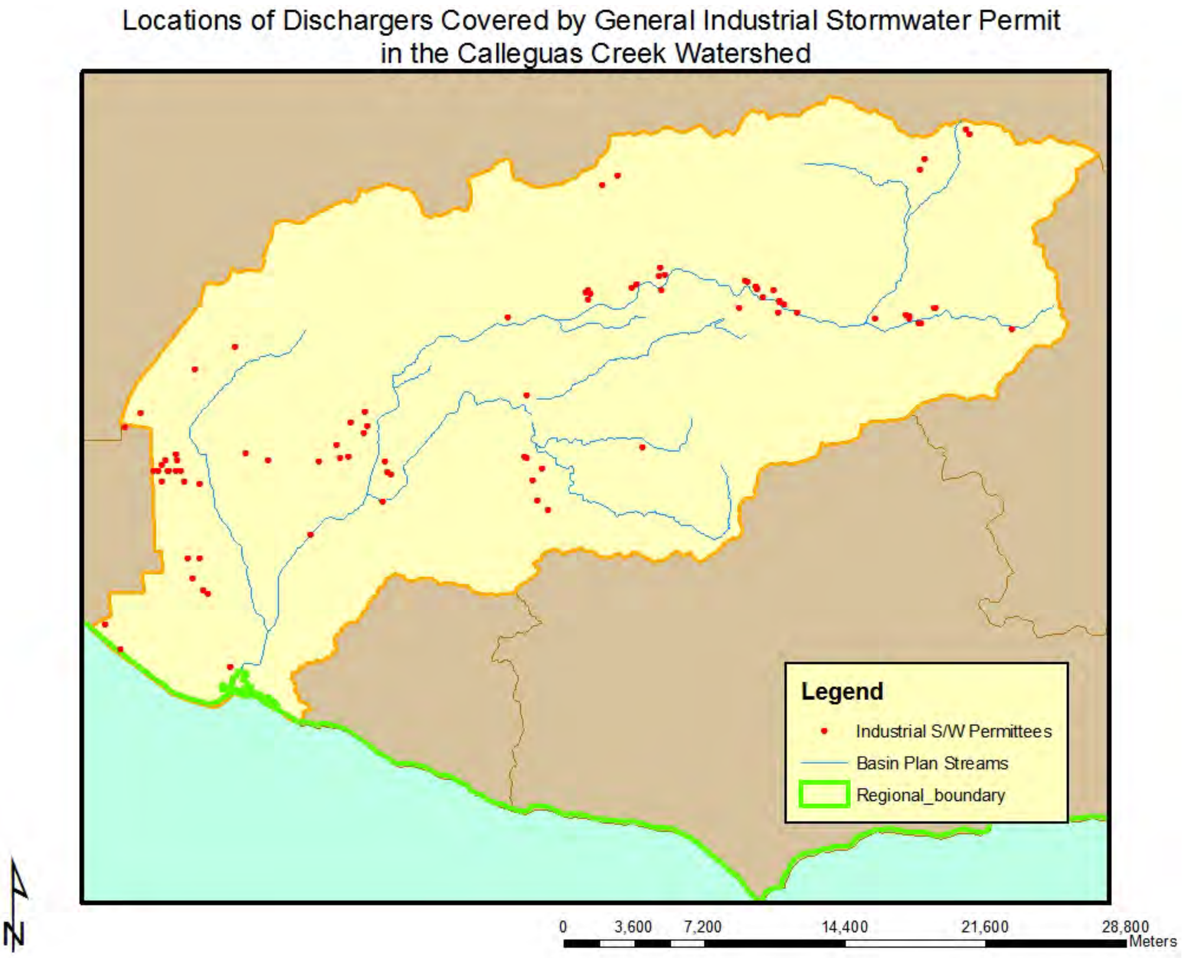
The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure. Major NPDES discharges are from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity.

NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Calleguas Creek Watershed



Discharges are fairly evenly spread around the watershed; four of the 26 NPDES discharges go to the Arroyo Conejo, while six discharge to Revolon Slough and twelve discharge to the Creek's various reaches.

Of the 90 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Simi Valley and Camarillo. There is a diverse mix of industries represented including electric, gas and sanitary services; local and interurban passenger transit; electric and electronic equipment; and stone, clay and glass products based on their Standard Industrial Classification (SIC) codes. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure.



There are 292 construction sites enrolled under the general construction storm water permit. About one-half of the sites are residential and about one-half are five acres or larger in size; one site is about 1,000 acres. Most of the sites are located in Camarillo, Simi Valley, and Thousand Oaks.

The table below gives the impairments for the watershed from the 2006 303(d) list:

Water Quality Limited Segment Name	Pollutant
Calleguas Creek Reach 1 (was Mugu Lagoon on 1998 303(d) list)	Chlordane (tissue)[1] Copper[2] DDT (tissue & sediment)[1] Endosulfan (tissue)[1] Mercury[2] Nickel[2] Nitrogen[3] PCBs (tissue)[1] Sediment Toxicity[1]

	Sedimentation/Siltation[1]
Calleguas Creek Reach 2 (estuary to Potrero Rd- was Calleguas Creek Reaches 1 and 2 on 1998 303d list)	Ammonia[3] ChemA (tissue)[1*] Chlordane (tissue)[1] Copper, Dissolved[2] DDT (tissue & sediment)[1] DDT[1] Endosulfan (tissue)[1] Fecal Coliform Nitrogen[3] PCBs (tissue)[1] Sediment Toxicity[1] Sedimentation/Siltation[1] Toxaphene (tissue & sediment)[1]
Calleguas Creek Reach 3 (Potrero Road upstream to confluence with Conejo Creek on 1998 303d list)	Chlordane Chloride DDT[1] Dieldrin[1] Nitrate and Nitrite[3] Sedimentation/Siltation[1] Total Dissolved Solids Toxaphene[1]
Calleguas Creek Reach 4 (was Revolon Slough Main Branch: Mugu Lagoon to Central Avenue on 1998 303d list)	Boron ChemA (tissue)[1*] Chlordane (tissue & sediment)[1] Chlorpyrifos (tissue)[1] DDT (tissue & sediment)[1] Dieldrin (tissue)[1] Endosulfan (tissue & sediment)[1] Fecal Coliform Nitrate as Nitrate (NO3)[3] Nitrogen[3] PCBs (tissue)[1] Sedimentation/Siltation[1] Selenium[2] Sulfates

	Total Dissolved Solids Toxaphene (tissue & sediment)[1] Toxicity[4] Trash
Calleguas Creek Reach 5 (was Beardsley Channel on 1998 303d list)	ChemA (tissue)[1*] Chlordane (tissue & sediment) Chlorpyrifos (tissue)[1] Dacthal (sediment)[1] DDT (tissue & sediment)[1] Dieldrin (tissue)[1] Endosulfan (tissue & sediment)[1] Nitrogen[3] PCBs (tissue)[1] Sedimentation/Siltation[1] Toxaphene (tissue & sediment)[1] Toxicity[4] Trash
Calleguas Creek Reach 6 (was Arroyo Las Posas Reaches 1 and 2 on 1998 303d list)	Ammonia[3] Chloride DDT (sediment)[1] Fecal Coliform Nitrate and Nitrite[3] Nitrate as Nitrate (NO3)[3] Sedimentation/Siltation[1] Sulfates Total Dissolved Solids
Calleguas Creek Reach 7 (was Arroyo Simi Reaches 1 and 2 on 1998 303d list)	Ammonia[3] Boron Chloride Fecal Coliform Organophosphorus Pesticides[4] Sedimentation/Siltation[1] Sulfates Total Dissolved Solids
Calleguas Creek Reach 8 (was Tapo Canyon Reach 1)	Boron Chloride Sedimentation/Siltation[1]

	Sulfates Total Dissolved Solids
Calleguas Creek Reach 9A (was lower part of Conejo Creek Reach 1 on 1998 303d list)	ChemA (tissue)[1*] Chlordane (tissue)[1] DDT (tissue)[1] Dieldrin (tissue)[1] Endosulfan (tissue)[1] Fecal Coliform Lindane/HCH (tissue)[1] Nitrate as Nitrate (NO3)[3] Nitrogen, Nitrate[3] PCBs (tissue)[1] Sulfates Total Dissolved Solids Toxaphene (tissue & sediment)[1]
Calleguas Creek Reach 9B (was part of Conejo Creek Reaches 1 and 2 on 1998 303d list)	Ammonia[3] ChemA (tissue)[1*] Chloride DDT (tissue)[1] Endosulfan (tissue)[1] Fecal Coliform Sulfates Total Dissolved Solids Toxaphene (tissue & sediment)[1] Toxicity[4]
Calleguas Creek Reach 10 (Conejo Creek (Hill Canyon)-was part of Conejo Ck Reaches 2 & 3, and lower Conejo Ck/Arroyo Conejo N Fk on 1998 303d list)	Ammonia[3] ChemA (tissue)[1*] Chloride DDT (tissue)[1] Endosulfan (tissue)[1] Fecal Coliform Nitrogen, Nitrite[3] Sulfates Total Dissolved Solids Toxaphene (tissue & sediment)[1] Toxicity[4]

Calleguas Creek Reach 11 (Arroyo Santa Rosa, was part of Conejo Creek Reach 3 on 1998 303d list)	Ammonia[3] ChemA (tissue)[1*] DDT (tissue)[1] Endosulfan (tissue)[1] Fecal Coliform Sedimentation/Siltation[1] Sulfates Total Dissolved Solids Toxaphene (tissue & sediment)[1] Toxicity[4]
Calleguas Creek Reach 12 (was Conejo Creek/Arroyo Conejo North Fork on 1998 303d list)	Ammonia[3] Chlordane (tissue)[1] DDT (tissue)[1] Sulfates Total Dissolved Solids
Calleguas Creek Reach 13 (Conejo Creek South Fork, was Conejo Cr Reach 4 and part of Reach 3 on 1998 303d list)	Ammonia[3] ChemA (tissue)[1*] Chloride DDT (tissue)[1] Endosulfan (tissue)[1] Sulfates Total Dissolved Solids Toxaphene (tissue & sediment)[1] Toxicity[4]
Duck Pond Agricultural Drains/Mugu Drain/Oxnard Drain No 2	ChemA (tissue)[1*] Chlordane (tissue)[1] DDT (tissue & sediment)[1] Nitrogen[3] Sediment Toxicity[1] Toxaphene (tissue)[1] Toxicity[4]
Fox Barranca (tributary to Calleguas Creek Reach 6)	Boron Sulfates Total Dissolved Solids
Rio De Santa Clara/Oxnard Drain No. 3	ChemA (tissue)* Chlordane (tissue) DDT (tissue) Nitrogen PCBs (tissue)

	Sediment Toxicity Toxaphene (tissue)

* ChemA refers to the sum of the chemicals aldrin, dieldrin. chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

[1] Calleguas Creek, its Tributaries, and Mugu Lagoon OC Pesticides, PCBs, and Siltation TMDL, 2005

[2] Calleguas Creek, its Tributaries, and Mugu Lagoon Metals and Selenium TMDL, 2007

[3] Calleguas Creek Nitrogen TMDL, 2003

[4] Calleguas Creek Toxicity TMDL, 2005

CURRENTLY SCHEDULED TMDLS:

- salts
- trash

Stakeholder Groups

Calleguas Creek Watershed Management Committee and Technical Subcommittees: Recognizing that many of the water quality problems in the lagoon stem from land use practices and pollutant sources above the lagoon, members of these committees meet regularly to exchange data and discuss coordinated approaches to solving the many problems in this watershed, including development of a watershed management plan. The watershed group consists of about 130 stakeholders who have been meeting since November 1996 with the purpose of developing a watershed management plan. As we expect that much effort will need to be focused on resolving agricultural and flood control issues, a concerted effort to include appropriate stakeholders. Besides the main management committee of stakeholders, five technical subcommittees deal with more specific issues such as water quality, flood protection/ sediment management, habitat/open space/recreation, public outreach, and land use. A Steering Committee attends to the details of management plan development. The full Management Plan Committee meets on a quarterly basis, generally conducting business in a half-day session. Staff have been and will continue to work with these committees. For further information concerning this group, please visit their website at http://www.calleguas.com/cc.htm.

A number of the above committee members were also on the *Mugu Lagoon Task Force* which was formed in 1990 in response to concerns about sedimentation filling in Mugu Lagoon which is at the mouth of the Calleguas Creek Watershed. A major focus of the early meetings was exchange of information on the extent of sedimentation with related concerns such as pesticide transfer. A sediment and erosion control plan was prepared for the Ventura County RCD by the U.S. Natural Resource Conservation Service (USNRCS) using Coastal Conservancy funds ("Calleguas Creek Watershed Erosion and Sediment Control Plan for Mugu Lagoon", May 1995). This group no longer meets; however, information gained from this effort continues to be used by the other Calleguas Watershed Committees.

Significant Past Activities

CORE REGULATORY

The majority of Calleguas Creek Watershed permits were revised in June 1996. This watershed, as well as the Ventura River Watershed, were pilot watersheds in our implementation of the watershed management approach. The Ventura County Municipal Stormwater NPDES Permit had most recently been adopted in 2000. The watershed was targeted again for NPDES permit renewals in FY01/02.

MONITORING AND ASSESSMENT

As the first integrated watershed monitoring program in the Region, the six POTWs in the watershed each implemented a portion (Characterization Study) in 2000 which also included other agencies in the effort. In conjunction with the receiving water monitoring, land-use based monitoring was done as a part of the Ventura County Municipal Storm Water Program. The monitoring supported compliance valuation, nonpoint source identification, and potential TMDL development. The expanded monitoring by the dischargers also served to evaluate beneficial uses.

Calleguas Creek was a focus for SWAMP monitoring in FY00/01 as the watershed was targeted in the rotating watershed cycle. Since extensive monitoring has already occurred here, particularly in the lower watershed, a more directed approach to sampling site selection was taken. A short-term watershed-wide regional monitoring program was created to fill in data gaps and eliminate duplicative and unnecessary monitoring. A total of thirteen sites were sampled once by SWAMP in the Calleguas Creek Watershed. Twelve directed sites were sampled for toxicity, bioassessment, conventional water chemistry and organophosphate chemistry in the water column. One estuary station was sampled for bioaccumulation in addition to abovementioned analyses. POTWs contributed significant resources to do a surface and ground water characterization study. It also served to assess nonpoint source pollution from a variety of land uses.

UCLA was under contract with the State Board to provide data needed for establishment of nutrient TMDLs in several watersheds within the Region including Calleguas Creek, Santa Clara River, and Malibu Creek. By understanding the inter-relationships between water quality and habitat condition and the resulting effects that these interactions have on the biological communities of coastal watersheds, this research was intended to further our understanding of the ecology of southern California watersheds. Besides providing information supporting the establishment of nutrient TMDLs for these three impaired coastal watersheds, the data collected would provide insight into how these TMDLs might be complied with in the future. Three specific objectives of this project were: 1) investigate the relationships between water quality (e.g. nutrients), habitat quality, and the biological community, 2) investigate how water quality and biological communities change throughout particular target reaches representing different land uses, and 3) compare the relationships between water quality, habitat quality, and biological communities among different watersheds. The work was a continuation and extension of a Regional Environmental Monitoring and Assessment Program (R-EMAP) project in the watershed. R-EMAP us part of a larger national effort by the USEPA to assess the condition of the nation's ecological resources.

BASIN PLANNING

In 1990, the Regional Board adopted Resolution No. 90-004 (**Drought Policy**) which had a term of three years and provided interim relief to dischargers who experienced difficulty meeting chloride objectives because of a state-wide drought. The policy adjusted effluent limits to the lesser of 1) 250 mg/l or 2) the chloride concentration in the water supply plus 85 mg/l. In 1995, the Regional Board extended the interim limits for three years and directed staff to develop a long-term solution to deal with the impact of changing water supply, especially during droughts. In 1997, the Regional Board adopted Resolution No. 97-002 (**Chloride Policy**) which set the chloride objective at 190 mg/l except in the Calleguas Creek and Santa Clara River Watersheds where, due to the great concern for protection of agriculture, staff were directed to determine the chloride concentrations sufficient to protect agricultural beneficial uses.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project funded a restoration project in the watershed, the Grimes Canyon Stream Restoration Project.

NONPOINT SOURCE PROGRAM

Work on nonpoint source problems in the watershed has been a long-term effort, initiated in 1990, with the support of 319(h) funds and other funding from, and support by, stakeholders. The 319(h) grant projects, special studies, and other activities that have been completed to date include:

- ***Irrigation Demonstration Project***: In 1994, the Ventura County Resource Conservation District successfully completed an irrigation project that demonstrated the water quality and conservation benefits of drip irrigation. This project was funded through a 319(h) grant.

- ***Toxicity Testing***: In order to detect sources of toxicity, we had collected water samples under three sequential studies (toxicity testing by UC Davis). Results of this sampling indicated sporadic toxicity, generally during wet weather seasons, with strong implication of organophosphate pesticides. A peer-reviewed paper on the results is pending.

- ***Calleguas Creek Watershed Treatment – Phases I and II***: The Ventura County Resource Conservation District served as contractor for this project which focused on Best Management Practices that involved small, individual landowners/ farmers. This demonstration project was designed to implement streambed protection practices. The two phases were funded through 319(h) grants.

Current Activities

The following is a summary of current regional board activities and strategies for dealing with point and nonpoint source pollution as well as other issues of concern in the Calleguas Creek Watershed.

CORE REGULATORY

Current regulatory activities include compliance inspections, review of monitoring reports, response to complaints, and enforcement actions, as needed.

Most urban areas in Ventura County, including this watershed, are implementing Best Management Practices (BMPs) under the Municipal Storm Water Permit (revised in 2000). The "Discharger" consists of the co-permittees Ventura County Flood Control District, the County of Ventura, and the Cities of Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, San Buenaventura, Santa Paula, Simi Valley, and Thousand Oaks. The Discharger is required to implement the Ventura Countywide Stormwater Quality Urban Impact Mitigation Plan (SQUIMP), which requires the implementation of BMPs to reduce the discharge of pollutants in storm water from new development and significant redevelopment. Other requirements of the Municipal Storm Water Permit include a public education program, an educational site inspection program for industrial and commercial facilities, program for construction sites, public agency activities, and a storm water monitoring program.

The Calleguas Creek receives municipal storm drain discharges from the City of Camarillo, City of Moorpark, City of Simi Valley, City of Thousand Oaks (part), and unincorporated Ventura County (part).

The storm water monitoring program has consisted of land-use based monitoring, receiving water and mass emission station monitoring, and bioassessment. The Discharger also participates in regional monitoring activities, such as the Storm Water Monitoring Coalition, organized by the Southern California Coastal Water Research Project. Furthermore, the Discharger participates in the development and implementation of volunteer monitoring programs in the Ventura Coastal watersheds.

Regulation of groundwater protection activities is intended to eventually become fully integrated into the watershed management approach; currently, groundwater monitoring (for POTWs using ponds) is being coordinated with surface water monitoring.

MONITORING AND ASSESSMENT

The BPTCP has identified the lagoon and tidal prism as "toxic hot spots" based on sediment contamination. Staff have completed a preliminary cleanup plan for the areas which was adopted as part of a statewide consolidated plan by the State Board in June 1999. Cleanup/remediation alternatives identified include dredging, in-situ capping, and treatment; however, dedicated funding for cleanup activities has not been provided by the state. Continuing Regional Board activities include working with stakeholders to further characterize historical sources of pollution as well as the extent of existing contributions. While remediation of the lagoon (as part of a military facility) may proceed on its own timeline, in general, there is a concerted effort by all stakeholders to prepare a comprehensive watershed management plan to address all problems in the watershed.

The Calleguas Creek Watershed Management Plan Habitat/Recreation and Land Use Subcommittees are jointly working on aspects of a Watershed Evaluation Study that is scheduled to be finished in 2002. This is a GIS-based effort with the goals of identifying high quality habitat and those areas that would help link them, the current level of protection, land ownership, and information from local entities land use plans. Another goal is to make the information available via the Internet.

NONPOINT SOURCE PROGRAM

We expect that stakeholders will continue work on developing a watershed management plan, which will include measures for reducing pollutants from nonpoint sources. Accordingly, our efforts in the Calleguas Creek watershed will focus on continuing the nonpoint source phase of the watershed cycle, including integrating results of our on-going nonpoint source efforts. The 319(h) grant projects, special studies, and other activities that are currently on-going include:

319(h) Grants

Calleguas Creek Water Quality Monitoring Program: The Wishtoyo Foundation received 319(h) grant funds in 2001 to educate and train volunteers to conduct a citizen monitoring program in the watershed. The goal is to measure the effectiveness of BMPs created to manage the flow of nutrients, pesticides, and sediments. Bioassessments will also be conducted.

We continue to support as high priorities for grant funding projects relating to implementation of TMDLs, habitat enhancement/restoration, and reduction of pollutants from agricultural activities.

Other NPS Activities

Our efforts to involve stakeholders also shall include exploration of funding options (especially for implementation of nonpoint source measures) and continuation of other outreach activities, such as speeches, meetings, and participation in environmental events.

Mugu Lagoon/Revolon Slough is identified as Critical Coastal Area (CCA) #58 in the State Water Resources Control Board's and California Coastal Commission's Critical Coastal Area Draft Strategic Plan. It has been identified as such in 1995 as an impaired water body and one of the few remaining saltwater wetland habitats remaining in Southern California. The major efforts listed to implement NPS management measures include: activities of Wishtoyo Foundation and Ventura CoastKeeper; streambank restoration projects conducted by Ventura County Resources Conservation District for growers; the Calleguas Municipal Water District's Regional Salinity Management Project; work conducted by the Calleguas Creek Watershed Management Plan Committee; the Erosion and Sediment Control Plan prepared in 1995 by the Ventura County Resources Conservation District; the watershed-wide monitoring program; BMPs implemented under the Ventura County municipal stormwater permit; and implementation of various TMDLs.

Laguna Point to Latigo Point is identified as CCA #59 in the CCA Draft Strategic Plan. It has been identified as such since the watersheds drain into a Marine Protected Area. This CCA covers parts of both Los Angeles and Ventura Counties from Calleguas Creek to Malibu. The major efforts listed to implement NPS management measures include: activities of the Malibu Creek Watershed Council and construction of Calleguas Municipal Water District's Regional Salinity Management Project.

BASIN PLANNING

Several high priority issues were identified in the 2005 - 2007 Triennial Review which affect this watershed management area and will require Basin Planning resources. As in all watersheds, adopting TMDLs as Basin Plan amendments is required under the Consent Decree with an estimated resource need of 0.5 PY/TMDL. This is considered a currently funded activity. The ongoing Tiered Aquatic Life Uses Pilot Project may affect many watersheds in the Region. The purpose of tiered aquatic life uses (TALUs) is to have more appropriate goals for protecting aquatic life that account for these inherent physical limitations. The purpose of this pilot project is to develop more tailored water quality standards (through beneficial use designations and associated biocriteria) to protect the biological communities of semi-arid urban coastal streams and, If deemed appropriate, recommend appropriate tiered aquatic life uses for these semi-arid urban coastal streams. Other high priority issues identified by the Triennial Review common to multiple watersheds may be found in the Region-wide Section.

Review and comment on EIRs for the highest priority projects within the watershed will continue; however, there is currently no funding for this program.

WETLANDS PROTECTION AND MANAGEMENT

The Wetlands Recovery Project has listed the Lower Conejo Creek Acquisition as a priority project on the current workplan. Being listed on the workplan is not a guarantee of funding however. More information about the workplan may be found at http://www.scwrp.org.

A wetlands restoration plan for the watershed has been prepared (with Coastal Conservancy and USEPA funding) by a local consultant through the Habitat Subcommittee of the Calleguas Creek Watershed Plan Committee. This document is available on the Calleguas Creek Watershed Management Plan website at http://www.calleguas.com/ccbrochure/cc.htm. The next step in the process, completion of a Wetlands Restoration Feasibility Study, is ongoing.

The Santa Monica Mountains Conservancy is a state agency created by the Legislature in 1979 charged with primary responsibility for acquiring property with statewide and regional significance, and making those properties accessible to the general public. The Conservancy manages parkland in the Santa Monica Mountains, Santa Susana Mountains, the Simi Hills, the Santa Clarita Woodlands, the Whittier-Puente Hills, the Sierra Pelona, the Los Angeles River Greenway, the Rio Hondo, the Verdugo Mountains, the San Gabriel Mountains, and the San Rafael Hills. The agency's goals are to: 1) implement the Santa Monica Mountains Comprehensive Plan, 2) implement the Rim of the Valley Trails Corridor Master Plan, 3) implement the Los Angeles County River Master Plan, 4) further cooperation with local governments in the region to secure open space and parkland, and 5) expand education, public access, and resource stewardship components in a manner that best serves the public, protects habitat, and provides recreational opportunities. Additional information on their priorities may be found at http://www.smmc.ca.gov/.

DOD SITE CLEANUP PROGRAM

The Regional Board is working with the Department of Toxic Substances Control (DTSC) to investigate soil and groundwater quality at Department of Defense (DoD) facilities. Sites currently under assessment/remediation include Mugu Lagoon, a former landfill, the Naval Exchange gas station, two Installation Restoration Program (IRP) sites, numerous underground storage tanks, and the former oxidation sewage ponds.

The Navy disposed of inert, contaminated and hazardous wastes to an unlined unpermitted landfill constructed by depositing and compacting wastes into Calleguas Creek. An erosion berm was installed as an interim remedial measure to prevent further erosion of the former landfill by storm water flowing through the creek during storm events. Long-term groundwater monitoring will be required for this site. Sediments and surface water at IRP Site 5 are contaminated with chrome. An initial emergency removal action (sediment excavation) failed to adequately remediate all impacted sediments and additional sediment remediation and surface water monitoring is ongoing.

Soil and groundwater at IRP Site 24 is contaminated with chlorinated solvents. Groundwater is being treated by implementation of a new biodegradation technology. It is not yet determined to what extent groundwater remediation or monitoring will be required to restore this site.

It is anticipated the Navy will implement a base-wide groundwater/surface water investigation to evaluate the overall groundwater and surface water quality, evaluate the interactions of surface water and groundwater, and determine the cumulative risk of multiple groundwater-surface water contamination sites on the overall water quality of the area and the risk to human health and the environment.

Prior to 1979, the Navy was allowed to discharge partially treated wastewater to surface water oxidation ponds that were constructed in the Calleguas Creek tidal prism. The ponds were unlined and allowed to percolate unevaporated water to the underlying groundwater, which is located about four feet below grade. The Regional Board rescinded the Navy's discharge permit in 1979 and required the Navy to pump all wastewater to the Oxnard POTW. However, periodic unpermitted discharges of wastewater continued to the ponds during planned repairs of the wastewater discharge line and wastewater overflow conditions, which occurred during heavy rains.

To prevent additional wastewater discharges to the ponds, the Regional Board issued a Cleanup and Abatement Order to the Navy in 1998 directing the Navy to cease all unpermitted discharges, construct a lined emergency wastewater retention basin, upgrade the wastewater discharge line, and remove the sludge that has accumulated in the ponds.

Current funding for the investigation and remediation of contaminated solids, surface water and groundwater at the base is through the DoD/CalEPA funding agreement; however, this funding is not satisfactory for the investigation or control of contaminants from upstream sources for the protection of Mugu Lagoon and continued funding cuts have had significant impacts on the level of oversight by Regional Board staff on these areas.

Near-term Activities

Specific resource needs are described in the Region-wide Section of this document.

NPDES Permits in the watershed will come up for renewal in FY 2003/04. In the meantime, core regulatory activities will focus on permit compliance, monitoring report review, and enforcement as needed. In addition, integration of stormwater and nonpoint source issues will continue. Members of the watershed team will be involved with periodic updates of the State of the Watershed Report. Additionally, there will be on-going interaction with stakeholders and followup on goals established during the permit renewal phase. Pending results from the discharger pollutant characterization study, a decision on waste load and load allocations will be pursued.

A review of resources for core regulatory activities against cost factors has determined that our region is seriously underfunded for our baseline program. We will be seeking more funding for our core program activities.

We shall have made significant progress later in this watershed's first cycle, toward identifying and assessing problems (through the characterization study) and involving stakeholders. At that point we (and the stakeholders) may also enough information to get a headstart on establishing load allocations for certain pollutants of concern.

Additional monitoring and assessment tasks include continued involvement in updates to the baseline State of the Watershed Report, focusing on filling data gaps and evaluating cumulative impacts as monitoring data become available from dischargers, evaluating the results of the SWAMP monitoring, follow-up on pollutants identified through toxicity identification evaluations, implement TMDLs to actually begin to solve problems found through monitoring, and implementing the municipal storm water program.

Our efforts to involve stakeholders shall also include exploration of funding options (especially for implementation of nonpoint source measures) and continuation of other outreach activities, such as speeches, meetings, and participation in environmental events. We shall continue our involvement in the watershed group's efforts to develop and implement a watershed management plan.

We will maintain involvement with stakeholder activities and pursue funding options, especially those involving implementation of nonpoint source measures (coordinate grant activities) as well as other outreach activities such as speeches, meetings, and participation in environmental events. As resources permit, we will also work with stakeholders to implement provisions of the Coastal Zone Act Reauthorization Amendments.

Potential Mid- to Long-term Activities

In the long-term, activities will include continued participation in both internal and external watershed planning efforts and further implementation of watershed-specific solutions. Several Basin Planning issues will be addressed through the Characterization Study and watershed planning efforts. More resources are needed for these activities.

Other mid- to long-term issues include:

- Beneficial uses: Studies to evaluate beneficial use issues.
- Site specific objectives: Review studies conducted by dischargers or other watershed interests.
- Land use planning: Integrate water supply and quality issues with local land use planning and management.
- Groundwater: Integrate inter-related ground and surface waters--optimizing protection for both.
- Flood control: Institute better coordination of multi-agency reviews of environmental impacts for flood control and development projects, including the consideration of regional mitigation programs. Optimize the use of environmentally-friendly flood control facilities.
- Implementation of watershed-wide biological monitoring is a long-term goal for all of our watersheds.

Review and comment on watershed issues in CEQA documents (for the highest priority projects) will also continue; however, this is currently an unfunded program.

Under the BPTCP, we estimated that about 20% of the Western Arm and 10% of the Eastern Arm of Mugu Lagoon contain contaminated sediments (about 725,000 cubic yards). We estimate that about 3 miles of Calleguas Creek contains 50,000 to 100,000 cubic yards of contaminated sediments. We want to work with local groups to develop remediation plans. Due to sensitive nature of Mugu Lagoon, we would suggest no action or in-situ treatment, rather than dredging, as remediation options. Treatment is expensive (probably would exceed $100 per cubic yard). Dredging could be used to remediate Calleguas Creek, although finding a suitable disposal site could be difficult; it would cost $1 to 5 million.

Section 3 . Regionwide Activities

There are many activities conducted at the Regional Board which do not apply to a specific watershed; instead they represent ongoing regionwide strategies and policies, or programs which are not directly linked to the rotating watershed cycle. Also, statutory, regulatory, or funding requirements may dictate completion of some activities at odd intervals throughout the five-year watershed cycle (such as increased emphasis on pretreatment inspections). We expect that some of these activities, which include triennial reviews, water quality assessment (305(b)) reports, updating lists of impaired waterbodies (e.g. the federal 303(d) list), can be negotiated into a watershed. See the table below for more examples of watershed versus non-watershed related activities.

Watershed Tasks	*Non-Watershed Tasks*
Renew permits	Issue new permits
	Develop new general permits
Integrate municipal storm water program	Issue individual industrial and storm water permits
Conduct inspections for watershed permits	Conduct inspections on new permits
Enforcement (in-cycle compliance)	Enforcement (spills, out of cycle compliance)
Implement NPS controls	Develop regional strategies to address NPS problems
TMDL/WLAs	
Develop, coordinate and implement watershed monitoring	Coordinate monitoring on a regional scale
Water Quality Assessments (State of the Watershed Reports, partial updates to 305(b) by watershed)	Biennial 305(b) Reports to USEPA
Develop watershed policies	Develop regional policies
Watershed-specific Basin Plan Updates	Regional Basin Plan Updates, Triennial Reviews
Data management (input and use by watershed)	Regional Database management
GIS (input of watershed-specific layers and information)	GIS (development and input of regional layers and Maintenance of system)
Watershed-specific outreach/education	General outreach education
Incorporation of CEQA and 401 Decisions into watershed planning (as groups are formed, and as timing permits)	Timely review of CEQA documents, 401 certifications per statutory deadlines

And, while the Watershed Management Initiative strives to integrate and coordinate the various Regional and State Board programs and address the highest priority funding needs for those programs, there is also need to respond to and accommodate priorities established by the individual Regional and State Boards' members, priorities established prior to the WMI which run on their own timelines, or other new mandates which may affect the way the WMI is implemented in a Region. It is important to re-state here that the WMI is not a new program but rather a way to describe our approach to integrating existing and newly evolving programs and mandates. The following describes our overall approach to implementing a number of programs (some statewide mandates) and other Board priorities.

Core Regulatory

One activity involves renewing individual permits in a timely fashion. General permits (see below) are also renewed to incorporate Basin Plan amendments and fine-tune other requirements. Other activities include inspections and audits. Major NPDES dischargers are inspected at least once per year while minor dischargers are inspected at least once during the life of the permit. There are twelve POTWs with pretreatment programs which are either inspected or audited once per year. The twelve programs are: Burbank, Camarillo SD, Las Virgenes MWD, Los Angeles CSD, City of Los Angeles, Ojai Valley SD, Oxnard, San Buenaventura, Simi Valley CSD, Thousand Oaks, Moorpark WTP, and Santa Paula. Major discharges are POTWs with a yearly average flow of over 0.5 MGD or an industrial source with a yearly average flow of over 0.1 MGD and those with lesser flows but with acute or potential adverse environmental impacts. Minor discharges are all other discharges that are not categorized as a Major. Minor discharges may be covered by a general permit, which are issued administratively, for those that meet the conditions specified by the particular general permit.

Another activity which has taken up considerable time, and contributes to backlogged permits, is responding to appeals and lawsuits. At issue for a number of permits is a lack of regional nutrient objectives which has translated into a lack of permit limitations and subsequent petitions and/or lawsuits. Ideally, TMDLs would be adopted in the year proceeding permit renewals for a particular watershed. Permit limitations could then be based on allocations from the TMDLs. Also ideally, we would have state-adopted water quality objectives (or an implementation plan for federal numbers) or ecologically-relevant regional objectives for parameters such as nitrogen and phosphorus to use for development of permit limitations. Nutrient objectives will likely be available in the near future but, in the meantime, we continue to experience challenges to their absence.

Core Regulatory – Region 4 General Permits

There are many dischargers in this Region covered by general permits for discharges to surface water through a letter issued by the Executive Officer. This activity occurs as often outside as within the watershed cycle. 40 CFR §122.28 provides for issuance of general permits to regulate a category of point sources if the sources:

a) Involve the same or substantially similar types of operations;

b) Discharge the same type of waste;

c) Require the same type of effluent limitations or operating conditions;

d) Require similar monitoring; and

e) Are more appropriately regulated under a general permit rather than individual permits.

General NPDES permits currently in effect include:

- NPDES Permit No. CAG914001 – for discharges of treated volatile organic compound contaminated groundwater to surface waters (threat/complexity rating 2B)

- NPDES Permit No. CAG994004 – for discharges of groundwater (treated or untreated) from construction and project dewatering to surface waters (threat/complexity rating to be determined)

- NPDES Permit No. CAG994005 – for discharges of groundwater from potable water supply wells to surface waters (threat/complexity rating to be determined)

- NPDES Permit No. CAG674001 – for discharges of low-threat hydrostatic test water to surface waters (threat/complexity rating 3C)

- NPDES Permit No. CAG834001 – for discharges of treated groundwater and other wastewaters from investigation and/or cleanup of petroleum fuel pollution to surface waters (threat/complexity rating 2B)

- NPDES Permit No. CAG994003 – for discharges of nonprocess wastewaters not requiring treatment systems to surface waters (threat/complexity rating 3C)

As a point of comparison, the highest threat/complexity rating is 1A and the lowest 3C.

General waste discharge requirements currently in effect include:

- Order No. R4-2007-0019 and Resolution No. R07-001 – groundwater remediation at petroleum hydrocarbon fuel, volatile organic compound and/or hexavalent chromium impacted sites

- Order No. R4-2004-0146 – waste discharge requirements for residential onsite wastewater treatment systems

- Order No. 01-031 – small commercial and multifamily residential subsurface sewage disposal systems

- Order No. 93-010 – specified discharges to groundwater in Santa Clara River and Los Angeles River Basins. Examples of the activities leading to a discharge of water that, because of its characteristics, results in little or no pollution when discharged to groundwater include: hydrostatic testing of tanks, pipes, and storage vessels; construction dewatering; dust control application; water irrigation storage systems, subterranean seepage dewatering; well development and test pumping; aquifer testing; and monitoring well construction.

- Order No. 91-94 – private subsurface sewage disposal systems in areas where groundwater is used or may be used for domestic purposes

- Order No. 91-93 – discharge of non-hazardous contaminated soils and other waste in Los Angeles and Santa Clara River Basins

Core Regulatory – State Board General Permit

In 2001, State Board adopted a general NPDES permit (NPDES Permit No. CAG990003) for discharges of aquatic pesticides. The permit covers the uses of properly registered and applied aquatic pesticides; it does not cover indirect or nonpoint source discharges from agricultural or other applications of pesticides to land that may be conveyed in storm water or irrigation runoff. It also does not cover applications of pesticides that are not registered for use on aquatic sites.

Although Notices of Intent (NOIs) to be covered under this general permit will be handled by State Board, the Regional Board is responsible for approving monitoring plans, reviewing monitoring reports, conducting compliance inspections, and conducting any appropriate enforcement actions.

Core Regulatory – Storm Water

Storm water activities include those involving the three municipal permits in the Region, facilities regulated under the State's general industrial permit, and construction sites regulated under the State's general construction permit.

Municipal permits

Municipal storm water regulations at 40CFR 122.26 require that pollutants in storm water discharges be reduced to the maximum extent practicable (MEP). The definition of MEP has generally been applied to mean implementation of controls to reduce the discharge of pollutants to the maximum extent practicable using appropriate management practices, control techniques and system, design and engineering methods. Municipalities are required to implement or require the implementation of the most effective combination of BMPs for storm water/urban runoff pollution control.

Municipal permits currently in effect include:

- NPDES Permit No. CAS004003 – adopted in 1999 this is the permit for municipal storm water and urban runoff discharges within the city of Long Beach
- NPDES Permit No. CAS004002 – adopted in 2000 this is the permit for municipal storm water and urban runoff discharges within the Ventura County Flood Control District, county of Ventura, and cities of Ventura County
- NPDES Permit No. CAS004001 – revised in 2001 (and amended in 2006 and 2007) this is the permit for municipal storm water and urban runoff discharges within the county of Los Angeles

An important part of the municipal permits (Los Angeles County and City of Long Beach) are the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs) which were adopted on March 8, 2000 and implemented by municipalities beginning in February 2001. The SUSMPs are designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new development and redevelopment.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system. Other standards also apply; additional information on the SUSMP may be found on the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/susmp/susmp_details.html.

The Ventura County Municipal Storm Water Permit co-permittees are required to implement similar requirements under the Ventura Countywide Stormwater Quality Urban Impact Mitigation Plan (SQUIMP). The SQUIMP similarly addresses conditions and requirements for new development and significant redevelopment.

Monitoring has indicated that mass emissions of pollutants to the ocean are significant from the urban watersheds such as the Los Angeles River, Ballona Creek, and Coyote Creek. Studies have found chemical concentrations of pollutants that exceed state and federal water quality criteria in storm drains flowing to the ocean and that beach water quality standards for bacteria indicators (Assembly Bill 411) are often exceeded. The presence of these high levels of bacteria indicate the existence of other pathogenic microorganisms that pose a health risk to humans. A 1996 epidemiological study, conducted by USC under the direction of the Santa Monica Bay Restoration Project, confirmed that swimming in water with significant concentrations of bacteria indicators increases the potential for contracting illnesses, such as stomach flu, ear infection, upper respiratory infection or major skin rash.

Industrial permit

The 1987 amendments to the Clean Water Act established a framework for regulating municipal and industrial storm water discharges under the NPDES Program. In 1990, the USEPA published final regulations that established application requirements for storm water permits. The regulations require that storm water associated with industrial activity that discharges either directly to surface waters or indirectly through municipal storm drains must be regulated by an NPDES permit.

State Board adopted the Industrial Activities Storm Water General Permit in 1997 (Order 97-03-DWQ). The permit requires facility operators to (1) eliminate unauthorized nonstorm water discharges through implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT), (2) develop and implement a Storm Water Pollution Prevention Plan (SWPPP), and (3) perform monitoring of storm water discharges and authorized nonstorm water discharges. Facility operators may be able to participate in group monitoring program. Facilities that discharge storm water associated with industrial activity requiring a General Permit are listed by category in the Code of Federal Regulations. These categories include manufacturing, mining/oil, recycling, steam electric generating, and light industry, among others. There are approximately 2,800 facilities in this Region covered by the general industrial permit. Most of these sites are in the Los Angeles River Watershed with the San Gabriel River Watershed and the Dominguez Channel and LA/LB Harbor WMA also containing a considerable number. There has been a general increase in the number of facilities covered by the permit over time. More information about the permit may be found at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/sw_industrial.html.

Construction permit

In 1990, USEPA published final regulations that establish storm water permit application requirements for specified categories of industries. The regulations provide that discharges of storm water to waters of the United States from construction projects that encompass five or more acres of soil disturbance are effectively prohibited unless the discharge is in compliance with an NPDES permit.

State Board adopted a general permit for storm water discharges associated with construction activity in 1999 (State Board order No. 99-08-DWQ). It contains narrative effluent limitations and requirements to implement appropriate Best Management Practices (BMPs) which emphasize source controls. Dischargers from sites of one acre in size or larger are required to be covered by the construction stormwater permit.

Elimination or reduction of nonstorm water discharges is a major goal of the general permit. It prohibits the discharge of materials other than storm water and authorized nonstorm water discharges. It also requires development of a Storm Water Pollution Prevention Plan (SWPPP) and monitoring program.

There are approximately 2,680 sites covered under the construction storm water permit as of October 2007; this is almost twice the number covered at the time of the 2004 update of the WMI Chapter. The majority of sites are in the Los Angeles River Watershed (759), up from 456 sites three years ago. The San Gabriel River Watershed also has a large number of construction sites at 446 as well as the Santa Monica Bay Watershed Management Area (401), and Santa Clara River Watershed (367). About half of the sites in most watersheds are at least 5 acres or larger with some sites up to 1,000 acres in size.

The Construction General Permit was modified in 2001 by State Board Resolution No. 2001-046. The modifications require that a sampling and analysis strategy and sampling schedule for discharges from construction activity be developed and included in projects' Storm Water Pollution Prevention Plans. Additional information may be found on the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/html/programs/stormwater/sw_construction.html.

Monitoring and Assessment

Surface Water Ambient Monitoring Program: California Water Code Section 13192 required the SWRCB to assess and report on the State monitoring programs and to prepare a proposal for a comprehensive surface water quality monitoring program. It was envisioned that implementation of the Surface Water Ambient Monitoring Program (SWAMP) would utilize a scientifically-sound monitoring design with meaningful indicators of the environment and the results would be readily available to the public.

Ambient monitoring serves as a measure of the overall quality of water resources and the overall effectiveness of Regional Boards prevention, regulatory, and remedial actions, and the SWAMP is intended to meet four goals:

1) Identify specific problems preventing the SWRCB, RWQCBs, and the public from realizing beneficial uses in targeted watersheds.

2) Create an ambient monitoring program that addresses all hydrologic units of the State using consistent and objective monitoring, sampling and analysis methods; consistent data quality assurance protocols; and centralized data management.

3) Document ambient water quality conditions in potentially clean and polluted areas.

4) Provide the data to evaluate the effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

Each of the pre-existing SWRCB and RWQCBs existing monitoring programs (e.g., the State Mussel Watch Program, Toxic Substances Monitoring Program, Coastal Fish Contamination Program, and toxicity studies) have been incorporated into SWAMP to ensure a coordinated approach without duplication.

During the first five years of the SWAMP, we focused on monitoring each of our 10 watersheds. Due to funding constraints, we spent most of our funding allocation on monitoring of wadeable streams, relying upon a triad of indicators to assess whether the aquatic life beneficial use was being supported (benthic macroinvertebrate community, water column toxicity, water column chemistry [primarily conventional pollutants, such as nitrates and phosphates]). At a small subset of sampling stations (integrator or confluence sites), trace metal and trace organic analyses, bioaccumulation sampling and sediment chemistry/sediment toxicity analyses were conducted.

The review of SWAMP conducted by the Scientific Planning and Review Committee (SPARC) in 2005 concluded that SWAMP had focused too much on regional issues during its first five years and that there was too much inconsistency between the regional monitoring designs to allow monitoring results to be integrated into a meaningful statewide assessment. Consequently, SWAMP is shifting its focus to ensure the development of robust statewide monitoring programs to assess three categories of beneficial uses (recreational use, fishing uses, aquatic life support) for each of the six major waterbody types present in the state (ocean waters, estuaries, lakes/reservoirs, large rivers, wadeable streams, wetlands). At the same time, SWAMP intends to continue to provide some funding to allow the Regional Boards to conduct local monitoring (but possibly at a reduced level compared to previous years).

It is impossible for SWAMP to develop 18 statewide monitoring programs all at once with the current level of funding. Therefore, SWAMP has decided to focus on two high priority issues: aquatic life protection in wadeable streams and fishing uses in lakes and reservoirs. Once statewide monitoring programs have been designed and implemented for these 2 areas, SWAMP will develop a plan to address the remaining monitoring needs.

The Nonpoint Source Program has been supporting a wadeable stream program based on a randomized design for the past five years (California Monitoring and Assessment Program, or CMAP), and most of the regional boards have been conducting bioassessment monitoring in wadeable streams (although most have employed targeted, rather than randomized, sampling designs), so SWAMP simply plans to expand the scope of CMAP into a more comprehensive statewide program (Perennial Streams Survey). Design of the statewide program still is underway, but plans call for approximately 500 random stations to be sampled statewide each year plus a smaller number of targeted integrator sites. Concurrently, the Stormwater Monitoring Coalition (SMC) is developing a monitoring plan for Southern California (Regions 4, 8 and 9), which also would be based on a random design of 510 stations within 17 watershed management areas to be sampled over a 5-year period, plus a small number of integrator sites. The Statewide Perennial Streams Survey and the SMC monitoring are scheduled to commence in 2008.

Under the old Toxic Substances Monitoring Program, many of the Regional Boards conducted bioaccumulation sampling of fish from lakes and reservoirs, but without a coordinated design. SWAMP's Bioaccumulation Oversight Group is nearing completion on a statewide monitoring program, based on a randomized design, which is scheduled to commence in spring 2007. Approximately 200 of the most popular fishing lakes where anglers consume their catch will be sampled in 2007 and 2008, targeting a predator species (preferably largemouth bass) and a bottom feeder (preferably catfish). During 2007, fifty of the lakes in the other category will be sampled randomly. The statewide program should provide a useful framework for implementing this type of sampling in the Los Angeles Region where we have identified 31 lakes and reservoirs that meet these criteria. We propose to sample these 31 lakes in our region so that we can assess this significant issue for all of our fishable lakes. The statewide design still is under development, but it appears that additionally several of our lakes would be sampled via the random station draw.

Bight monitoring of ocean waters conducted in 1994, 1998, 2003 has provided sufficient data to assess recreational use of coastal waters (1998 survey included a randomized sampling design to assess shoreline conditions) and aquatic life protection (all three surveys), and the study planned for 2008 probably will include fishing uses as well. Therefore, we have not needed to expend SWAMP resources for this type of monitoring.

As SWAMP develops statewide monitoring programs for other waterbody/beneficial use combinations, we expect to contribute a portion of our regional allocation to expand the monitoring effort within the Los Angeles Region. SWAMP currently is assessing the need for a statewide monitoring program focused on recreational use in wadeable streams. Once the design for the bioaccumulation study in lakes and reservoirs has been completed, the SWAMP Bioaccumulation Oversight Group will consider the need for statewide programs to assess fishing uses in ocean waters, estuaries, large rivers, wadeable streams and wetlands.

The U.S. Environmental Protection Agency (USEPA) will be conducting a national lake study during 2007, which includes 21 lakes in California. SWAMP concluded that it would not be useful to augment that study with SWAMP funds (due to funding constraints and monitoring design issues). However, SWAMP is interested in developing a statewide monitoring program to assess recreational use and aquatic life protection in lakes and reservoirs. That effort probably will occur in 2008 or later, after we have reviewed the results of the EPA study.

The table below summarizes the monitoring programs underway or under development. Many gaps still exist, as evidenced by the blanks in the table. As SWAMP develops statewide monitoring programs for other waterbody/beneficial use combinations, we expect to contribute a portion of our regional allocation to expand the monitoring effort within the Los Angeles Region. SWAMP currently is assessing the need for a statewide monitoring program focused on recreational use in wadeable streams. Once the design for the bioaccumulation study in lakes and reservoirs has been completed, the SWAMP Bioaccumulation Oversight Group will consider the need for statewide programs to assess fishing uses in ocean waters, estuaries, large rivers, wadeable streams and wetlands.

Waterbody Type	Recreational Use (e.g., is it safe to swim)	Fishing Uses (e.g., is it safe to eat seafood)	Aquatic Life Protection
Ocean	Bight 94, Bight 98, Bight 03, AB 411 monitoring, shoreline monitoring network for Santa Monica Bay	Coastal Fish Contamination Program 1999-2001; Probably will be added to Bight 08	Bight 94, Bight 98, Bight 03, Bight 08
Estuaries		Coastal Fish Contamination Program 1999-2001; Probably will be added to Bight 08 for certain estuaries	Bight 94, Bight 98, Bight 03, Bight 08
Lakes/Reservoirs	SWAMP may develop statewide design in future	SWAMP statewide monitoring in 2007/2008	EPA Lake Study in 2007, SWAMP statewide design expected in near future
Large Rivers	None in Region 4	None in Region 4	None in Region 4
Wadeable Streams	SWAMP may develop statewide design in future	SWAMP statewide design expected in near future	SWAMP statewide monitoring in 2008; Stormwater Monitoring Coalition Monitoring in 2008
Wetlands			Probably will be added to Bight 08 for coastal wetlands; SWAMP statewide monitoring in 2008 will provide some assessment of riparian habitat in wadeable streams

Another major focus of SWAMP, per SPARC recommendations, will be to leverage other monitoring program resources to augment the limited SWAMP funds. The Regional Board already has done this very successfully with the San Gabriel Watershed Regional Monitoring Program. To help get the program started, we subsidized about half of the 2005 monitoring program with funds from our SWAMP allocation (the other half came from dischargers, EPA, SCCWRP, and volunteers), but the 2006 sampling was conducted without financial assistance from SWAMP and the program now is self-sufficient and will be conducting coordinated and integrated regional monitoring of wadeable streams each year. Our goal is to facilitate the implementation of similar programs in other watersheds, namely Calleguas Creek, Ventura River, Santa Clara River, Malibu Creek, Ballona Creek, Los Angeles River and Dominguez Channel. By taking advantage of existing monitoring required by POTWs and stormwater dischargers, TMDL-mandated monitoring, and volunteer monitoring programs, we hope to redesign monitoring programs and reallocate existing resources to create self-sufficient regional monitoring programs. However, these programs may require some contribution of SWAMP funds from our regional allocation to get started or to continue monitoring.

Coastal Fish Contamination Program: Governor Wilson's Executive Order W-162-97 (issued October 8, 1997) required Cal/EPA to inventory existing ocean and coastal water quality monitoring programs and make recommendations for a comprehensive program for monitoring water quality and reducing pollution within coastal watersheds, bays, estuaries, lagoons and nearshore ocean waters. The State Water Resources Control Board was assigned the responsibility to implement this mandate (funded by AB 1581 and AB 1429). SB 753 required the SWRCB to establish a statewide monitoring program to assess human health risks associated with recreational fishing and seafood consumption. A screening study was initiated during 1999 to assess approximately ten sites and supplement the information already available for Santa Monica Bay. However, oceanic conditions associated with an El Nino event precluded adequate collection of fish samples during 1999, so the screening study was extended into 2000. Sampling during 2001 and 2002 was geared towards collecting additional data for areas where fish tissue contamination levels were high. The ultimate goal was to develop a regional (Region 4 coastline, not just Santa Monica Bay) sampling program, which would keep most of the original framework created by the Bay Restoration Project, but expand it throughout the region. An inventory of coastal water quality monitoring programs has been prepared for Southern California with the assistance of SCCWRP; it can be accessed at: http://www.sfei.org/camp. This program is now under the auspices of SWAMP.

State Mussel Watch/Toxic Substances Monitoring Programs (SMW/TSMP): Water column monitoring for toxic substances can be unreliable since toxic substances are often transported intermittently and can be missed with standard "grab" sampling of water. In addition, harmful levels of toxicants are often present in such low concentrations that detecting them can be difficult and expensive. In some cases, a more realistic and cost-effective approach is to test the flesh of fish and other aquatic organisms that bioaccumulate these compounds in their tissues and concentrate toxicants through the food web.

In 1977, two biomonitoring programs were initiated by State Board: the Toxic Substances Monitoring and State Mussel Watch Programs. The Los Angeles Region is active in both programs which are implemented jointly by the State Board and the California Department of Fish and Game. Tissue samples collected under the TSMP are usually fish but can also include benthic invertebrates. The tissue is analyzed for trace metals and synthetic organic chemicals. The fish are generally collected from inland fresh waters but are occasionally collected from estuaries. The SMWP provides similar documentation of the quality of coastal marine and estuarine waters. Mussels, which are sessile (attached) bivalve invertebrates, serve as indicator organisms and provide a localized measurement of water quality, as they accumulate trace metals and synthetic organic chemicals in their tissues. Mussels are generally transplanted into the test site from "clean" areas of the state (generally Bodega Bay) although occasionally local, "resident" mussels are collected. Other types of shellfish can be used at times and sediments have, at times, been collected. The focus of TSMP sampling in the region has tended to be trend monitoring while the SMWP has been used more for "hot spot" identification although with lesser resources available in recent years, the SMWP has moved away from hot spot identification in favor of long-term trend monitoring at fewer sites in recent years. Data from these two programs have been critical in determining beneficial use impairments in coastal waters. These programs are now under the auspices of SWAMP; their data may be found on the State Board's website at: http://www.waterboards.ca.gov/swamp/mussel_watch.html .

Basin Planning

Water Quality Legislation

The Porter-Cologne Water Quality Control Act (California Water Code) was enacted by the State in 1969 and became effective January 1, 1970. This legislation authorizes the State Board to adopt, review, and revise policies for all waters of the state and directs the Regional Boards to develop regional Basin Plans.

The Clean Water Act (CWA), enacted by the federal government in 1972, was designed to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. One of the national goals states that wherever attainable, water quality should provide for the protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water (i.e., fishable, swimmable). The CWA directs states to establish water quality standards for all "waters of the United States" and review and update such standards on a triennial basis.

The USEPA has delegated responsibility for implementation of portions of the CWA to the State and Regional Boards, including water quality planning and control programs such as the National Pollutant Discharge Elimination System (NPDES).

Besides state and federal laws, several court decisions provide guidance for basin planning. One decision reaffirmed the public trust doctrine, holding that the public trust is "an affirmation of the duty of the state to protect the people's common heritage in streams, lakes, marshlands, and tidelands, surrendering that right of protection only in rare cases when the abandonment of that right is consistent with the purposes of the trust." Public trust encompasses uses of water for commerce, navigation, fisheries, and recreation.

Basin Plans

Regional Board Basin Plans are designed to preserve and enhance water quality and protect the beneficial uses of all regional waters by providing consistent long-term standards and program guidance for the Region. Specifically, Basin Plans (i) designate beneficial uses for surface and ground waters, (ii) set narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state's antidegradation policy, and (iii) describe implementation programs to protect all waters in the Region. In addition, Basin Plan incorporate (by reference) all applicable State and Regional Board plans and policies and other pertinent water quality policies and regulations. A copy of the Basin Plan may be found at http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/Basin_plan/basin_plan.html .

As part of the State's Continuing Planning Process, components of Basin Plans are reviewed as new data and information become available or as specific needs arise. Comprehensive updates of Basin Plans occur in response to state and federal legislative requirements and as funding becomes available. State Board and other governmental entities' (federal, state and local) plans, that can affect water quality, are incorporated into the planning process. Following adoption by Regional Boards, the Basin Plans and subsequent amendments are subject to approval by the State Board, the State Office of Administrative Law (OAL), and the United States Environmental Protection Agency (USEPA).

Basin Plan Amendments

Basin Plan amendments will be completed periodically as new standards, policies, and other information are developed. TMDLs will also be adopted as Basin Plan amendments and will generate a significant workload over the next 13 years. We also anticipate that watershed efforts utilized, in part, to accomplish TMDLs will identify other possibilities for Basin Plan studies and amendments (e.g., new or revised standards, new policies).

A Basin Plan amendment updating municipal and domestic water supply designations was brought to the Board for consideration in late 1998. In November 1998, the Regional Board voted to amend the Water Quality Control Plan for the Los Angeles Region (Basin Plan), by adopting a resolution to "Incorporate Changes in Beneficial Use Designations for Selected Waters." This amendment removed the beneficial use designation for "Municipal and Domestic Supply" (MUN) from eight surface waters and two ground water areas along the coast. The State Board voted to approve this amendment at the February 1999 Board hearing, however, in July 1999, the State Office of Administrative Law (OAL) issued a Notification of Disapproval due to a number of details including our responses to comments. The Regional Board resubmitted groundwater portion of the amendment, which was approved by OAL in 2000.

In 1990, the Regional Board adopted Resolution No. 90-004 (Drought Policy) which had a term of three years and provided interim relief to dischargers who experienced difficulty meeting chloride objectives because of a state-wide drought. The policy adjusted effluent limits to the lesser of 1) 250 mg/l or 2) the chloride concentration in the water supply plus 85 mg/l. In 1995, the Regional Board extended the interim limits for three years and directed staff to develop a long-term solution to deal with the impact of changing water supply, especially during droughts. In 1997, the Regional Board adopted Resolution No. 97-002 (Chloride Policy) which amended the Basin Plan by setting the chloride objective at 190 mg/l except in the Calleguas Creek and Santa Clara River Watersheds where, due to the great concern for protection of agriculture, staff were directed to determine the chloride concentrations sufficient to protect agricultural beneficial uses. The Chloride Policy has since been approved by the State Board and Office of Administrative Law (OAL).

Recent Basin Plan amendments may be found on the Regional Board’s website at http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/Basin_plan/basin_plan_amendment_tmdl.htm.

Water Quality Objectives

The CWA (§303) requires states to develop water quality standards for all waters and to submit to the USEPA for approval all new or revised water quality standards are established for inland surface and ocean waters. Water quality standards consist of a combination of beneficial uses and water quality objectives, as well as an antidegradation policy. Water quality objectives may be expressed as either numeric limits or a narrative statement.

In addition to the federal mandate, the California Water Code (§13241) specifies that each Regional Board shall establish water quality objectives. The Water Code defines water quality objectives as "the allowable limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." Thus, water quality objectives are intended (i) to protect the public health and welfare and (ii) to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. Water quality objectives are achieved through Waste Discharge Requirements and other programs. These objectives, when compared with future water quality data, also provide the basis for identifying trends toward degradation or enhancement of regional waters.

Triennial Review Process

The California Water Code, (§13240), directs the State and Regional Boards to periodically review and update Basin Plans. Furthermore, the CWA (§303 [c]) directs states to review water quality standards every three years (triennial review) and, as appropriate, modify and adopt new standards.

In the Triennial Review Process, basin planning issues are formally identified and ranked during the public hearing process. These and other modifications to the Basin Plan are implemented through Basin Plan amendments as described below. In addition, the Regional Board can amend the Basin Plan as needed. Such amendments need not coincide with the Triennial Review Process.

The 2005 - 2007 Triennial Review identified 56 new basin planning priorities (24 issues were identified as high priorities, 14 as medium priorities, and 10 as low priorities); an additional eight projects are ongoing from the previous triennial review. The Basin Planning Program currently operates with less than two PYs (1.8 PYs) per year or 5.4 PYs over a three-year period. Completing all 56 over the next three years would require an estimated 18.65 PYs. A total of 2.6 Basin Planning PYs are needed to complete the eight ongoing projects leaving 2.8 Basin Planning PYs available over the following three years to address the highest priorities identified during this Triennial Review. Given these resource constraints, staff further ranked the 24 high priorities relative to each other. An estimated 7.95 Basin Planning PYs would be necessary to complete all 24 high priority issues. Ultimately, staff recommended addressing the eight ongoing projects (Basin Planning resource commitment of 2.6 PYs) along with the top eleven high priorities (Basin Planning resource commitment of 2.9 PYs) over the next three years.

The ongoing projects include: 1) develop & oversee pilot project on "tiered aquatic life uses"; 2) clarification of uses related to fish consumption, development of new use(s) and or subcategories of use; 3) oversee stakeholder-led studies to develop copper site-specific objectives (SSOs); 4) evaluate appropriate averaging period(s) for mineral quality objectives; 5) evaluate groundwater MUN de-designation requests, consider as an alternative maintaining the MUN use, but suspending objectives for natural constituents where it can be demonstrated the source is natural in origin; 6) adopt ammonia SSO (in the San Gabriel River, Los Angeles River, and Santa Clara River Watersheds); 7) participate in statewide effort to adopt total residual chlorine objectives and implementation provisions; and 8) develop a regional policy on hydromodification of watercourses in the Los Angeles Region, consider including criteria and evaluation requirements to be used by Board staff when evaluating projects for certification or WDRs.

The new high priority projects to be addressed are: 1) adopt the upcoming TMDLs as Basin Plan Amendments; 2) develop a general policy for interpreting narrative objectives, identify and prioritize narrative objectives for addition or revision, address one or two of the identified priorities; 3) consider developing a regional policy, or work with State Board staff on a statewide policy, on interpreting narrative toxicity objectives; 4) work with State Board staff to develop numeric or narrative objectives for sediment quality and sediment toxicity; 5) continue groundwork, including participation in RTAG, in support of developing nutrient criteria as required by USEPA; 6) update maps in Basin Plan; 7) evaluate what hardness value(s) should be used in the calculation of permit limits (or TMDLs) for hardness-dependent metals; 8) assess what temperature and pH values of what waters should be used in determining the ammonia objective for a waterbody, clarify how the 30-day objectives are evaluated; 9) continue groundwork in support of developing numeric biocriteria, develop a narrative objective for biological integrity (statewide effort); 10) clarify application of the tributary rule; and 11) participate in Statewide effort on Effluent-Dominated Waters Policy. Many of these issues were raised due to EPA recommendations, new legislation, court orders, or stakeholder input. The 2007 Triennial Review Process is currently underway.

Additional information on triennial reviews may be found on the Regional Board website at http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/Basin_plan/2004Triennial/2004Triennial.html.

Waivers

Regional Boards may issue both categorical and individual waivers. In the case of categorical waivers, the Regional Board must approve and issue categorical waiver criteria either through adopting a specific resolution or Basin Plan amendment. Once a categorical waiver is approved by the Regional Board, Regional Board staff may be delegated the responsibility to review and approve categorical waivers. Four categorical waivers have been approved in the Region, as set forth in Resolution No. 53-5 (adopted in 1953). These are: septic tanks, swimming pool discharges, on-site drilling mud discharges from single oil wells, and discharges from private impoundments or lakes. Individual waivers are typically for construction or development projects that are short-term or one-time events.

Section 13269, Paragraph (a), of the Water Code states that certain Water Code provisions "may be waived" by a Regional Board for a specific discharge or a specific type of discharge "if the waiver is not against the public interest." However, recent legislation (Senate Bill 390, amending Section 13269) requires that all waivers or waiver categories be evaluated and renewed every 5 years. The legislation stated that, initially, Regional Boards must evaluate and renew all waivers and waiver categories by January 1, 2003, otherwise they will automatically terminate. After this initial evaluation and renewal, Regional Boards must conduct on-going compliance monitoring and renew, every 5 years, all waivers and waiver categories. The evaluation of waivers requires an initial review of all waivers and waiver categories, as well as validation of the adequacy of waiver conditions through field sampling at a representative number of discharges granted waivers. Depending on the data generated from this exercise, the Regional Board may decide to renew the waiver category (based on the adequacy of waiver conditions and their observance), amend the conditions (based on their inadequacy as documented through field tests), or allow the waiver category to automatically terminate on 1/1/2003 (based on the documented impact on water quality). If the last option is chosen, the Regional Board will then have to determine how those discharges should be regulated—either through general WDRs or individual WDRs.

Conditional Waiver for Onsite Wastewater Treatment Systems (OSWS)

The septic tank waiver involved many complexities. The Regional Board issued waivers for residential onsite wastewater treatment systems (septic systems) in the early 1950's as Resolution Nos. 52-4 and 53-6. Through these waivers, the Regional Board delegated its septic system permitting responsibility to Los Angeles and Ventura Counties, among other local agencies with land use and planning powers. Recent legislation amending section 13269 of the CWC required that the Regional Board review its septic system waivers and either renew or terminate them by June 30, 2004. The Regional Board would need to issue general or individual WDRs for ongoing discharges in the event waivers were not renewed. The revised section also requires that the Regional Board enforce the waivers and renew and/or terminate them every five years.

According to section 13269 of the CWC and the Basin Plan, in order for the Regional Board to renew the waivers, they must find that discharges from residential septic systems pose a minimal threat to water quality. At the June 10, 2004 regular Board meeting, the Regional Board approved Resolution No. R4-008, adopting waivers and a template memorandum of understanding (MOU) for residential and certain de minimis commercial septic systems. The waivers were in effect for a period of 60 days in the unincorporated portion of the County of Los Angeles and the City of Malibu and 120 days in the remaining areas of the Region. Local agencies were required to enter MOUs with the Regional Board based on the template MOU in order for the waivers to be extended beyond these deadlines.

According to the template MOU, local agencies shall amend their municipal plumbing code and permitting program to be substantially equivalent to upcoming statewide standards for septic systems adopted pursuant to sections 13290 and 13291 of the California Water Code. The template MOU also requires local agencies to conduct an inventory of all septic systems under their jurisdiction and take additional interim measures to ensure that septic systems pose a minimal threat to water quality. The MOUs shall be reviewed every five years. The Regional Board adopted general WDRs on September 2, 2004 (Order No. R4-2004-0146) to issue to homeowners in cities without waivers.

The Regional Board will issue Order No. R4-2004-0146 in cities where there is no MOU and where residents apply for permits for new or repaired systems.

AB 885 was passed in 2000 and requires the State Water Board to draft and implement statewide regulations for siting, installation, operation, and maintenance of OWTS. A draft of these regulations is available at http://www.waterboards.ca.gov/ab885/docs/ab885_draftrule.pdf.

Conditional Waiver for Irrigated Lands

The Los Angeles Regional Water Quality Control Board adopted the Conditional Waiver for Irrigated Lands at its November 3, 2005, Board meeting.

Statewide monitoring has shown the presence of chemicals associated with agriculture operations in waters of the state. And, in Ventura County, the Regional Board has observed water quality impairments related to agriculture. Under Section 13269 of the Porter Cologne Water Quality Control Act, waivers are appropriate when they are consistent with other water quality control plans and are in the public interest and are not to exceed 5 years in duration. The overall goal of the Conditional Waiver program is to improve and protect water quality in the Region through extensive water quality monitoring and implementation of Best Management Practices (BMPs). If the monitoring results show an exceedance of a water quality benchmark, development of a Water Quality Management Plan (WQMP) is triggered which will include the implementation of BMPs to mitigate the impairment.

The first year focused on enrollment and initiation of the program and identified the location of the Dischargers and monitoring sites. Once enrollment documents were reviewed, the Regional Board's Executive Officer issued the Notice of Applicability (NOA), which is the formal notice that the enrollment documents are approved. Water quality monitoring started in January 2007.

Dischargers can enroll in the program as an Individual or as a member of a Discharger Group. The majority of growers have enrolled as members of a Discharger group. The waiver program also requires 8 hours of educational training for growers.

There are currently two established Discharger Groups participating in the Conditional Waiver program. The Group representing growers in Ventura County is the Ventura County Agriculture Irrigated Lands group which consists of 1,080 landowner members representing 73,697 acres. There are 27,000 acres enrolled in the Santa Clara River Watershed.

Seven monitoring sites have been selected to characterize agriculture inputs in the watershed within Ventura County. The monitoring locations are generally located at the lower end of mainstem tributaries or agricultural drainages and were selected in areas that were primarily influenced by irrigated agriculture and unlikely to receive inputs from other land uses.

The Nursery Growers Association – Los Angeles County Irrigated Lands Group is the Discharger Group formed to represent growers in Los Angeles County.

Water Quality Priorities

Our major water quality priorities, as first described in the Introduction of this document, and roughly organized along program lines are reiterated below. In addition to those that are Regional Board-directed, priorities are mandated by legislation, statute, regulation, State Board, Cal-EPA, USEPA, and from sheer need to protect, restore, or enhance water quality. A list of the highest of these collective priorities follows along with brief highlights of past successes and future issues as appropriate. TMDL-related work is considered the highest statewide, as well as, regional priority. These Board priorities are further highlighted in the watershed and region-wide sections as appropriate. Grant funding may aid in addressing some of these priorities, at least in part, while other of these priorities will need to remain within the sole purview of the Board's regulatory programs. Some priorities that are seemingly associated with a single program, such as municipal stormwater permitting or TMDL development, in fact affect work in multiple programs which can make funding these priorities a complex task. Basin Planning, in particular, is often impacted by work done in other programs.

TMDLs

- Development, adoption, and implementation of **TMDLs** – about 20 TMDLs (with implementation plans) have been approved by USEPA and about 10 are awaiting approval; about 10 more are scheduled for development over the short-term
- Addressing **beach closures** – a number of beach bacteria TMDLs have been adopted including the Santa Monica Bay wet weather and dry weather TMDLs. Upcoming will be the potential adjustment of implementation schedules based on development of integrated water resources approaches and a re-evaluation of the reference system approach for setting allowable exceedance days.
- Implementation of **agricultural waiver** – good success in Ventura County (80% enrollment and WQ monitoring instituted) thus far; now need increased enrollment in LA County and overall strategic implementation of BMPs

Non Point Sources

- Need for strategies to address **agriculture** and **septic systems** - implementation of the agricultural waiver to further TMDL compliance is also helping fulfill NPS program goals; new septic systems located in areas without sufficient separation from groundwater and nearby surface waters must install advanced treatment; the next challenge for septic systems will be to address cumulative effects which occur with infilling new systems in areas already dense with existing systems.

Basin Planning and Standards

- Full implementation of our **water quality standards** program is a necessity – site-specific objectives were adopted for ammonia in the Santa Clara, San Gabriel, and Los Angeles Rivers Watersheds while a water effects ratio was adopted for copper in the Calleguas Creek Watershed.

- Work is ongoing to target a **design storm** for implementation of wet weather BMPs
- **Tiered Aquatic Life Uses**, in relation to biocriteria, are in development

NPDES Permits

- Controlling compounds from point sources which continue to cause instream toxicity and/or accumulate in sediments or biota – pthalates and other **emerging chemicals**, including pharmaceuticals are becoming major issues.
- **Power plants** – the nine facilities in the Region are conducting plankton studies and investigating possible alternatives to once-through cooling water discharges
- Municipal stormwater/urban runoff – the LA County **MS4 permit** was reopened twice to incorporate the summer dry weather provisions of two bacteria TMDLs; renewals of permits are in progress.
- **New/re-development** – proactively addressing water quality issues through CEQA, 401 certifications, or stormwater permits; ensuring wet weather compliance with construction permits.

Water Reclamation Requirements/Water Conservation

- Reduce, reuse, and **recycle water** – maximize water conservation in Region.
- Addressing the **regional salt management**/salt imbalance issue which is becoming increasingly critical in the region, and balancing this issue with the need to promote the use of reclaimed water.

Habitat Protection

- Preservation of high quality habitats – ensure maintenance of beneficial uses at these sites through support of **low-impact development** coupled with minimized/avoided hydromodification
- **Habitat loss/restoration** – even with strides in improving instream water quality, unless habitat is restored (riparian/wetlands, in particular), in many cases beneficial uses can not be fully restored.

Monitoring

- Coordination of existing resources and participation in the Surface Water Ambient Monitoring Program is of great importance as is more use of **bioassessment** as a tool.
- **Coordinated watershed-wide monitoring** programs exist in the San Gabriel River, Calleguas Creek, and Malibu Creek Watersheds while programs are being developed in the Los Angeles River and Santa Clara River Watersheds.

Contaminated Sediments/Waste Discharge Requirements

- Many of the impairments in the Region, particularly in harbors, are related to **contaminated sediments**. While source reduction will decrease pollutant levels over time, remediation of these sediments will also be needed which will be a long-term project. Cleanup of contaminated sediments in Consolidated Slip in Los Angeles Harbor will be a long-term project.
- Accurately characterizing the threat from contaminated sediments throughout the Region will be aided with adoption of **sediment quality objectives** in the near future by State Board.

Potential Projects, Activities, or Needs to Meet Board Priorities or Otherwise Improve Water Quality

The table below contains a cumulative list of activities, projects, or needs which we, or our stakeholders, see as ways to improve water quality and beneficial uses in the various watersheds (or region-wide). Those activities, projects, or needs most directly involved with our water quality priorities listed above are highlighted in **bold**. In general, funding is available from a large variety of state and federal agencies as well as private groups and these should be utilized as fully as possible even when a proposal involves addressing one of our water quality priorities. Funding source requirements should be carefully researched to ensure a good match with potential projects. Consulting the California Watershed Funding Database at http://calwatershedfunds.org/ may be helpful.

Our long-term, cumulative list of potential grant projects

Project/Activity/Needs Type and Description	San Gabriel River	Los Angeles River	Santa Monica Bay	Ventura River	Calleguas Creek	Santa Clara River	Misc. Ventura Coastal	Dominguez Ch/Harbors	Los Cerritos/Alamitos Bay	Region-wide
TMDLs										
Implement TMDLs & projects supporting TMDLs										X
Investigate loading contributions from septic systems			X			X	X			
Evaluate impacts of antifouling paints and pump-outs in marinas			X					X	X	
Evaluate impacts from large-scale development in the upper river, and integration of sustainable land uses and landscape designs						X				
Identify conflicts between water supply and water quality in lower watershed						X				
Loading contributions from agricultural activities:					X	X				
Quantify & characterize nitrogen and salt loading contributions to ground and surface water					X	X				
Quantify & characterize historic pesticides loading					X	X				
Quantify & characterize chlorpyrifos & diazinon loading					X	X				
Quantify & characterize sediment loading					X					
Investigate toxicity from agriculture loading					X	X				
Quantify & characterize crop- or practice-specific pollutant loading contributions (i.e., strawberries or nurseries)	X	X	X	X	X	X	X			
Agricultural practices:										
Quantify & characterize irrigation practices										X
Quantify & characterize pesticide application rates					X	X	X		X	X
Quantify & characterize tile drains					X				X	
Quantify & characterize existing Agriculture Management Measures										X
Loading contributions from urban activities:										X
Investigate loading contributions from residential and urban activities					X	X	X			
Quantify & characterize organics and/or metals accumulation and loadings				X	X			X	X	
Evaluate and identify sources of urban runoff toxicity			X							

Prioritize storm drains needing diversion; focus efforts on major problem drains for coliform TMDL implementation	X		X							
Identify and evaluate opportunities to promote recovery and restoration of steelhead trout			X	X		X				
Develop TMDLs										X
Investigate loading contributions from golf courses										X
Evaluate impacts of reservoir cleaning on water quality	X									
Evaluate impacts of reclaimed water on surface/groundwater	X									
Evaluate impacts of urban runoff on isolated water bodies									X	
Evaluate impacts of loss of tidal exchange									X	
Evaluate peak storm water runoff discharge control to reduce erosion			X							
Assess fish contamination levels in entire Santa Monica Bay			X							
Investigate eutrophication in the Ventura River Estuary				X						
Investigate sedimentation in Mugu Lagoon					X					
Non Point Sources										
Nonpoint pollution control strategies:										X
Implement Irrigation Management Measures										X
Implement septic corrective measures		X	X				X			
Implement management measures to reduce NPS pollution in marinas			X				X	X		
Implement Erosion & Sediment Control Management Measures (natural/non-structural) to reduce erosion while increasing wildlife habitat			X	X	X	X	X			
Urban nonpoint pollution control:										X
Implement trash reduction BMPs	X	X	X							
Implement urban runoff reduction BMPs	X	X	X					X	X	
Manage urban runoff	X	X	X		X	X	X	X		
Agricultural nonpoint source control:	X	X	X	X	X	X	X			
Implement Ag waiver BMP program				X	X	X	X			
Implement Integrated Farm Management Plans				X	X	X	X			
Implement Nutrient Management Measures				X	X	X	X			
Implement agricultural buffer BMPs				X	X	X	X			
Pesticide Management:										X
Implement Integrated Pest Management Practices					X	X				
Implement chlorpyrifos & diazinon loading control measures					X	X				
Manage horse corral runoff	X	X	X	X						
Manage golf course irrigation runoff		X			X				X	
Manage nursery runoff	X	X								
Research management measures to reduce NPS pollution in marinas							X			
Evaluate which BMPs are most effective for the various industrial sectors										X
Study effectiveness of non-structural BMPs (public outreach)			X							

Evaluate design and performance standards for implementation of storm water BMPs										**X**
Analyze storm water quality data and trends from various industrial sectors (e.g. metal yards, waste management facilities, etc.)										**X**
Develop nonpoint pollution control strategies										**X**
Basin Planning and Standards										
Further investigate efficacy of Tiered Aquatic Life Uses										**X**
Support continued work in development of nutrient objectives										**X**
NPDES Permits										
Septic tank education/outreach			**X**				**X**			
Implement Agriculture Management Measures Education/Outreach					**X**	**X**	**X**			
Conduct activities to increase public awareness of nonpoint source pollution and the related solutions available										**X**
Implement watershed education and outreach										**X**
Water Reclamation Requirements/Water Conservation										
Expand water recycling/conservation facilities										**X**
Habitat Protection										
Restore pocket wetlands along highly altered waterways where there were historic wetlands	**X**	**X**						**X**	**X**	
Restoration impaired riparian and aquatic habitats (i.e. Malibu Lagoon, McGrath Lake, Topanga Lagoon, Ormond Beach area, Colorado Lagoon, Dominguez Ch. soft bottom)	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	
Restore river channels and habitat following impacts from mining	**X**					**X**				
Enhance/restore steelhead trout habitat			**X**	**X**		**X**				
Enhance the water's beneficial and recreational uses	**X**	**X**	**X**				**X**			
Implement mitigation measures for floodplain development						**X**				
Monitoring										
Implement a watershed wide monitoring program								**X**		
Implement biological & toxicity monitoring	**X**		**X**		**X**	**X**	**X**	**X**	**X**	
Implement ag waiver monitoring program										**X**
Research and develop indicators and a "report card" format										**X**
Develop practical sanitation survey tools			**X**							
Implement citizen monitoring	**X**								**X**	
Contaminated Sediments/Waste Discharge Requirements										
Mitigate groundwater overdraft						**X**	**X**			
Investigate nitrogen and salt loading contributions to ground and surface water					**X**	**X**			**X**	**X**
Demonstrate water reuse projects to lower demand on supply										**X**
Identify conflicts between water supply and water quality in lower watershed						**X**				

Watersheds where projects/activities/needs to be addressed are of the greatest important *(independent of whether a water quality priority is being addressed)* are marked with an "X". We would prefer the identified projects/activities/needs in these watersheds specifically be funded.

Since many funding sources require proposed projects be consistent with watershed management, restoration, or other plans for the watershed (otherwise collectively identified here as "Watershed Restoration Action Strategies"), the table below list those we know about, whether final, draft, or in process. Additionally, many State grant funding sources are now requiring a proposed project be included in an Integrated Regional Water Management Plan (IRWMP).

Watershed Restoration Action Strategies in the Los Angeles Region

Watershed or Watershed Management Area	Watershed Restoration Action Strategies or Equivalent Documents (in progress, draft, or final)
Los Angeles River Watershed	US Forest Service. *Forest Plan, Angeles National Forest*. (Final) http://www.fs.fed.us/r5/scfpr/projects/lmp/index.htm San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy. *Guiding Principles Watershed and Open Space Plan* (Final) http://www.rmc.ca.gov/ City of Los Angeles, US Army Corps of Engineers, et al. *Los Angeles River Revitalization Master Plan*, 2007. (Final) http://www.lariver.org Northeast Trees. *Arroyo Seco Watershed Management and Restoration Plan* (Final), 2006. http://www.waterboards.ca.gov/losangeles/html/programs/funding/ArroyoSeco%20WMRP.pdf San Gabriel Valley Council of Governments. *Rio Hondo Watershed Management Plan*, 2004 (Final) http://www.rmc.ca.gov/rio_hondo/rh_index.html The River Project. *Tujunga Watershed Management Plan* (in progress) http://www.theriverproject.org/tujunga/ Los Angeles and San Gabriel Rivers Watershed Council. *Compton Creek Watershed Management Plan* (Final) http://www.lasgrwc.org/ComptonCreek.htm
Calleguas Creek Watershed	Natural Resources Conservation Service. *Calleguas Creek Watershed Erosion and Sediment Control Plan for Mugu Lagoon*, 1995. (Final) Calleguas Creek Watershed Management Plan Committee. *Draft Calleguas Creek Watershed Management Plan* (draft) http://www.calleguas.com/ccbrochure/cc.htm David Magney Environmental Consulting. *Calleguas Creek Watershed Wetland Restoration Plan*, 2000. (Final) http://www.calleguas.com/ccbrochure/ccwrp.pdf
Santa Monica Bay WMA	Santa Monica Bay Restoration Project. *Santa Monica Bay Restoration Plan*, 1995. (Final) RCD of the Santa Monica Mountains. *Topanga Creek Watershed Management Plan*, 2002 (Final) http://www.topangaonline.com/twc/index.html Natural Resources Conservation Service. *Malibu Creek Watershed Natural Resources Plan*, 1995. (Final) Los Angeles County Department of Public Works. *Watershed Management Area Plan for the Malibu Creek Watershed* (Draft) Los Angeles County Department of Public Works. *Ballona Creek Watershed Management Plan*, 2004 (Final) http://www.ladpw.org/wmd/watershed/bc/
San Gabriel River Watershed	US Forest Service. *Forest Plan, Angeles National Forest*. (Final) http://www.fs.fed.us/r5/scfpr/projects/lmp/index.htm Los Angeles County Department of Public Works. *San Gabriel River Master Plan* (Final) http://www.sangabrielriver.com San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy. *Guiding Principles Watershed and Open Space Plan* (Final) http://www.rmc.ca.gov/ *Coyote Creek Watershed Management Plan* (Final) http://www.ocwatersheds.com/watersheds/coyotecreek.asp
Los Cerritos Channel/Alamitos Bay WMA	*Colorado Lagoon Restoration Feasibility Study* (Final). http://www.longbeach.gov/news/displaynews.asp?NewsID=561

Watershed or Watershed Management Area	**Watershed Restoration Action Strategies or Equivalent Documents (in progress, draft, or final)**
Dominguez Channel WMA	Los Angeles County Department of Public Works. *Dominguez Channel Watershed Management Area Plan*, 2004. (Final) http://ladpw.org/wmd/watershed/dc City of LA Department of Recreation and Parks and Palos Verdes/South Bay Audubon Society. *Ken Malloy Harbor Regional Park Development Program. Volume I. Habitat Restoration and Lake Water Quality Improvement Design Development Report*, Prepared by Parsons. 2001. (Final)
Channel Islands WMA	Department of Navy. *San Clemente Island Integrated Natural Resources Management Plan*. 2002 (Final)
Santa Clara River Watershed	Santa Clara River Enhancement and Management Plan Steering Committee. *Santa Clara River Enhancement and Management Plan.* (Final) http://www.vcwatershed.org/Watersheds_SantaClara.html City of Santa Clarita. *Santa Clara River Corridor Plan.* (Final) US Forest Service. *Forest Plan, Los Padres National Forest*. (Final) http://www.fs.fed.us/r5/scfpr/projects/lmp/index.htm Upper Santa Clara River IRWMP (in progress) http://www.ladpw.org/wmd/scr/
Ventura River Watershed	Entrix, Inc. *Steelhead Trout Restoration and Recovery Plan*, 1997. (Final) US Forest Service. *Forest Plan, Los Padres National Forest*. (Final) http://www.fs.fed.us/r5/scfpr/projects/lmp/index.htm
Regionwide	California Regional Water Quality Control Board, Los Angeles Region. *Watershed Management Initiative Chapter*, 2007. (Final) http://www.waterboards.ca.gov/losangeles/html/programs/regional_programs.html California Regional Water Quality Control Board, Los Angeles Region. Adopted TMDLs. http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/tmdl.html Los Angeles County IRWMP (Final) http://www.lawaterplan.org/ Ventura County IRWMP (Final) http://www.watershedscoalition.org/
Regionwide, wetlands	Current fiscal year workplan adopted by Board of Governors of the Southern California Wetlands Recovery Project. (Final) http://www.scwrp.org

Wetlands Protection and Management

Wetlands acres in the Region have diminished greatly over the past several decades as coastal development, in particular, has increased. Wetlands provide habitat, serve to slow down water flow, decrease total volume through infiltration, and filter out a number of pollutants through active uptake by plants as well as deposition in sediments. Wetlands such as coastal estuaries are a buffer zone between ocean and inland water resources and are heavily utilized by aquatic organisms. Continuous stretches of riparian habitat function as wildlife corridors to allow animal movement between increasingly isolated populations. They also serve as popular recreational destinations for residents and visitors. Unfortunately, many of our Region's wetlands are impacted by varying kinds and amounts of pollutants and alterations.

Over the past approximately 15 years, we have embarked on a number of efforts to inventory and evaluate our Region's wetlands. These efforts have included the following:

- We funded a 1993 study, entitled *Waterbodies, Wetlands, and their Beneficial Uses in the Los Angeles Region* which provides descriptions, maps, photos, and functional values of wetlands throughout the region.

- The Santa Monica Bay Restoration Project funded a wetlands inventory in 1993 which outlines historical changes in wetlands in the Santa Monica watershed, an inventory of current wetlands in the watershed, and potential restoration and creation projects in the watershed.

- The Regional Board continues involvement in the Southern California Wetlands Recovery Project (WRP) which is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the International border with Mexico. Using a non-regulatory approach and an ecosystem perspective, the WRP works to identify wetland acquisition and restoration priorities, prepare plans for these priority sites, pool funds to undertake these projects, implement priority plans, and oversee post-project maintenance and monitoring. When compared to estimated historical acreages, Los Angeles County has lost 93% of its wetlands while Ventura County has lost 58% of its wetlands. Currently, the Project funds wetlands projects which involve planning, restoration, or acquisition. Some of the this region's wetlands given a high priority for funding include Los Cerritos Wetlands, Malibu Lagoon, Ormond Beach Wetlands, and the Ventura River estuary. More information about the Project may be found on its webpage at http://www.scwrp.org.

  Several major recent activities of the WRP (and partners) has direct relevance to our wetlands protection efforts. The WRP participated in development of a method to assess the condition of wetlands, the California Rapid Assessment Method (CRAM). It is envisioned that this method will eventually be incorporated into monitoring for various regulatory programs such as 401 certifications. It will also serve as a major component of the Integrated Wetlands Regional Assessment Program (IWRAP) which is under development by the WRP in coordination with similar efforts elsewhere in the State. Coordination with Bight '08 is in the planning stages. Finally, remaining activities include the mapping of existing wetland and riparian acreages to serve as a baseline in the IWRAP since monitoring will include a regional survey every ten years, the digitizing of historic topographic maps to help inform restoration work, and development of a Wetlands Tracker database to aid in tracking gains and losses of wetlands acres across both regulatory and non-regulatory programs.

Water Quality Certification (401) Program

A key wetlands regulatory tool for the Regional Board is the CWA Section 401 Water Quality Certification Program which regulates discharges of dredge and fill materials to waters. The 401 certification program is one of the most effective tools the state has for regulating hydrologic modification projects, especially those which directly impact the region's diminishing acres of wetlands and riparian habitat. Program work is conducted in conjunction with U.S. Army Corps of Engineers and the California Department of Fish & Game.

Key program activities should include CEQA documents review/response (possibly involvement as lead agency), pre-construction meetings with applicants, site visits, application processing, follow-up monitoring and inspections, and enforcement. Unfortunately, the program is currently severely underfunded with only application processing being undertaken. Any incremental increases in the baseline PYs would go first toward follow-up work and enforcement, then toward increased support of application processing, then coordination meetings, site visits, and CEQA documents review/response. Follow-up work is especially critical since mitigation wetlands often do not function as well as projected during the planning phase. Another very important activity that could be funded is the development of policies regarding in-stream gravel mining and use of in-stream sediment basins.

Furthermore, beginning in FY00/01, the program began requiring in-house certification rather than sign-off by State Board. This has resulted in more detailed review of all projects, even those which would previously have been given less attention (those with little likelihood of producing impacts) with less time then being available for large projects likely to produce impacts. Another program change which occurred during FY00/01 was allowing third-party petitions of certification decisions; previously, only the applicant was allowed to do this. This leads to potentially needing to divert scarce resources from application processing to litigation work.

Approximately 150-200 applications are processed each year. Information about projects and the program in general is available on the Regional Board website at http://www.waterboards.ca.gov/losangeles/html/meetings/401wqc.html. Additional information may be found on the State Board website at http://www.waterboards.ca.gov/cwa401/index.html

It is envisioned that the eventual use of CRAM and Wetland Tracker as a condition of granting a 401 certification will lead to better information on the effectiveness of mitigation projects in replacing wetlands acres and lost ecosystem values.

Management of Nonpoint Source Pollution

Background

Management of NPS pollution is based upon the requirements of the Porter-Cologne Water Quality Control Act (Porter-Cologne Act). The Porter-Cologne Act, Division 7 of the California Water Code, establishes a comprehensive program for the protection of water quality and beneficial uses of the State's waters and makes explicitly clear the law applies to nonpoint as well as point source discharges. The implementation portion of this comprehensive program should provide for the attainment of water quality standards. The Porter-Cologne Act also establishes the administrative permitting authority—in the form of Waste Discharge Requirements (WDRs), waivers of WDRs or basin plan prohibitions—to be used to control NPS discharges. Additional legislative requirements state that all waivers must be conditional, they are to be re-evaluated and subsequently reissued every five years, and the RWQCBs must require compliance with waiver conditions.

California's Nonpoint Source (NPS) Pollution Control Program has been in effect since 1988 and was updated in 2000. In August 2004 the Office of Administrative Law approved the NPS Policy. The policy supersedes certain elements of the NPS Program Plan and formally eliminates the "three-tiered approach" in informal use.

The two primary federal statutes that establish a framework for addressing nonpoint source pollution in this Region are **Clean Water Act (CWA) Section 319** and the **Coastal Zone Act Reauthorization Amendments (CZARA) of 1990 Section 6217**. Together these statutes encourage states to assess water quality problems associated with nonpoint sources of pollution and to develop programs to control these sources.

- CWA Section 319 requires that, in order to be eligible for federal funding, states develop an assessment report detailing the extent of nonpoint source pollution, and a management program specifying nonpoint source controls.

- CZARA Section 6217(a) requires the state to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters; establish coastal nonpoint source programs.

These programs are being implemented through changes to the state's nonpoint source control program approved by USEPA under CWA Section 319 and through the state's coastal zone management program (implemented in this state by the California Coastal Commission) approved by NOAA under Coastal Zone Management Act Section 306.

Under CZARA, California must (1) provide for the implementation of management measures that are in conformity with the USEPA *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1993) and (2) provide a process for developing and revising management measures to be applied in critical coastal areas and in areas where necessary to attain and maintain water quality standards.

Management measures are defined in CZARA as: "economically achievable measures to control the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollution reduction achievable through application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other available alternatives." Mechanisms for implementation of these management measures may include, for example, permit programs, zoning, enforceable water quality standards, and general environmental laws and prohibitions by which a state exerts control over private and public lands and water uses and natural resources in the coastal zone (including those which may be implemented by agencies other than the State Water Resources Control Board and the California Coastal Commission). States may also use voluntary approaches like economic incentives if they are backed by appropriate regulations.

The State's updated nonpoint source management plan includes a 5-year implementation plan as well as a longer-term 15-year implementation strategy. The plan was adopted by USEPA and NOAA in July 2000. Implementation of the plan will entail the use of considerable resources at the Regional Board level. The "Policy For Implementation And Enforcement Of The Nonpoint Source Pollution Control Program" was adopted by State Board in 2004.

Documents relating to the management plan as well as other useful information may be found at http://www.waterboards.ca.gov/nps/index.html .

The Plan for California's Nonpoint Source Pollution Control Program includes requirements for Critical Coastal Area (CCA) designation. The intent of CCA designation is to direct needed attention to coastal areas of special biological, social, and environmental significance and to provide an impetus for these areas to receive special support and resources. The goal was to identify areas of the coast that are adjacent to coastal water bodies impacted by nonpoint source pollution, or adjacent to high quality waters threatened but not yet impacted by nonpoint source pollution. Documents relating to CCAs can be found at http://www.coastal.ca.gov/nps/cca-nps.html .

While it is clear nonpoint sources of pollution are difficult to manage, the state's current nonpoint source management plan approach which can be tailored to the particular situation:

- Regulatory-based encouragement of management practices (MPs), may occur when voluntary implementation is lacking. Encouragement may be effected through Regional Board waiving of waste discharge requirements if compliance with MPs occurs. Or, MPs may be enforced indirectly by entering into management agency agreements (MAAs) with agencies which have the authority to enforce. These MAAs would reference the specific MPs to be used and the means of implementation.

- The Regional Board can adopt and enforce requirements on any waste discharge including those from nonpoint sources. This involves prescribing effluent limitations which would in turn require implementation of MPs in order to insure compliance.

Specific nonpoint source issues and implementation activities relative to individual watersheds are described in the appropriate watershed section while a general outline of our approach in addressing nonpoint pollution follows.

Our Approach

The State's Nonpoint Source Management Plan puts an emphasis on prioritization of nonpoint source categories as well as those waters impacted by nonpoint source pollution. It also states that management activities and implementation schedules needs are to be identified (e.g. monitoring for source identification, education, training, regulation, interagency agreements, and employment of MPs). As is discussed elsewhere, many of these activities are severely underfunded. However, with that in mind, the following presents this Region’s goals and objectives for the implementation of the State’s Nonpoint Source Management Plan. Program objectives which apply most specifically to particular watersheds are highlighted and enlarged upon in the appropriate watershed section, as appropriate. The following program objectives will serve as a basis for workplan development; the final list of tasks will be dependent on the level of funding.

Nonpoint Source Program Goals

Long-term Program Goal: improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013

- Coordinate the nonpoint source program
- Manage Clean Water Act Section 319(h) nonpoint source control contracts
- Implement the Region’s Waiver of Waste Discharge Requirements for Irrigated Agriculture
- Reduce pollutant loadings through atmospheric deposition control

Nonpoint Source Program Objectives

1) Program coordination – To coordinate 319(h) work plan activities to reflect Water Board priorities; to better coordinate our resources with other divisions and agencies; and implement a strategy that reflects all the NPS Programs contributions to improve water quality.

2) Contract management - Continue focusing 319(h) grant management effort toward building measurable water quality improvements.

3) Agricultural waiver implementation - Continue with first year of agricultural waiver water quality monitoring, review Discharger Group and Individual Discharger 1st annual monitoring reports (includes monitoring data). Initiate development of Water Quality Management Plans as necessary and oversee first round of BMP implementation (irrigation management, pesticide management, nutrient management and erosion control.). Continue grower education and outreach meetings, particularly in LA County to increase enrollment. Set up database to house water quality data generated by the Ag Waiver program

4) Atmospheric deposition control - Collection of data and rigorous and comprehensive assessment of the contribution of atmospheric deposition to water quality impairments; establishment of a working group with local air quality agencies to participate on the Los Angeles and Long Beach Harbors metals TMDL; development of parts of an implementation plan/guidance which addresses air deposition.

REGIONAL NPS* PROBLEMS BY MANAGEMENT MEASURE CATEGORY

	Pollutants impairing or threatening Beneficial Uses arranged by Management Measure Category					
Watershed	Agriculture	Silviculture	Urban	Marinas & Recreational Boating	Hydromodification	Wetlands & Vegetated Treatment Systems
Calleguas Creek Watershed	nitrogen sediment toxicity siltation toxicity salts selenium historic pesticides chlorpyrifos		nitrogen sediment toxicity siltation toxicity mercury other metals historic pesticides chlorpyrifos PCBs trash		siltation	
Los Angeles River Watershed	nitrogen chlorpyrifos historic pesticides coliform		nitrogen chlorpyrifos historic pest. trash selenium other metals coliform PCBs oil VOCs			
Miscellaneous Ventura Coastal Waters WMA	sediment toxicity historic pesticides		sediment toxicity historic pesticides coliform PCBs metals	coliform PCBs TBT metals		
Santa Clara River Watershed	historic pesticides nitrogen salts toxicity chlorpyrifos diazinon		historic pesticides nitrogen coliform toxicity chlorpyrifos diazinon trash			
San Gabriel River Watershed	nitrogen coliform toxicity diazinon		nitrogen coliform toxicity PCBs trash chloride diazinon selenium mercury other metals			

REGIONAL NPS* PROBLEMS BY MANAGEMENT MEASURE CATEGORY (cont'd)

	Pollutants impairing or threatening Beneficial Uses arranged by Management Measure Category					
Watershed	Agriculture	Silviculture	Urban	Marinas & Recreational Boating	Hydromodification	Wetlands & Vegetated Treatment Systems
Santa Monica Bay WMA	coliform		coliform	coliform	exotic vegetation	reduced tidal flushing
	nitrogen		nitrogen PCBs sediment toxicity benthic community effects toxicity PAHs arsenic mercury other metals historic pesticides trash fish consumption advisory debris salts	metals PCBs sediment toxicity benthic community effects toxicity PAHs TBT	habitat alteration hydromodification reduced tidal flushing fish barriers	exotic vegetation
Dominguez Channel and LA/LB Harbors WMA			coliform sediment toxicity benthic comm. effects PCBs historic pesticides PAHs metals nitrogen trash	coliform sediment toxicity benthic comm. effects PCBs historic pesticides PAHs metals TBT		
Los Cerritos Channel and Alamitos Bay WMA			historic pesticides PCBs sediment toxicity PAHs metals nitrogen coliform			
Ventura River Watershed	eutrophication DDT selenium		eutrophication metals trash		diversions	diversions

* Problems may be partially or fully due to NPS. Point sources may also be contributing to the problem.

Regional Board Enforcement Strategy

The statewide Water Quality Enforcement Policy adopted by State Board in 1996 and revised again in 2002 is intended to make all enforcement consistent, predictable, and fair throughout the state. On March 3, 1997, the Regional Board adopted Resolution No. 97-005 which confirmed the Board's desire to carry out enforcement in a manner consistent with State Board's enforcement policy and that Regional Board staff prepare a regional enforcement strategy consistent with State Board's enforcement policy. The Resolution directed staff to implement the Regional Enforcement Strategy.

The statewide Water Quality Enforcement Policy upon which the Region Board Enforcement Strategy is based states that "(v)iolations of Waste Discharge Requirements (WDRs) or applicable statutory or regulatory requirements should result in a prompt enforcement response against the discharger. At a minimum, the Regional Board staff must bring the following to the attention of their Regional Board for possible enforcement action:" effluent limit violations/other permit violations - major dischargers; effluent limit violations/other permit violations - other NPDES/WDR dischargers; toxicity violations - all NPDES dischargers; violations of compliance schedules and enforcement orders - all dischargers; failure to submit reports/deficient reports (excluding stormwater); violations of POTW pretreatment programs; stormwater permit violations/deficiencies/failure to submit reports; other violations and enforcement actions; and spills (generally, non-permittees).

Priority violations include: all NPDES violations that the United States Environmental Protection Agency (USEPA) requires to be reported on the Quarterly Non-Compliance Report (QNCR) for the purpose of tracking significant non-compliance; all violations subject to mandatory minimum penalties pursuant to California Water Code section 13385; and other violations that the SWRCB and/or RWQCB considers to be significant and therefore high priority. Depending on the circumstances, violations that are not included on this list could nonetheless be considered “priority” as well. A copy of the Policy may be found at http://www.waterboards.ca.gov/plnspols/index.html .

Board staff are also involved in a number of interagency environmental task/strike forces including the U.S.EPA Environmental Strike Force, Los Angeles County Strike Force, Ventura County Strike Force, and Santa Monica Mountains Task Force.

Data Management And GIS

Historically, the State Water Information Management system (SWIM) was used as an organizational-wide database designed to facilitate electronic reporting, tracking, and analysis of regional data and information. The California Integrated Water Quality System (CIWQS) has succeeded SWIM as the computer system used by the Water Boards. CIWQS tracks permits, inspections, violations, and enforcement actions. CIWQS also allows on-line submittal of information by Permittees within certain programs and makes data available to the public through reports. A link to CIWQS can be found at http://www.waterboards.ca.gov/ciwqs/index.html. Of great importance is collection of location information so that data and information can be portrayed in layers in a Geographic Information System(GIS).

Other Region-wide Activities

Other activities may be undertaken at odd intervals during the watershed cycle. These include, among others, reviewing CEQA and NEPA documents, reviewing and commenting on requests for Section 401 water quality certification, landfill regulation, site (including DOD/DOE) cleanups, well investigation program activities, leaking underground storage tank cleanups, routine public outreach, and responding to spills, complaints (unrelated to permits), and special requests from the Regional Board. Some of the other region-wide strategies and programs the Regional Board implements are described in more detail below.

BEACHES/COASTAL WATERSHED ACTIVITIES

This Region's coastal resources support many of our most valuable beneficial uses. Our beaches, from Ventura through Zuma, Malibu, Venice and Long Beach are world-renowned. The Region's coastal estuaries, dunes, and wetlands are nearly gone and what is left are highly degraded. These resources, while inherently valuable as natural resources, also have a high economic value to the State with many vacationers naming beaches and lakes as their prime vacation destination. These beaches and coastal resources are a huge tourist dollar generator.

Concurrently, our Region's ports and marinas support valuable beneficial uses providing important avenues of trade as well as recreational boating opportunities and marine habitat. They too are impacted by the need to dredge and dispose of sediments often contaminated by upstream watershed sources.

It is clear the impacts to beaches, bays, coastal wetlands and estuaries, and nearshore waters is especially critical to address from both an economic and ecological perspective. The Regional Board is focusing on protecting these resources through a combination of integrated coastal planning and an aggressive effort to assess and control watershed loadings of key pollutants which continue to degrade coastal areas and increase the costs of dredging. Specific elements of our Beaches/Coastal Watersheds activities that have funding are described below.

Contaminated Sediment Long-term Management Strategy

The Los Angeles County's coastline includes two of the nation's largest commercial ports and several major marina complexes and small-vessel harbors. Maintenance of authorized depths in existing channels and berthing areas and expansion and modernization of ports, harbors, and marinas, requires periodic dredging in virtually all of these facilities. Some of the sediments dredged from these harbors contain elevated levels of heavy metals, pesticides, and other contaminants. In most cases, the concentrations of these contaminants do not approach hazardous levels. However, the sediments contain enough contaminants that they are not suitable for unconfined ocean disposal. The State's Bay Protection and Toxic Cleanup Program identified bays and estuaries containing areas with contaminated sediments. Remediation of these sites may require dredging and disposal of this material. Disposal of any contaminated dredged materials requires special management, such as placement in a confined aquatic disposal site, capping, or disposal in an upland site. Additionally, some ports and harbors have considered other management techniques, such as treatment and beneficial re-use.

The ports and harbors have at times delayed or canceled dredging projects because of contaminated sediment issues. The regulatory agencies were evaluating disposal options for these projects on a case-by-case basis without the benefit of a regional perspective on management alternatives, cumulative impacts, and long-term solutions to prevent re-contamination of sediment. This approach has led to public concern over the ecological and human health implications of contaminated dredged material disposal. To resolve these issues, the regulatory and resource agencies, ports and harbors, environmental groups, and other interested parties agreed to establish a task force. The mission of the **Contaminated Sediment Task Force** (CSTF) is to prepare a Contaminated Sediment Long-Term Management Strategy (Strategy) for the Los Angeles Region (limited to Los Angeles County). Past projects suggest that the major sources of contaminated dredge material will continue to be Marina del Rey Harbor, the ports of Los Angeles and Long Beach, and the mouth of the Los Angeles River.

The members of the CSTF agreed that the Strategy will consider confined aquatic and upland disposal, sediment treatment, beneficial re-use, other management techniques, and contamination source control. The CSTF agreed on a number of goals including identifying the scope of the contaminated sediment problem, an analysis of management and disposal alternatives, development of a unified regulatory approach, and identify inputs of contaminants to coastal waters and ongoing regional efforts to reduce such inputs with a view towards promoting efforts that would reduce the inflow of contaminants. Initially, the CSTF will work with existing watershed management programs.

The CSTF was established through a Memorandum of Understanding (MOU) among the state and federal agencies with regulatory jurisdiction over dredging and disposal activities, as identified by SB 673, and other agencies representing ports, harbors, and marinas. The following agencies are signatory to that MOU: U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; California Coastal Commission; Regional Water Quality Control Board, Los Angeles Region; County of Los Angeles Department of Beaches and Harbors; City of Long Beach; Port of Long Beach; and Port of Los Angeles.

The CSTF is carrying out its operation by two main committees (Executive and Management Committees), and five strategy development committees (Watershed Management and Source Reduction, Aquatic Disposal and Dredging Operations, Upland and Beneficial Re-use, Sediment Screening Thresholds, and Implementation Committees). The membership of the Management Committee includes those parties that signed the MOU and one organization selected to represent the environmental community (Heal the Bay). This committee is the main decision-making group with the CSTF. The Executive Committee consists of the chief executives of the four major agencies that regulate and manage dredging and disposal in Southern California. This committee will facilitate final agency concurrence, adoption, and implementation of the completed strategy. The strategy development committees will develop specific elements of the long-term management plan.

The CSTF completed a Contaminated Sediment Long-Term Management Strategy in 2005 and the document is available at http://www.coastal.ca.gov/sediment/long-term-mgmt-strategy-5-2005.pdf . Other relevant documents may be found at http://www.coastal.ca.gov/sediment/sdindex.html.

Areas of Special Biological Significance

The California Ocean Plan (Ocean Plan) establishes water quality objectives for California's ocean waters and provides the basis for regulation of wastes discharged into the State's coastal waters. It applies to point and non-point source discharges. The State Board adopts the Ocean Plan, and both the State Board and the six coastal Regional Boards implement the Ocean Plan. In 1972 the Ocean Plan stated: "Waste shall be discharged a sufficient distance from areas designated as being of special biological significance to assure maintenance of natural water quality conditions in these areas." In the mid-1970's, thirty-four areas on the coast of California were designated as requiring protection by the State Board and were called Areas of Special Biological Significance (ASBS). The ASBS were intended to afford special protection to marine life through prohibition of waste discharges within these areas. Similar to previous versions of the Ocean Plan, the 2005 Ocean Plan states: "Waste shall not be discharged to areas designated as being of special biological significance. Discharges shall be located a sufficient distance from such designated areas to assure maintenance of natural water quality conditions in these areas."

During the latter half of the 20th century, various state agencies and the Legislature designated some 18 different major categories of Marine Protected Areas and Marine Managed Areas. The Marine Managed Areas Improvement Act added sections to the Public Resources Code (PRC) that simplified the nomenclature and created a system of six defined categories of Marine Managed Areas (MMAs): Marine Reserves, Marine Parks, Marine Conservation Areas, Marine Recreation Management Areas, Marine Cultural Preservation Areas, and State Water Quality Protection Areas (SWQPAs). Under state law the Reserves, Parks, and Conservation Areas are further categorized as Marine Protected Areas (MPAs).

The PRC defines a SWQPA as "a non-terrestrial marine or estuarine area designated to protect marine species of biological communities from an undesirable alteration in natural water quality, including, but not limited to, areas of special biological significance that have been designated by State Board through its water quality control planning process." The PRC goes on to state: "In a state water quality protection area point source waste and thermal discharges shall be prohibited or limited by special conditions. Non-point source pollution shall be controlled to the extent practicable. No other use is restricted." The classification of ASBS as SWQPAs went into effect on January 1, 2003.

Senate Bill 512 later amended the marine managed areas portion of the PRC, effective January 1, 2005, to clarify that ASBS are a subset of SWQPAs and require special protection as determined by the State Board pursuant to the Ocean Plan and the California Thermal Plan. SB 512 also replaced the prior language that required point sources into ASBS to be prohibited or limited by special conditions, but allowed non-point sources to be controlled to the extent practicable. Instead, the absolute discharge prohibition in the Ocean Plan is maintained, unless an exception is granted.

In 2005, the Ocean Plan was amended to change the names of specific ASBS and incorporate the classification of ASBS as SWQPAs pursuant to the PRC. In addition, the Ocean Plan was amended to state that exceptions would be reviewed during the Triennial Review.

Despite the designation of these areas for protection, little was known about the presence and types of discharges occurring within ASBS. And, State Board hearings on the 2001 Ocean Plan amendments brought to light the fact that there are storm water and non-point source discharges into ASBS, despite the Ocean Plan prohibition. The State Board decided in 2001 to fund a study to assess the extent of storm water and non-point source discharges into ASBS/SWQPAs. In July of 2003, the Southern California Coastal Water Research Project (SCCWRP) issued its final report on these discharges. Information gained from the study was intended to be used to guide future action on these discharges. However a more comprehensive monitoring program is necessary to fully determine the status and protection of beneficial uses in ASBS over time. State Board Ocean Unit staff presented an initial set of monitoring requirements in a June 2006 draft Special Protections document to address storm water and nonpoint source discharges. Ocean Unit staff intends to continue working with the Natural Water Quality

Committee, the Multi Agency Rocky Intertidal Network (MARINe), and Water Board's Surface Water Ambient Monitoring Program (SWAMP) staff to further design and plan an ASBS monitoring program. Coordination and/or integration with Bight '08 monitoring may also play an important role in an ASBS monitoring program.

There are eight ASBS within the Los Angeles Region.

- In the Mugu Lagoon to Latigo Point ASBS, 538 drainages were identified. Most of the drainages in this ASBS are discharges, 88 of which are considered a higher threat. Responsible parties include Los Angeles County Department of Public Works, City of Malibu Department of Public Works, California Department of Parks and Recreation, and California Department of Transportation.

- The San Nicolas Island and Begg Rock ASBS has 47 drainages; twelve are discharges, eleven of which are considered a higher threat. The island is owned and operated by the U.S. Navy; there is no access to the public.

- The Santa Barbara and Anacapa Islands ASBS and has two discharges, both of which are considered a higher threat. The islands are managed by the National Park Service.

- The San Clemente Island ASBS has 123 drainages with 23 discharges, fourteen of which are considered a higher threat. The island is owned and operated by the U.S. Navy; there is no access to the public.

- Santa Catalina Island:
  - Subarea One, Isthmus Cove to Catalina Head - This is the largest of the four subareas on Catalina covering approximately 17 miles on the west end. This area has 58 drainages, 38 of which are discharges and are all considered to be a higher threat. The Two Harbors is served by a sewage treatment plant; the effluent is disposed of via spraying on a hillside. In addition, Two Harbors has marina facilities.
  - Subarea Two, North End of Little Harbor to Ben Weston Point - This subarea is relatively small covering approximately 2.7 miles and ranging from the north end of Little Harbor to Ben Weston Point. This area has three discharges, all of which are considered to be a higher threat. This area is used primarily for recreation by islanders and boaters and consists of areas used for camping, picnicking, hiking, and surfing.
  - Subarea Three, Farnsworth Bank Ecological Reserve - This subarea's location offshore precludes it from having any direct land-based anthropogenic inputs. There are no discharges. This area is popular for such activities as scuba diving and fishing
  - Subarea Four, Binnacle Rock to Jewfish Point - This subarea covers approximately 2.8 miles and ranges from Binnacle Rock to Jewfish Point on the east end of the island. It has two discharges , both of which are considered a higher threat. Its major source of anthropogenic inputs most likely would come from a large quarry.

Drainages include both outlets (naturally occurring streams) and discharges, which have an anthropogenic source. Higher threat discharges include municipal, transportation (including stream crossings), construction and industrial storm water, marine operations and piers, agricultural discharges, contaminated surface seeps, sources of human sewage, fish cleaning stations, and marine laboratories and aquaria. Higher threat sources of wastes should be addressed immediately. The State Board report, *Status Report - Areas of Special Biological Significance - August 2006*, describes actions underway to address higher threat discharges. The results of the statewide survey may be found in the report, *Discharges Into State Water Quality Protection Areas* produced in 2003 by SCCWRP for the State Board. Both reports and other information about ASBS may be found at http://www.waterboards.ca.gov/plnspols/asbs.html .

Regional Monitoring of Ocean Waters

The Southern California Bight Pilot Project conducted a survey in 1994 to assess the spatial extent and magnitude of ecological disturbances on the mainland shelf between Point Conception in Central California to the California-Mexico border. The survey was a cooperative effort between four large discharger agencies (City of Los Angeles, County Sanitation Districts of Los Angeles County, Orange County Sanitation District, and City of San Diego), regulators (U.S. Environmental Protection Agency, State Water Resources Control Board, and Los Angeles, Santa Ana, and San Diego Regional Water Quality Control Boards), as well as the Southern California Coastal Water Research Project, and the Santa Monica Bay Restoration Project. Monitoring focused on benthic infauna, sediment chemistry, sediment toxicity, demersal fish/invertebrate populations (trawling), water quality (CTD measurements), and bioaccumulation (fish tissue with species not consumed by humans). Final reports were published in 1998.

A second regional survey of the Southern California Bight was conducted in 1998. Rather than simply repeat the 1994 survey, the participants in the 1998 survey agreed to expand the monitoring program to include a larger geographic scope (including enclosed bays, harbors and estuaries, the Mexican coastline south of California, and offshore channel islands), new monitoring components (microbiology, greater emphasis on stormwater runoff impacts) and additional participants (small point source dischargers, stormwater groups and other interested parties, including volunteer monitoring programs being implemented by environmental organizations). Most of the sampling occurred over a six-week period from late July to early September, although certain components (water quality, microbiology) were performed during different time periods. Sampling of benthic infauna and sediment chemistry took place at approximately 250 stations, sediment toxicity at approximately 200 stations, and demersal fish/invertebrate populations and bioaccumulation at approximately 175 stations. The microbiology sampling was conducted at approximately 250 stations once per week over a 5-week period in August-September 1998 (dry season) and February-March 1999 (wet season). The water quality component included sampling once during dry weather (September-October) and twice during wet weather along several transect lines throughout the Bight.

A third regional survey was conducted in 2003 and planning for Bight ’08 has begun. More information about the Bight and other related projects may be found on the SCCWRP webpage http://www.sccwrp.org/.

Other Regional Monitoring Programs (BPCTP)

Bay Protection and Toxic Cleanup Program (BPTCP): In 1989, state legislation added Sections 13390 through 13396 to the California Water Code which established the BPTCP. The program has four main goals: 1) to provide protection of existing and future beneficial uses of bays and estuarine waters, 2) to identify and characterize toxic hot spots, 3) to plan for cleanup or other mitigating actions of toxic hot spots, and 4) to develop effective strategies to control toxic pollutants, abate existing sources of toxicity, and prevent new sources of toxicity.

While in its identification and characterization phase, the program implemented regional monitoring at each of the coastal Regions. Sediment toxicity tests, chemical analyses, and benthic community surveys were used to classify each bay or estuarine waterbody. Waters were generally "pre-screened" for contamination using toxicity tests; if enough was found, more intensive monitoring followed to confirm the existence and spatial extent of monitoring. Using this approach, the Santa Monica Bay/Palos Verdes Shelf, parts of, Consolidated Slip/Dominguez Channel, Cabrillo Pier, Mugu Lagoon/Calleguas Creek, McGrath Lake, Los Angeles River Estuary, Marina Del Rey, and Marina Del Rey Entrance Channel were identified as candidate toxic hot spots. A number of other waters were identified as sites of concern.

State Board adopted a statewide, consolidated cleanup plan in June 1999 with Office of Administrative approval following in November 1999. Regional cleanup plans deal specifically with high priority candidate toxic hot spots; detailed cleanup plans were not required for moderate priority candidate toxic hot spots or sites of concern although listed in the document. Identified remediation/cleanup alternatives for toxic hot spots range from specific actions such as in-situ capping, issuing waste discharge requirements, or dredging to more regional/watershed activities such as long-term management of contaminated sediments or proactive application of the watershed management approach as a preventive measure. At this point, no specific funding source has been identified to pay for remediation activities although potential funding mechanisms are addressed in the statewide consolidated cleanup plan. The best chance for obtaining funds for cleanup appears to be through the use of Supplemental Environmental Projects (SEPs) from enforcement actions or by partnering with other groups within the context of the watershed management approach to take advantage of local efforts. Funding for staff resources ended in June 1999.

After the Consolidated Plan was approved, the Regional Board was required to reevaluate WDRs in compliance with Water Code Section 13395. The reevaluation was to consist of (1) an assessment of the WDRs that may influence the creation or further pollution of the known toxic hot spot; (2) an assessment of which WDRs need to be modified to improve environmental conditions at the known toxic hot spot; and (3) a schedule for completion of any WDR modifications deemed appropriate. We evaluated WDRs associated with high priority known toxic hot spots (i.e., Palos Verdes Shelf, Consolidated Slip, Cabrillo Beach, Mugu Lagoon, McGrath Lake) and did not identify any existing WDRs which required modifications Similarly, we did not need to modify any WDRs associated with moderate and low priority known toxic hot spots. As we renew, modify, or issue new WDRs, we need to include a finding that the discharge may contribute to the pollution present at the toxic hot spot.

The program also has a website which may be consulted for additional information: http://www.waterboards.ca.gov/bptcp.

TMDL Scheduling And Development

The 303(d)-listed waterbodies/reaches were listed in the watershed sections. The TMDLs scheduled in the near-term were also listed. Clearly, there are a large number of waters in the Region which are impaired by a number of constituents (over 700 individual impairments). All TMDLs covered by a consent decree must be completed by 2011. The overriding problem associated with TMDL development needs to be reiterated here, namely, staff resources at the Regional Board to either directly conduct or be involved in stakeholder-led TMDL investigations and in general stay dedicated to nonpoint source activities are still minimal. **In general, depending on the watershed, it is anticipated that 0.5 -2.0 PYs/watershed more will be needed** at a minimum to make additional headway on TMDLs and implementation of our nonpoint source strategy (as well as augment point source regulation, where needed); this need will increase as we add more TMDLs in the next two years to fully accomplish our TMDL mandate. Additionally, AB1740 (Ducheny) was enacted in 2000 and requires that to the extent interest is expressed by the public, and resources are available, each Regional Board shall establish for each watershed where a water body is listed as impaired, an Advisory Committee consisting of the public and interested stakeholders who wish to be involved in the process of adoption and implementation of the corrective actions necessary to eliminate the impairment.

However, with a seemingly impossible workload before us, there is a reasonable and logical way to collapse or group TMDLs to make the most effective use of resources we currently have and any which we may obtain in the future. This is largely due to the fact that some of the "pollutants" for which a water may be listed are actually "effects" of pollutants. For example, many reaches of the Los Angeles River are listed for ammonia. Some of the same reaches are listed for pH problems while other reaches are listed for algae, scum, and odors. It is very likely the presence of these "pollutants" are interrelated. Excessive nitrogen (reflected here as high levels of ammonia) may lead to a condition of eutrophication (excessive nutrient loading) which can influence pH levels as well as promote increased algal growth. Scum may be evident due to floating algal material and odors may result when excessive algae starts to die off. Thus, it is reasonable to group together these TMDLs (calling it a "nitrogen and related effects" TMDL) and approach the problem by determining the sources of nitrogen loading into the watershed and the appropriate allocations in order to reduce loadings.

Another example relates to the Malibu Creek Watershed. Many of its reaches are listed as impaired due to coliform. Other reaches are listed for swimming restrictions or shellfish harvesting advisories (an effect of elevated coliform levels). It is reasonable to group together these various reaches and "pollutants" together when performing a TMDL. USEPA has produced a number of documents relating to TMDL development; these may be found at http://www.epa.gov/owow/tmdl/.

3.0 WATERSHED ACTIVITIES

The following sections provide descriptions of Regional Board activities in each of the ten watershed management areas (WMAs) identified in Section 1.0.

3.1 CHINO BASIN WATERSHED

Overview

As shown in **Figure 3-1**, the Chino Basin Watershed covers about 405 square miles and lies largely in the southwestern corner of San Bernardino County, though a small part of Los Angeles County (Pomona area) and part of western Riverside County are included. Surface drainage is generally southward, from the San Gabriel Mountains toward the Santa Ana River and Prado Flood Control Basin. Major waterbodies in the Chino Basin Watershed include:

- San Antonio Creek
- Chino Creek
- Cucamonga Creek
- Mill Creek
- Santa Ana River, Reach 3
- Chino I, II and III Groundwater Subbasins
- Cucamonga Groundwater Subbasin
- Prado Park Lake

Although originally developed as an agricultural area, the watershed is being steadily urbanized. Cities in the Chino Basin Watershed include Pomona, Chino Hills, La Verne, Upland, Montclair, Claremont, Ontario, Rancho Cucamonga, Rialto, Chino, Fontana, and Norco. In addition, there are several pockets of urbanized unincorporated county areas. The 1995 population of the watershed was approximately 1.1 million people. The principal remaining agricultural area is the Chino Dairy Preserve. Located in the south-central part of the watershed, the Preserve contains approximately 340,000 cows, which generate the waste equivalent of more than two million people. Since the Preserve is unsewered, dairy operations have significantly affected the quality of the water resources in the area.

The major water resource in the Watershed is the 5 to 6 million acre-feet of groundwater in storage in Chino Basin. Groundwater basins and sub-basins, generally, drain south toward the Santa Ana River. Groundwater bodies within the watershed include Claremont Heights, Pomona and Canyon Basins (plus the Live Oak Basin and part of the Spadra Basin), which are located primarily in Los Angeles County, and the Cucamonga and Chino Basins, which are located primarily in San Bernardino County. A small portion of Chino Basin is located in Riverside County. The Metropolitan Water District of Southern California provides imported water to the area through local wholesalers including Inland Empire Utilities Agency (IEUA), Three Valleys Municipal Water District, and Western Municipal Water District.

Water Quality Concerns

The quality and quantity of the area's water supply are major concerns. In 1978, the Chino Groundwater Basin was adjudicated by the California State Superior Court. The Basin serves as the primary source of water for the basin’s cities, industry, and remaining agriculture. Historic and existing agricultural operations have severely degraded surface water and groundwater quality in several parts of the watershed. This degradation is a major concern for the Regional Board.

Wastewater recycling, industrial operations, hazardous materials spills and other sources of pollution have also affected groundwater quality in more localized areas. Treated wastewater is discharged to tributaries of the Santa Ana River, along with rising groundwater, non-point source discharges and seasonal rainfall runoff. The River flows into Orange County where it recharges the groundwater basin and is put through another cycle of use. To maintain a balance of use between the upper (inland) and lower (coastal) basins of the Santa Ana Watershed, the quality and quantity of water flowing in the Santa Ana River through Prado Dam is adjudicated,

Several significant studies of water quality and water supply in the Chino Basin have been completed in the past few decades. The 1975 Water Quality Control Plan (Basin Plan), produced under contract by the Santa Ana Watershed Project Authority (SAWPA), was based largely on the results of computer simulations using a model called the Basin Planning Procedure (BPP). Serious groundwater degradation was predicted unless major cleanup and management efforts were undertaken promptly. Those recommended actions were not taken. The 1983 Basin Plan basically confirmed the findings of the 1975 plan. The BPP was revised and refined, and was used in a large 1989 study which concluded that present and near-future water quality were even worse than previously thought. Consequently, the Regional Board imposed further restrictions on reclamation and wastewater recharge projects. More recently, a new computer model, the Chino Basin Integrated Ground and Surface Water Model (CIGSM), was developed as part of the Chino Basin Water Resources Management Study. The Regional Board and SAWPA have been active participants in all these studies.

SAWPA is also coordinating a study sponsored by the Nitrogen/TDS Task Force, a consortium of water supply and wastewater management agencies in the Region. The Task Force is supporting Regional Board participation in the study, which is being conducted for the Santa Ana River watershed as a whole, including the Chino Basin. The study is investigating questions related to nitrogen and TDS management in the watershed, including groundwater subbasin water quality objectives, subbasin boundaries, and regulatory approaches to wastewater reclamation and recharge. The study findings recommended changes in objectives and subbasin boundaries that would substantially affect the Chino Basin. Basin Plan amendments to incorporate these changes will likely be considered by the Regional Board in 2002-03.

Water quality issues identified for purposes of the Chino Basin Watershed Management Initiative focus on:

1) Quality and quantity of the groundwater supply,
2) Stormwater runoff and related water quality impacts,
3) Effects of wastewater recycling, and
4) Effects of agricultural operations, especially dairies, on water quality.

Making significant water quality improvements in the Chino Basin Watershed will depend on many factors, which must be thoroughly evaluated before efforts begin.

Stakeholder Agencies:

- – Santa Ana Watershed Project Authority (SAWPA)
- – Inland Empire Utilities Agency (IEUA)
- – Western Municipal Water District (WMWD)
- – Three Valleys Municipal Water District (TVMWD)
- – Chino Basin Watermaster (CBWM)
- – Chino Basin Water Conservation District (CBWCD)
- – Santa Ana River Watershed Group (SARWG)
- – Orange County Water District (OCWD)
- – Milk Producers Council (MPC)
- – Western United Dairymen (WUD)
- – United States Army Corps of Engineers
- – San Bernardino County Transportation and Flood Control District (SBCTFCD)
- – Riverside County Flood Control and Water Conservation District (RCFCWCD)
- – Cucamonga County Water District (CCWD)
- – Jurupa Community Services District (JCSD)
- – Monte Vista Water District (MVWD)
- – Fontana Union Water Company (FUWC)
- – Fontana Water Company (FWC)
- – Cities of:
  - Ontario
  - Rancho Cucamonga
  - Chino
  - Chino Hills
  - Upland
  - Montclair
  - Rialto
  - Fontana
  - Pomona
  - Claremont
  - La Verne
  - Norco

Regional Board Program Activities

Funded activities in the Chino Basin WMA for each of the eight program areas incorporated into the WMI are listed below.

Program	Activities
TMDLs	▪ TMDL development and implementation tasks including monitoring and assessment, preliminary analyses, implementation planning, and stakeholder participation
Nonpoint Source Program	▪ Working with stakeholders to develop potential 205(j), 319(h), and Prop 13 grant proposals and oversight/management of grants ▪ Work with stakeholders to develop dairy BMPs ▪ Develop dairy education/outreach activities ▪ Coordinate Prop 13 Water Bond activities for Chino Basin area
Monitoring &Assessment	▪ Collect and compile surface water monitoring data maintained by stakeholder agencies including OCWD, SAWPA, Chino Basin Watermaster, Riverside County and San Bernardino County flood control districts, and local water purveyors. ▪ Review monitoring well data from Chino Basin Watermaster for general water quality trend analysis; especially with reference to nitrate and TDS ▪ Conduct periodic surface water sampling and analysis for nutrients, pathogens, and general minerals following storm events ▪ Groundwater sampling at private wells for chlorinated solvents and general minerals
Core Regulatory	▪ Conduct regular NPDES, WDR, and stormwater inspections, reviews, and audits. Issue informal and formal enforcement actions as necessary for permit violations. ▪ Pursue additional CAFO enforcement actions ▪ Monitor manure removal from CAFOs (and basin) and management of wastewater
Watershed Management	▪ Continued participation in implementing the court-ordered Chino Basin Optimum Basin Management Plan, required in part, to address NPS issues. ▪ Interaction with stakeholders in developing water resource and non–point source management projects.

Program	Activities
Standards/ Basin Planning	▪ Regional Board expected to consider Basin Plan amendments to incorporate revised water quality objectives/subbasin boundaries
Wetlands	▪ Participate in discussions with other agencies pertaining to wetlands enhancement efforts ▪ Coordinate with local, state, and federal agencies on endangered species and wetland permitting issues ▪ Develop general WDRs (equivalent to 401 water quality certification) for sediment control projects ▪ Process 401 Water Quality Certification requests
Groundwater	▪ Solvent plumes will continue to be monitored by the SLIC unit, along with the oversight of ongoing plume investigations and cleanups. Nitrate and TDS in groundwater are being evaluated using Chino Basin Watermaster well data and GIS tools. ▪ The Regional Board will continue to participate in the N/TDS task force, which is evaluating issues related to N/TDS management, including groundwater quality objectives and subbasin boundaries in the Chino Basin.

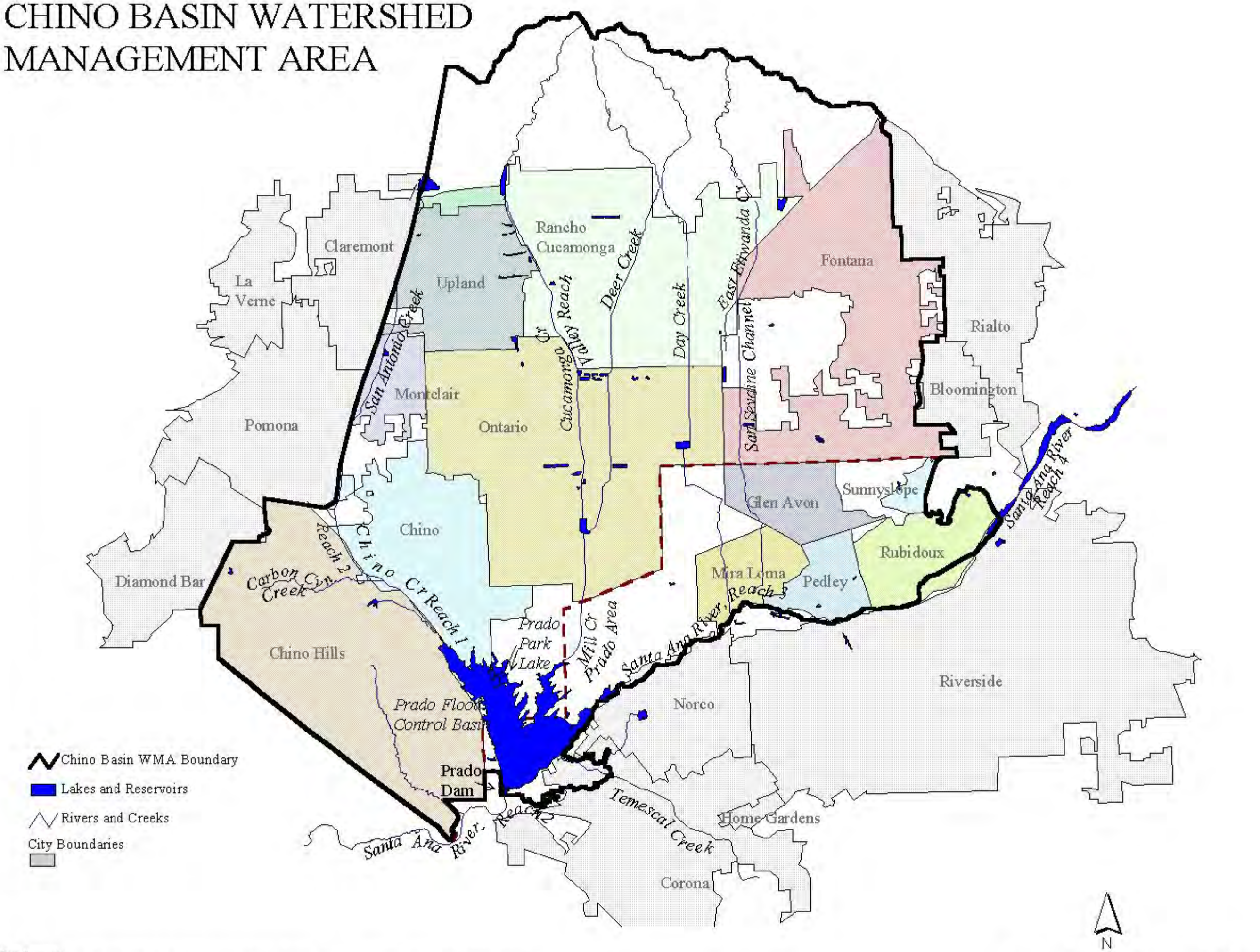
Selected Reference Documents:

Dairies and Their Relationship to Water Quality Problems in the Chino Basin, (Dairy Report), by Santa Ana Regional Water Quality Control Board (SARWQCB), 1990
Chino Basin Water Resources Management Study – Final Summary Report, by Chino Basin Water Resources Management Task Force, 1995
Optimum Basin Management Plan, (OBMP), by Chino Basin Watermaster, 1999
Peace Agreement – Chino Basin, by Chino Basin Watermaster, 2000
Dairy Waste Management, (Webb Report), Webb and Associates for SAWPA, 1974

Watershed Coordinator

The Regional Board watershed coordinator for the Chino Basin WMA is Bill Rice: (909) 782-4459.

FIGURE 3-1
CHINO BASIN WATERSHED MANAGEMENT AREA



Data Sources:
City boundaries are from the US Dept. of Commerce Census Bureau TIGER/Line 2000 Consolidated Cities dataset.
The hydrography layer is based on USGS DLG-3 format on a 1:100,000 scale.

3.7 MIDDLE SANTA ANA RIVER WATERSHED MANAGEMENT AREA

Overview

As shown in **Figure 3-7**, the Middle Santa Ana River Watershed Management Area extends from Prado Dam to the foothills of the San Bernardino and San Gabriel Mountains and includes the following major waterbodies:

Santa Ana River, Reaches 3, 4 and 5
Temescal Creek
San Timoteo Creek
Mill Creek – Reach 1
Lytle Creek
Warm Creek
Plunge Creek
City Creek
Yucaipa Creek
Reche Canyon Creek
San Timoteo Basin
Bunker Hill Basin – I, II, and Pressure
Rialto–Colton Basin
Riverside Basin – I, II, and III
Arlington Basin
Temescal Basin
Bedford Basin
Lee Lake Basin
Coldwater Basin

Cities in the Middle Santa Ana River Watershed include Corona, Norco, Riverside, Colton, San Bernardino, Grand Terrace, Highland, Loma Linda, Redlands, Calimesa, Yucaipa, and portions of Beaumont.

The 1975, 1983 and 1995 Basin Plans reported that the most serious problem in the Santa Ana River Basin is the buildup of dissolved minerals, or salts, in the ground and surface waters. Sampling and computer modeling of groundwaters showed that the levels of dissolved minerals (TDS) were exceeding water quality objectives or would do so in the future unless appropriate controls were implemented. Nitrogen levels in the Santa Ana River, largely in the form of nitrate, were likewise projected to exceed objectives. These high levels of TDS and nitrate adversely affect the beneficial uses of ground and surface waters. In addition, mineralization problems in the Middle Santa Ana River WMA significantly affect the potential of reclamation activities.

As discussed in Section 2.1, SAWPA is coordinating a study sponsored by the Nitrogen/TDS Task Force, a consortium of water supply and wastewater management agencies in the Region. The Task Force is supporting Regional Board participation in the study, which is being conducted for the Santa Ana River watershed as a whole. The Task Force is investigating questions related to nitrogen and TDS management in the watershed, including groundwater subbasin water quality objectives, subbasin boundaries, and regulatory approaches to wastewater reclamation and recharge. The Task Force recommends changes in objectives and subbasin boundaries that would substantially affect the Middle Santa Ana River. Basin Plan amendments to incorporate these changes will likely be considered by the Regional Board in 2001-02.

Non–native plants, specifically Giant Reed (*Arundo donax*) (hereafter Arundo) and Saltceder (*Tamarix sp*.), have significantly affected the beneficial uses of the Santa Ana River and its tributaries. Throughout the Santa Ana River Watershed, particularly the middle portions, Arundo and Saltcedar have invaded and destroyed riparian, endangered species, and aquatic habitat. Arundo's effect is more serious because it consumes water at a much higher rate than native species. Approximately 8,000 acres of Arundo have been identified along the Santa Ana River watershed. To address the Arundo problem, a number of local, federal and state agencies have formed "Team Arundo", with the intent to develop an Arundo eradication management plan and to initiate the eradication process. Education of local landowners and the nursery and landscape industry is also an important component of the eradication process.

Stakeholders

– Santa Ana Watershed Project Authority
– San Bernardino Valley Municipal Water District
– San Bernardino County Transportation and Flood Control District
– Riverside County Flood Control and Water Conservation District
– San Bernardino Valley Water Conservation District
– Metropolitan Water District of Southern California
– East Valley Resource Conservation District
– West San Bernardino County Water District
– Western Municipal Water District
– Inland Empire Utilities Agency
– US Army Corps of Engineers
– Fontana Water Company
– Fontana Union Water Company
– Cucamonga County Water District
– Riverside Highland Water Company
– San Gorgonio Pass Water Agency
– Western Heights Water Company
– East Valley Water District
– Upper Santa Ana Water Resources Association
– San Bernardino Regional Water Resources Authority
– Santa Ana Watershed Association of Resource Conservation Districts
– Team Arundo

– Cities of San Bernardino, Riverside, Corona, Norco, Redlands, Yucaipa, Beaumont, Highland, Grand Terrace, Colton, Rialto, Loma Linda, Calimesa, Fontana.

Fiscal Year 02-03 and 03-04 Program Activities

Funded activities in the Newport Bay WMA for each of the eight program areas incorporated into the WMI are listed below.

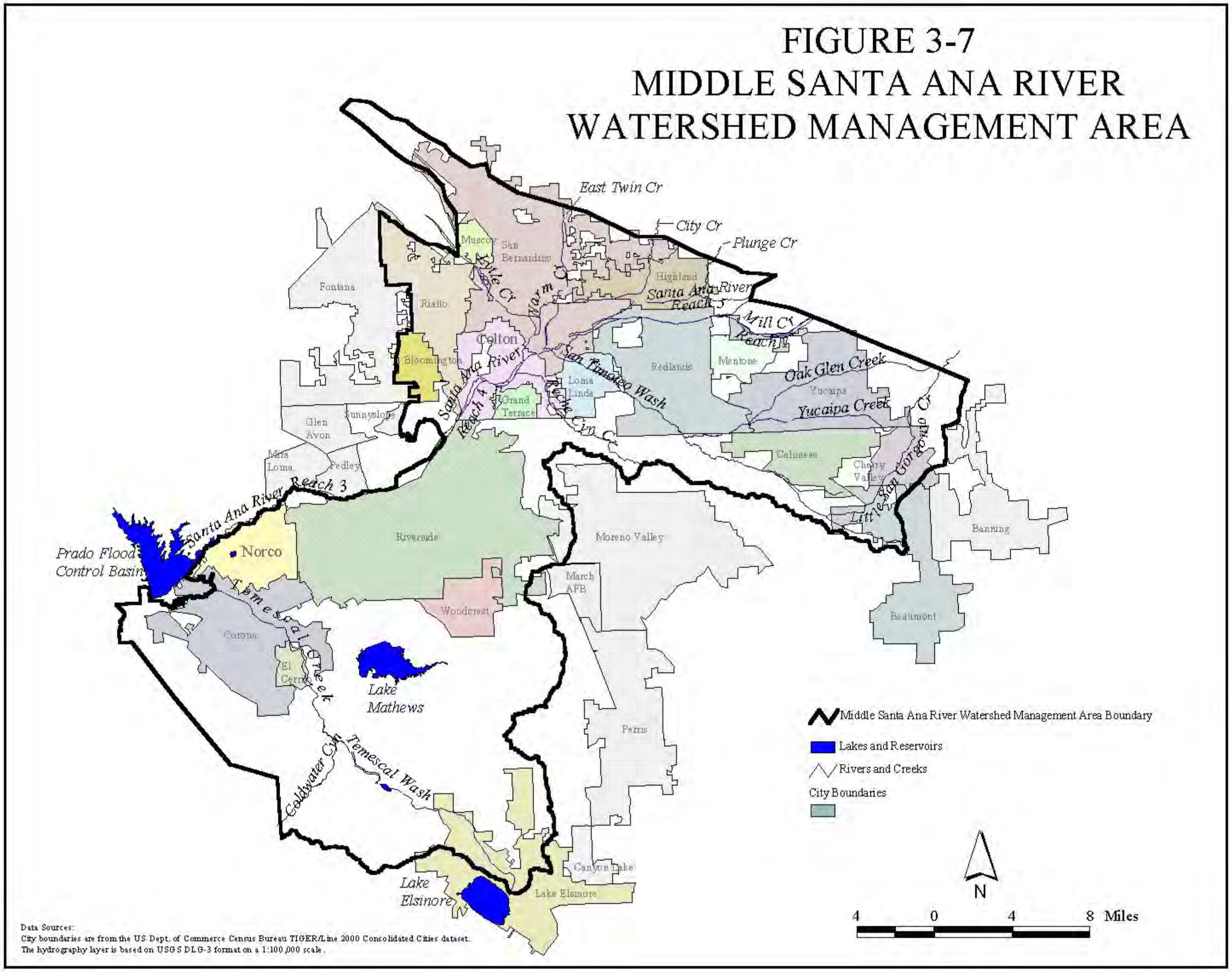
Unfunded activities include reconsideration of site-specific objectives (SSOs) for the middle Santa Ana River and certain tributaries for copper, cadmium, lead and un-ionized ammonia to address new scientific information. These SSOs are included in the 1995 Basin Plan but the USEPA has reserved action on their approval, given the new scientific information indicating that the objectives may be inappropriate.

Program	Activities
TMDLs	▪ (See Chino Basin activities for Santa Ana River – Reach 3 TMDL activities)
Nonpoint Source Program	▪ Grant activities involve working with stakeholders to develop potential 205(j), 319(h), and Prop 13 grant proposals and oversight/management of grants ▪ Work collaboratively with the Resource Conservation Districts and San Bernardino County to address and develop education/outreach material ▪ Conduct outreach activities
Monitoring &Assessment	▪ Conduct Santa Ana River monitoring at Prado Dam (pursuant to Basin Plan) and prepare assessment report for the Board and public

Program	Activities
Core Regulatory	▪ Conduct regular NPDES,WDR, and stormwater inspections, reviews, and audits. Issue informal and formal enforcement actions as necessary for permit violations
Watershed Management	▪ Participate in the Santa Ana Watershed Association (SAWA) ▪ Interaction with stakeholders in developing water resource management projects. ▪ Participate in Santa Ana Sucker coordination meetings
Standards/ Basin Planning	▪ Regional Board expected to consider Basin Plan amendments to incorporate revised water quality objectives/subbasin boundaries
Wetlands	▪ Coordinate with local, state, and federal agencies on endangered species and wetland permitting issues ▪ Develop general WDRs (equivalent to 401 water quality certification) for sediment control projects ▪ Identify and assess wetlands in middle Santa Ana River ▪ Wetland monitoring ▪ Process 401 Water Quality Certification requests
Groundwater	▪ Groundwater issues include development, by the Nitrogen/TDS Task Force, of guidelines for recycled water recharge projects that could affect groundwater.

Watershed Coordinator
The Regional Board designated watershed coordinator for the Middle Santa Ana River WMA is Bill Rice: (909) 782-4459.

FIGURE 3-7
MIDDLE SANTA ANA RIVER WATERSHED MANAGEMENT AREA



Data Sources:
City boundaries are from the US Dept. of Commerce Census Bureau TIGER/Line 2000 Consolidated Cities dataset.
The hydrography layer is based on USGS DLG-3 format on a 1:100,000 scale.

3.8 LOWER SANTA ANA RIVER WATERSHED MANAGEMENT AREA

Overview

As shown in **Figure 3-8**, the Lower Santa Ana River Watershed Management Area (Lower SAR WMA) extends from Prado Dam to the Pacific Coast but specifically excludes the Newport Bay Watershed and the Anaheim Bay, Huntington Harbour, and Bolsa Chica WMA. The major waterbodies found in the Lower SAR WMA include all or a portion of the:

- Santa Ana River, Reaches 1 and 2
- Santiago Creek
- Carbon Canyon Creek
- Santa Ana Forebay groundwater subbasin
- Santa Ana Pressure groundwater subbasin
- Santa Ana River Mouth Estuary
- Talbert Marsh

The cities in the Lower Santa Ana River Watershed include all or portions of Yorba Linda and Anaheim Hills, Orange, Villa Park, Anaheim, Garden Grove, Santa Ana, Fountain Valley, Huntington Beach, and Costa Mesa.

A portion of the lower reach of the Santa Ana River (River) directly below Prado Dam is diverted to recharge the Orange County groundwater subbasins. Rapid percolation basins located in the Santa Ana River streambed are operated and maintained by Orange County Water District (OCWD). OCWD also owns and operates a number of other recharge pits, ponds, and basins in the Santa Ana Forebay area that are supplied with Santa Ana River water via pipelines.

Groundwater comprises approximately 63% of the total water supply distributed within the OCWD territory. The River and several small tributaries provide about half of the recharge water into the groundwater subbasins. Orange County Water District (OCSD) is currently conducting studies on the effects of Santa Ana River recharge on the receiving groundwater subbasin, and is also evaluating the feasibility of recharging with high quality recycled water from the OCSD.

As discussed in **Section 3.1**, the Santa Ana Watershed Project Authority (SAWPA) is coordinating a study sponsored by the Nitrogen/TDS Task Force, a consortium of water supply and wastewater management agencies located within the Santa Ana Region. The Task Force is supporting Regional Board participation in the study, which is being conducted on the Santa Ana River watershed as a whole. A key study objective is to investigate water quality questions relative to nitrogen and TDS management in the watershed, including groundwater subbasin water quality objectives, subbasin boundaries, and regulatory approaches to wastewater reclamation and groundwater recharge. The study recommended revisions to the water quality objectives and subbasin boundaries that would substantially affect the Lower Santa Ana River. Basin Plan amendments to incorporate these changes will likely be considered by the Regional Board in the years 2002-03.

The OCSD has been conducting an extensive ocean monitoring program in conjunction with the issuance of their Clean Water Act Section 301(h) waiver (which defers the requirement to provide full secondary treatment) since 1985. The monitoring program has been structured since its inception to evaluate the potential environmental and public health effects resulting from the discharge of about 230 million gallons per day of treated wastewater to the Pacific Ocean approximately 4.5 miles off shore from Huntington Beach at a depth of 198 feet. The District's ocean monitoring program was enhanced during FY 97-98 when their ocean discharge NPDES permit was re-issued. The monitoring program was modified to require the District to conduct strategic process studies and to participate in the regional monitoring activities coordinated by the Southern California Coastal Water Research Project (SCCWRP). The additional monitoring activities, which extend beyond the core monitoring program designed to evaluate regulatory compliance, is intended to determine the potential impacts of the District's discharge in context of other municipal wastewater discharges and nonpoint source inputs to coastal waters.

SCCWRP has also provided its member agencies and the regulatory community with important scientific information about the sources, fates, and effects of wastewater and storm water discharged into the southern California Bight. In addition to their normal research activities, SCCWRP staff helped coordinate the summer 1998 ocean monitoring program efforts of 41 agencies into the second Bight-wide regional ocean monitoring survey. One goal of this second survey was to add to the data collected in the first survey completed in 1994. Another objective was to sample Bight locations not investigated in 1994 in order to answer questions about the health of the coastal ocean waters adjacent to Southern California. The planning for this survey required that the ocean dischargers and the regulatory community work closely together to utilize the available monitoring resources in a coordinated fashion. In addition to ocean monitoring, SCCWRP plans to implement an enclosed bays and estuary monitoring program.

Fiscal Years 02-03 and 03-04 Funded Activities

Funded activities in the Upper Santa Ana WMA for each of the eight program areas incorporated into the WMI are listed below.

Program	Activities
TMDLs	▪ No specific activities planned
Nonpoint Source Program	▪ CWA 319 and Prop. 13 grant activities including working with stakeholders to develop potential nonpoint source-related grant proposals; thereafter, oversight/management of those grants ▪ Conduct outreach activities
Monitoring &Assessment	▪ Coordinate with SCCWRP in the development and implementation of the Coastal Waters Monitoring Program ▪ Coordinate the Region's Coastal Waters Monitoring and Assessment Program activities, which include a fish contamination study and shellfish harvesting bed study ▪ Coordinate with the State Water Resources Control Board on beach/coastline water quality issues
NPDES Program	▪ Conduct regular NPDES, WDR, and stormwater inspections, reviews, and audits. Issue informal and formal enforcement actions as necessary for permit violations
Watershed Management	▪ Provide technical support to cities in understanding the State's water quality planning programs ▪ Conduct outreach to the cities located within the smaller watersheds to determine interest in developing watershed plans based upon specific water quality concerns.
Standards/ Basin Planning	▪ Participate in the OCWD Santa Ana River Water Quality Study meetings

Program	Activities
Wetlands	▪ Study beach closure and wetlands issues and coordination ▪ Identify and assess wetlands in lower Santa Ana River ▪ Identify potential wetlands restoration and/or preservation projects ▪ Coordinate with local, state, and federal agencies on endangered species and wetland permitting issues ▪ Develop general WDRs (equivalent to 401 water quality certification) for sediment control projects ▪ Process 401 Water Quality Certification requests
Groundwater	▪ See Standards/Basin Planning activities above

Watershed Coordinator

The Regional Board watershed coordinator for the Lower Santa Ana River WMA is Wanda Smith: (909) 782-4468.

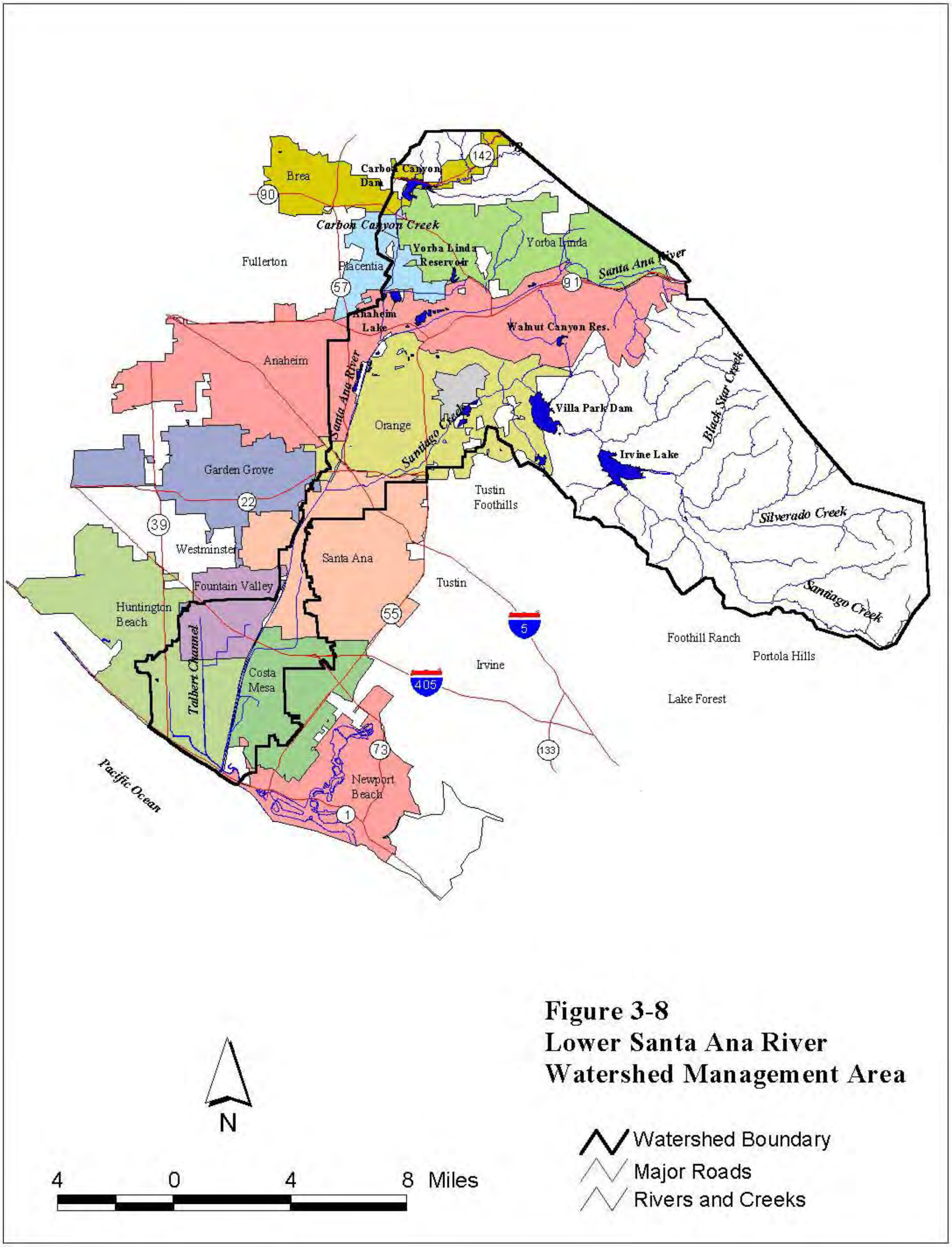


Figure 3-8
Lower Santa Ana River
Watershed Management Area

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

ORDER No. 90-079

NPDES NO. CA0061654 (CI 6948)

WASTE DISCHARGE REQUIREMENTS
STORMWATER/URBAN RUNOFF DISCHARGE
for
LOS ANGELES COUNTY
and
CO-PERMITTEES

The California Regional Water Quality Control Board, Los Angeles, (Regional Board) finds :

1. The County of Los Angeles, in cooperation with the following cities : Agoura Hills, Beverly Hills, Culver City, El Segundo, Hermosa Beach, Inglewood, Los Angeles, Manhattan Beach, Rancho Palos Verdes, Redondo Beach, Rolling Hills Estates, Rolling Hills, Santa Monica, Torrance, West Hollywood, and Westlake Village, has submitted a report of waste discharge (NPDES permit application) dated March 15, 1990 for issuance of waste discharge requirements for the County of Los Angeles and other cities tributary to Los Angeles County (excluding Antelope Valley) under the National Pollutant Discharge Elimination System (NPDES Permit No. CA0061654).

2. The discharges consist of surface runoff generated from various land uses in all the hydrologic drainage basins which discharge into water courses flowing into water bodies in Los Angeles County. The quality of these discharges varies considerably and is affected by land use, basin hydrology and geology, season, and the frequency and duration of storm events. The constituents of concern and significance in these discharges are: total and fecal coliform and enterococci bacteria, total suspended solids, biochemical oxygen demand, oil and grease, heavy metals, nutrients, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, pesticides and herbicides, and petroleum hydrocarbons.

3. The objective of this permit is to develop a timely, comprehensive, and cost-effective stormwater pollution control program to minimize pollutants in urban runoff/stormwater discharges to water bodies in Los Angeles County.

4. Due to the complexity and networking of drainage facilities within and tributary to Los Angeles County, the county and adjacent areas discharging storm water into Los Angeles County are divided and prioritized into five drainage basins for the implementation of the permit. The owners/operators of all facilities impacting stormwater quality will be ultimately a party to these waste discharge requirements. The County of Los Angeles together with the cities identified above, the initial parties filing for the system-wide permit, are 'Permittees', with the County of Los Angeles as the 'Principal Permittee' and the rest as 'Co-Permittees'. All other cities and recognized entities such as Caltrans, college/university campuses, hospitals, parks, agricultural areas, real estate developments and waste disposal facilities identified in this Order, are designated 'Co-Participants'. A 'Co-Participant' will be a 'Co-Permittee' upon becoming an active party to the permit.

   Attachments 1 and 2 show, respectively, the list of cities and a partial list of entities designated as Co-Participants for this permit. The list of entities will be revised as necessary.

5. The County of Los Angeles, as the 'Principal Permittee', will obtain the cooperation of 'Co-Participants' to become 'Co-Permittees'. The Regional Board has the discretion and authority to require non-cooperating cities and/or entities to become 'Co-Permittees' or obtain individual stormwater discharge permits, pursuant to 40 CFR 122.26 (a).

6. Los Angeles County as the 'Principal Permittee' is the permit coordinator responsible for general administration of this Order, and coordinating cooperation by 'Co-Permittees', including but not limited to the implementation of local self-monitoring programs and Best Management Practices, and the preparation and submittal of reports required by this Order.

7. Los Angeles County obtains its authority to :

   - control pollutants in stormwater discharge
   - prohibit illegal discharges and control spills
   - require compliance and carry out inspections

of drainage facilities in the County of Los Angeles from the Los Angeles County Flood Control Act and various county ordinances which address industrial wastes and waste discharges within the unincorporated areas of Los Angeles County and contract cities. 'Co-Permittees' with the status of incorporated cities have various forms of legal authority in place, such as charters, State Code provisions for General Law cities, city ordinances and applicable portions of Municipal Codes and the State Water Code, to regulate stormwater/urban runoff discharges.

8. The division and prioritization of Los Angeles County and adjacent areas into five drainage basins for program implementation are based on hydrological characteristics of the watersheds, perceived importance and beneficial uses of water bodies, and the existence of an adequate infrastructure for program implementation. The five drainage basins are :

I : Santa Monica Bay Drainage Basin

II : Upstream Los Angeles River Drainage Basin, to and including Sycamore Canyon Channel (San Fernando Valley);

III : Upper San Gabriel River (San Gabriel Valley) Drainage Basin.

IV : Lower Los Angeles River Drainage Basin

V : Lower San Gabriel River Drainage Basin; and Santa Clarita Valley Basin.

Attachment 3 shows a map of Los Angeles County with the boundary delineations of the five drainage basins.

Attachment 4 shows Co-Participant cities in Los Angeles County (and their respective populations).

[Note: Detailed maps of the Los Angeles County storm drain system with boundary delineations of drainage basins are available for review at the Regional Board Office.]

9. A number of studies on stormwater/urban runoff pollution in the permit areas has been conducted by agencies such as the City of Los Angeles, the Southern California Coastal Water Research Project and the Southern California Association of Governments. These studies indicate stormwater/urban runoff contributes significantly to the deterioration of the quality of water bodies in Los Angeles County.

The University of California at Los Angeles, under the sponsorship of the Santa Monica Bay Restoration Project, is currently compiling and summarizing data and information on stormwater/urban runoff discharges for the Santa Monica Bay watershed.

10. The Los Angeles County Department of Public Works has an active surface water quality monitoring program in the permit area, comprising twenty-eight monitoring stations located at principal storm drains and water conservation facilities. The Surface Water Quality Monitoring Program comprises the collection and analysis of dry weather water samples for general minerals, pesticides, total petroleum hydrocarbons, heavy metals and bacteria (total and fecal coliform, KF streptococci and enterococci). Volatile organic constituents are tested semi-annually at selected stations. Stormwater runoff is monitored three to four times annually at twenty-one stations for minerals, pesticides, heavy metals (total and dissolved), bacteria, total and organic suspended solids, oil and grease, biochemical oxygen demand, total organic carbon and volatile organics.

11. The Los Angeles County Department of Public Works and some cities have on-going activities that reduce stormwater/urban runoff pollutant loads. These activities include periodic catch-basin cleaning and street sweeping, public information on proper disposal of household hazardous waste, and emergency responses to reports of illegal dumping, illicit disposal, illegal connections, and industrial waste spills. The Los Angeles County Department of Public Works also participates and coordinates action with local, State, and Federal agencies responding to spills and illegal dumping reports that threaten surface waters.

12. The Regional Board currently regulates industrial process and point source non-process wastewater and stormwater discharges to storm drain systems through NPDES permits. Point source discharges including stormwater will continue to be regulated by the Regional Board. An information system will be developed and maintained to update pollutant loadings to designated

drainage facilities and water bodies from permitted point source discharges.

13. The State Water Resources Control Board (State Board) adopted a Water Quality Control Policy for the Enclosed Bays and Estuaries of California on May 16, 1974. The policy provides that the discharge of industrial process waters to enclosed bays and estuaries shall be prohibited. Storm water and urban runoff are not considered industrial process waters for the purpose of that policy.

14. The State Board adopted a revised Water Quality Control Plan for Ocean waters of California (Ocean Plan) on March 22, 1990, which amended the Plan adopted on September 22, 1988. The Plan contains water quality objectives for the coastal waters of California.

15. The Regional Board adopted a revised Water Quality Control Plan for the Los Angeles River Basin (Basin Plan) on November 27, 1978. The Basin Plan incorporates the Ocean Plan, and contains water quality objectives for the basin, including the beneficial uses of water bodies.

16. The beneficial uses of water bodies in Los Angeles County and their tributary streams include contact water recreation, non-contact water recreation, wildlife habitat, preservation of rare and endangered species, marine habitat, estuarine habitat, fish migration, fish spawning, industrial service and process supply, agricultural water supply, shellfish harvesting, navigation, commercial and sport fishing, and groundwater recharge.

17. Section 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act of 1972 to require the Environmental Protection Agency (EPA) to establish regulations for stormwater/urban runoff discharge under the National Pollutant Discharge Elimination System (NPDES).

18. The Federal Clean Water Act allows EPA to delegate its NPDES permitting authority to States with an approved environmental regulatory program. The State of California is one of the delegated States. The Porter-Cologne Act (State Water Code) authorizes the State Board, through its Regional Boards, to regulate and control the discharge of pollutants into waters of the state and tributaries thereto.

19. Although Water Code Section 13263 (a) requires that waste discharge requirements issued by Regional Boards shall include provisions to implement water quality based objectives, numerical water quality standards

are not provided in this Order. Information is not available to establish appropriate numerical limits, and determine locations where permittees shall be made accountable. The requirements in this Order will provide the necessary information while concurrently achieving reductions in pollutant loads to water bodies from stormwater/urban runoff discharges. Numerical water quality objectives will be developed by Board staff for consideration in the permit renewal process and utilized for the evaluation of Best Management Practices.

20. Due to the significance of the Los Angeles County Stormwater/Urban Runoff Program, the Regional Board, in recognition of the need for public involvement and participation in the development and implementation of an effective program will conduct at a minimum an annual workshop, prior to approving plans submitted by Permittees, to solicit comments and to inform the public of the progress of the program. Comments presented will be referred to Los Angeles County for response.

21. Stormwater/urban runoff discharges to drainage facilities that cross County boundaries and Regional Board jurisdictions, and which are regulated under NPDES permits, are the regulatory responsibility of those agencies issuing the permits.

22. The issuance of waste discharge requirements for this discharge is exempt from the provisions of the California Environmental Quality Act (CEQA); Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code in accordance with Water Code Section 13389.

The Board has notified the Permittees and interested agencies and persons of its intent to issue waste discharge requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

The Board, in a public hearing, heard and considered all comments pertaining to the discharge and to the tentative requirements.

This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Federal Clean Water Act, or amendments thereto, and shall take effect at the end of ten days from the date of its adoption provided the Regional Administrator, EPA, has no objections.

IT IS HEREBY ORDERED that the Permittees, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Clean Water Act as amended and regulations and guidelines adopted thereunder, shall comply with the following:

1.0 COMPLIANCE

1.1 The Permittees and Co-Permittees shall comply with the requirements contained in this Order according to the following schedule:

	DRAINAGE BASIN	STARTING DATE FOR COMPLIANCE WITH REQUIREMENTS
I.	Santa Monica Bay	July 1, 1990
II.	Upper Los Angeles River (San Fernando Valley)	July 1, 1992
III.	Upper San Gabriel River (San Gabriel Valley)	July 1, 1992
IV.	Lower Los Angeles River	July 1, 1993
V.	Lower San Gabriel River and Santa Clarita Valley	July 1, 1993

2.0 REQUIREMENTS - YEAR 1

2.1 For each Drainage Basin, prepare and submit to the Regional Board within 12 months of the starting date for compliance, according to the schedule under 1.1:

2.1.1 Water quality data and flow data from 1980 to the present to facilitate identification of sources of pollutants present in discharges from the prioritized drainage basin. "Drainage areas" in the drainage basin are to be reported and the "drainage areas" associated with each drainage basin clearly identified.

For purposes of stormwater/urban runoff, a "drainage area" is defined as a subdivision of a drainage basin which is unique in land use patterns, and pollutant characteristics and loadings.

2.1.2 The 90th percentile value for the water quality parameters, (i) Total Suspended Solids (TSS), and (ii) Oil and Grease, from the data set of all wet weather samples collected from 1980 to the present. These data will be used to establish guidance for early action control of stormwater pollution.

The 90th percentile for a given water quality parameter is defined as the concentration value exceeded in ten percent of the samples of the reference data set.

2.1.3 Additional information of a qualitative nature that would contribute to isolating and identifying sources of problems. Such information should include but not be limited to visual observations of factors exacerbating stormwater contamination, principal land use classifications and Standard Industrial Code (SIC) categories of facilities in "drainage areas", and a description of soils, dumps, landfills, waste disposal sites and Resource Conservation and Recovery Act (RCRA) facilities associated with each area.

2.1.4 Monthly precipitation data from rain gauge stations, relevant to the drainage basin, for the years 1980 to the present, and an estimate of the area of impervious surfaces (including paved areas and building roofs) within each "drainage area".

2.1.5 Documentation of existing procedures to detect and address illegal discharges and illicit disposal practices.

2.1.6 Documentation of existing practices and improvement plans to control pollutants in stormwater/urban runoff from construction sites.

2.1.7 Documentation of existing stormwater/urban runoff management practices and existing Best Management Practices (BMPs) for the control of pollutants in discharges from residential, commercial and industrial areas.

For purposes of this permit, a Best Management Practice is defined as a stormwater quality management practice that has been demonstrated to reduce stormwater/urban runoff constituents of concern in studies in the United States and elsewhere, or a stormwater/urban runoff quality management practice that can significantly control stormwater/urban runoff pollution.

2.1.8 Plan with schedule of implementation, for approval by the Executive Officer, of early action BMPs.

For purposes of this permit, an early action BMP is defined as an existing stormwater/urban runoff quality management practice that is optimized to the maximum extent practicable (MEP) in efficiency for the control of stormwater runoff pollution, such as improving the frequency of storm drain catchment basin cleaning or the stricter enforcement of existing regulations, or a BMP that is not specific to stormwater/urban runoff constituents or "drainage area" in its constituent removal capacity and can be applied on a system-wide basis, such as public outreach and educational programs.

For purposes of this permit, maximum extent practicable means to the maximum extent possible, taking into account equitable considerations of synergistic, additive and competing factors, including but not limited to gravity of the problem, fiscal feasibility, public health risks, societal concern, and social benefits.

The Principal-Permittee, in the submittal of plans and schedules to the Executive Officer, shall demonstrate that public input has been obtained.

For purposes of this permit, public input is demonstrated by, (i) disseminating the notice of availability of plans for review and comment, to the public at large, environmental groups, Federal, State and local officials and other interested parties, and (ii) addressing concerns expressed by the public.

The Board may modify the plans in response to public input received at the Board during its comment/review period. Permittees are required to implement the original or modified plan on approval by the Executive Officer.

2.1.9 A workplan for the development of a stormwater/urban runoff monitoring program, for approval by the Executive Officer, to include but not be limited to the following information :

o listing of constituents and parameters to be monitored and the rationale for their choice.

o listing of monitoring locations and the rationale for their choice.

o listing of sampling methodology of choice and frequency of sampling for both wet weather and dry weather flow.

o supplementary information that influences the design of the monitoring plan.

The Principal-Permittee, in the submittal of the workplan to the Executive Officer, shall demonstrate that public input has been obtained.

2.1.10 Documentation that each Permittee, individually and/or jointly, through the establishment of a joint powers authority or a stormwater utility, possesses adequate legal authority to operate and manage stormwater/urban runoff quality management programs, and/or plans to obtain the necessary legal authority to regulate illegal discharges and illicit disposal practices into storm drains, and to prosecute violators.

3.0 REQUIREMENTS - YEAR 2

3.1 For each Drainage Basin, prepare and submit to the Regional Board, for approval by the Executive Officer, within 24 months of the starting date of compliance, according to the schedule under 1.1:

3.1.1 A monitoring program based on the approved workplan. This program shall be designed to:

- o detect accurately the constituents and parameters of concern, in discharges indicated in the workplan, and to identify their possible sources.
- o identify illegal dischargers and/or locations of illicit disposal practices.

Monitoring reports for this program shall be submitted according to the format and frequency to be approved by the Executive Officer.

3.1.2 Plan with schedule of implementation for additional BMPs, judged appropriate for each city or drainage basin, to control pollutants from residential, commercial and industrial sites to the maximum extent practicable.

Both structural and non-structural BMP measures are to be evaluated at the MEP standard. Examples of non-structural measures include catch basin cleaning, street sweeping and public education, while controls such as detention/retention basins, first flush diversions, grassy swales and porous pavements are examples of structural measures.

3.1.3 Plan with schedule of implementation of procedures to detect and eliminate illegal discharges and illicit disposal practices.

3.1.4 Plan with schedule of implementation of measures to control pollutants in surface runoff from construction sites.

The Principal Permittee, in the submittal of plans and schedules (items 3.1.2, 3.1.3, and 3.1.4) to the Executive Officer shall demonstrate that public input has been obtained. The Board may modify the plans in response to public input received at the Board during its comment/review period. Permittees are required to implement the original or modified plans on approval by the Executive Officer.

3.2 Evidence of satisfactory progress of implementation of plan and schedule for early action BMPs.

3.3 Evidence of all requisite legal authority to regulate illegal discharges and illicit disposal practices to drainage facilities, and to prosecute violators.

4.0 REQUIREMENTS - YEAR 3

4.1 For each Drainage Basin, submit to the Regional Board, within 36 months of the starting date of compliance, according to the schedule under 1.1, the following:

4.1.1 Evidence of satisfactory progress of implementation of plan and schedule for early action BMPs and additional BMPs.

4.1.2 Evidence of implementation and progress of procedures to detect and eliminate illegal discharges and eliminate illicit disposal practices.

4.1.3 Evidence of implementation and progress of measures to control pollutants in surface runoff from construction sites.

5.0 EXPIRATION AND RENEWAL

5.1 This Order expires on June 18, 1995.

5.2 The Permittees shall file a report of waste discharge (ROWD), not later than 180 days before the expiration date, as application for reissuance of waste discharge requirements. This report of waste discharge shall include but not be limited to the following:

5.2.1 Summary of the results of the monitoring program.

5.2.2 Summary of BMPs implemented and evaluations of their effectiveness.

5.2.3 Summary of procedures implemented to detect illegal discharges and illicit disposal practices and an evaluation of their effectiveness.

5.2.4 Summary of measures implemented to control pollutants in surface runoff from construction sites and an evaluation of their effectiveness.

5.2.5 Evaluation of the need for additional BMPs, source control, and/or structural control measures.

5.2.6 Proposed plan of stormwater/urban runoff quality management activities that will be undertaken during the term of the next permit.

I, Robert P. Ghirelli, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Los Angeles Region, on June 18, 1990.

ROBERT P. GHIRELLI, D.Env.
Executive Officer

ATTACHMENT 1

LIST OF CO-PARTICIPANT CITIES

Agoura Hills
Arcadia
Avalon
Baldwin Park
Bellflower
Beverly Hills
Burbank
Cerritos
Commerce
Covina
Culver City
Downey
El Monte
Gardena
Glendora
Hawthorne
Hidden Hills
Industry
Irwindale
La Habra Heights
La Mirada
La Verne
Lawndale
Long Beach
Lynwood
Maywood
Montebello
Norwalk
Palos Verdes Estates
Pasadena
Pomona
Redondo Beach
Rolling Hills Estates
San Dimas
San Gabriel
Santa Clarita
Santa Monica
Signal Hill
South Gate
Temple City
Torrance
Walnut
West Hollywood
Whittier

Alhambra
Artesia
Azusa
Bell
Bell Gardens
Bradbury
Carson
Claremont
Compton
Cudahy
Diamond Bar
Duarte
El Segundo
Glendale
Hawaiian Gardens
Hermosa Beach
Huntington Park
Inglewood
La Canada Flintridge
Lakewood
La Puente
Lancaster
Lomita
Los Angeles
Manhattan Beach
Monrovia
Monterey Park
Palmdale
Paramount
Pico Rivera
Rancho Palos Verdes
Rolling Hills
Rosemead
San Fernando
San Marino
Santa Fe Springs
Sierra Madre
South El Monte
South Pasadena
Thousand Oaks
Vernon
West Covina
Westlake Village

ATTACHMENT 2

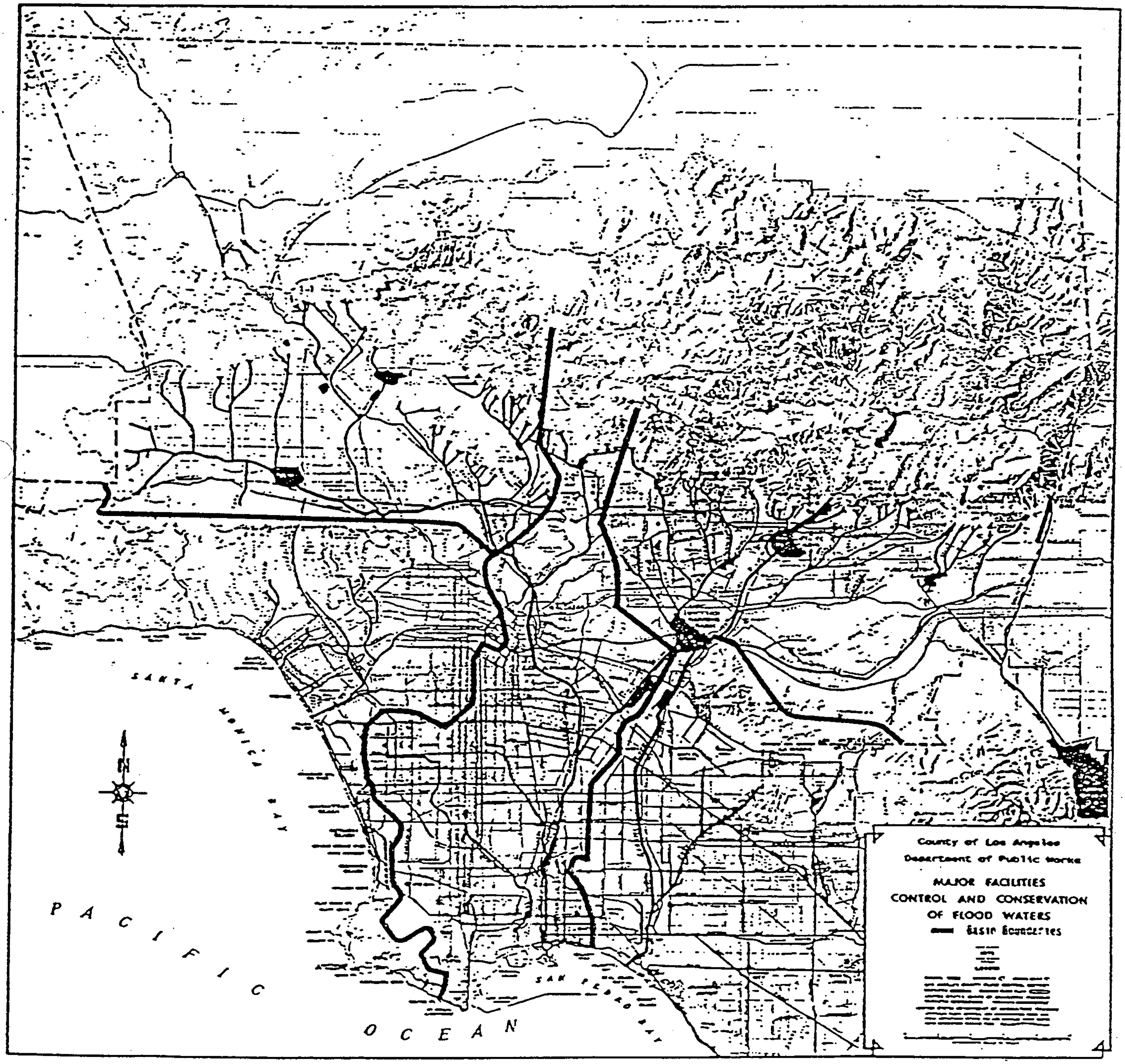
LIST OF ENTITIES (PARTIAL LIST)

Caltrans	The State University System
Army Corps of Engineers	University of California Campuses
Railroad Rights of Way	National Forest Service
Federal Hospitals	Federal Military Facilities

[This list will be updated during the permit process to indicate actual identity of agencies and entities.]

ATTACHMENT 3

DELINEATIONS OF DRAINAGE BASIN BOUNDARIES FOR LOS ANGELES COUNTY



ATTACHMENT 4

CITIES (AND POPULATIONS) TRIBUTARY TO DRAINAGE BASINS

Santa Monica Bay

Agoura Hills	19,000	Rancho Palos Verdes	46,000
Beverly Hills	34,000	Redondo Beach	64,700
Culver City	40,950	Rolling Hills	2,090
El Segundo	15,750	Rolling Hills Estates	7,875
Hermosa Beach	19,750	Santa Monica	96,500
Inglewood	102,300	Thousand Oaks	104,400
Los Angeles	3,400,500	Torrance	142,200
Manhattan Beach	35,300	West Hollywood	38,400
Westlake Village	8,025	Palos Verdes Estates	15,000

Upper Los Angeles River

Burbank	93,800	Glendale	166,100
Hidden Hills	1,950	Los Angeles	3,310,057
San Fernando	20,700		

Upper San Gabriel River

Alhambra	74,900	Arcadia	49,100
Azusa	38,250	Baldwin Park	63,300
Bradbury	930	Claremont	36,550
Covina	43,250	Diamond Bar	74,120
Duarte	21,350	El Monte	95,400
Glendora	47,400	Industry	370
Irwindale	1,230	La Canada Flintridge	20,800
La Habra Heights	5,450	La Puente	33,550
La Verne	30,500	Monrovia	34,000
Montebello	58,200	Monterey Park	64,600
Pasadena	132,200	Pomona	119,000
Rosemead	47,700	San Dimas	32,500
San Gabriel	34,900	San Marino	13,800
Sierra Madre	11,250	South El Monte	18,700
South Pasadena	24,500	Temple City	31,900
Walnut	26,400	West Covina	94,200

(CONTINUED)

Lower Los Angeles River

Alhambra	74,900	Bell	28,250
Bel Gardens	38,300	Carson	88,800
Commerce	11,700	Compton	93,000
Cudahy	20,700	Downey	86,800
El Segundo	15,750	Gardena	50,900
Glendale	166,100	Hawthorne	67,400
Huntington Park	51,200	Inglewood	102,300
La Canada Flintridge	20,800	Lakewood	76,500
Lawndale	27,300	Lomita	20,300
Los Angeles	3,400,500	Lynwood	53,700
Maywood	24,650	Montebello	58,200
Monterey Park	64,600	Palos Verdes Estates	15,000
Paramount	44,450	Pasadena	132,200
Pico Rivera	57,300	Rancho Palos Verdes	46,000
Redondo Beach	64,700	Rolling Hills	2,090
Rolling Hills Estates	7,875	Signal Hill	8,150
South Gate	79,200	South Pasadena	24,500
Torrance	142,200	Vernon	80

Lower San Gabriel River

Artesia	14,950	Bellflower	60,900
Cerritos	58,400	Downey	86,800
Hawaiian Gardens	12,350	La Habra Heights	5,450
Lakewood	76,500	La Mirada	42,600
Long Beach	419,800	Norwalk	90,800
Paramount	44,450	Pico Rivera	57,300
Santa Clarita	115,700	Santa Fe Springs	16,400
Signal Hill	8,150	Whittier	74,100

Population estimates are taken from Report 89 E-1 published by the State of California Department of Finance.

The cities of Avalon (Pop: 2,490), Lancaster (Pop: 82,200), and Palmdale (Pop: 45,850) which are within Los Angeles County are not part of this permit.

RB-AR22763

United States
Environmental Protection
Agency

Water Planning Division
WH-554
Washington, DC 20460

December 1983

Water

Results of the Nationwide Urban Runoff Program

Volume I - Final Report

RESULTS
OF THE
NATIONWIDE URBAN RUNOFF PROGRAM

December, 1983

VOLUME I - FINAL REPORT

Water Planning Division
U.S. Environmental Protection Agency
Washington, D.C. 20460

National Technical Information Service (NTIS)
Accession Number: PB84-185552

DISCLAIMER

FOREWORD

The U.S. Environmental Protection Agency was created because of increasing public and government concern about environmental quality. The complexity of our environment and the interplay among its components require concentrated and integrated approaches to pollution problems.

The possible deleterious water quality effects of nonpoint sources in general, and urban runoff in particular, were recognized by the Water Pollution Control Act Amendments of 1972. Because of uncertainties about the true significance of urban runoff as a contributor to receiving water quality problems, Congress made treatment of separate stormwater discharges ineligible for Federal funding when it enacted the Clean Water Act in 1977. To obtain information that would help resolve these uncertainties, the Agency established the Nationwide Urban Runoff Program (NURP) in 1978. This five-year program was designed to examine such issues as:

- The quality characteristics of urban runoff, and similarities or differences at different urban locations;
- The extent to which urban runoff is a significant contributor to water quality problems across the nation; and
- The performance characteristics and the overall effectiveness and utility of management practices for the control of pollutant loads from urban runoff.

The interim NURP report, published in March 1982, presented preliminary findings of the program. This document is the final report covering the overall NURP program. Several specialized technical reports are published under separate cover.

PREFACE

The Nationwide Urban Runoff Program (NURP) was conducted by the EPA and many cooperating federal, state, regional, and local agencies, distributed widely across the United States. The individual project studies, which were conducted over the past five years, were designed and overseen using a common technical team from EPA headquarters. This approach was taken to assure a desired level of commonality and consistency in the overall program, while allowing each individual project to specially tailor its effort to focus on local concerns.

The program has yielded a great deal of information which will be useful for a broad spectrum of planning activities for many years. Furthermore, it has fostered valuable cooperative relationships among planning and regulatory agencies. The most tangible products of the program are this report, the reports of various grantees (available under separate cover), and several technical reports which focus on specialized aspects of the program, its techniques, and its findings. In addition, a considerable number of individual articles drawing on information developed under the NURP program have already appeared in the technical literature and address specific technical or planning aspects of urban runoff.

At the time of publication of this Final Report, the main technical effort of the NURP program is complete; the field studies and the analysis of most of the resultant data are complete enough that the findings reported herein can be taken with confidence. However, there is still some work in progress to make certain details of the program available for future use. The products of this on-going work include:

- A summary database which is being compiled to make all technical information from the 28 projects available for review and use (DECEMBER 1985);

- A technical report which focuses on the program's studies and findings relative to detention and recharge devices (MAY 1984);

- A technical report on urban runoff effects on the water quality of rivers and streams (MARCH 1984); and

- A technical report on the effectiveness of street sweeping as a potential "best management practice" for water pollution control (MAY 1984).

This report and the supplementary technical documents identified above, supersedes the earlier NURP publication, "Preliminary Results of the Nationwide Urban Runoff Program," March 1982. Information presented there has been expanded, updated, and in some cases revised.

ACKNOWLEDGEMENTS

The Nationwide Urban Runoff Program was unusual in its large scale, covering a broad spectrum of technical and planning issues at many geographic locations. Because the program placed such emphasis on tailoring the results to support the planning process, it involved many participants - some from EPA, some from other federal agencies, and many from state, regional, and local planning agencies and other consultants.

The program was developed, implemented, and managed by the Water Planning Division, Office of Water, at EPA Headquarters, Washington, D.C. Principal contributors were: Dennis N. Athayde, Program Manager; and Patrice M. Bubar, Norman A. Whalen, Stuart S. Tuller, and Phillip H. Graham, all of whom served as Project Officers. Additional contributions from EPA personnel came from Rod E. Frederick and Richard P. Healy (Monitoring and Data Support Division), Richard Field (Storm and Combined Sewer Section, EPA Office of Research and Development), and many project staff in the various EPA Regional Offices.

As described elsewhere, much of the field work, water quality analysis, and data analysis was performed by the U.S. Geological Survey (USGS), under a Memorandum of Agreement with EPA. Both District Offices and National Headquarters participated actively. The contributions of Messrs. Ernest Cobb and David Lystrom are especially acknowledged.

Members of the project team which provided essential strategic, technical, and management assistance to the EPA Water Planning Division through a contract with Woodward-Clyde Consultants were: Gail B. Boyd, David Gaboury, Peter Mangarella, and James D. Sartor (Woodward-Clyde Consultants); Eugene D. Driscoll (E. D. Driscoll and Associates); Philip E. Shelley (EG&G Washington Analytical Services Center, Inc.); John L. Mancini (Mancini and DiToro Consultants); Robert E. Pitt (private consultant); Alan Plummer (Alan Plummer and Associates); and James P. Heaney and Wayne C. Huber (University of Florida).

The principal writers of this report were Dennis N. Athayde (EPA), Philip E. Shelley (EG&G Washington Analytical Services Center, Inc.), Eugene D. Driscoll (E. D. Driscoll & Associates), and David Gaboury and Gail B. Boyd (Woodward-Clyde Consultants).

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CHAPTER 1
INTRODUCTION

Rain falling on an urban area results in both benefits and problems. The benefits range from watering vegetation to area cleansing. Many of the problems are associated with urban runoff, that portion of rainfall which drains from the urban surfaces and flows via natural or man-made drainage systems into receiving waters.

The historical concern with urban runoff has been focused primarily on flooding. Urban development has the general effect of reducing pervious land surface area and increasing the impervious area (such as roof tops, streets, and sidewalks) where water cannot infiltrate. In comparison with an undeveloped area (for a given storm event), an urban area will yield more runoff, and it will occur more quickly. Such increases in the rate of flow and total volume often have a decided effect on erosion rates and flooding. It is not surprising, therefore, that at the local level the quantity aspect continues to be a principal concern.

In recent years, however, concern with urban runoff as a contributor to receiving water quality problems has been expressed. Section 62 of the Water Quality Act of 1965 (P.L. 89-234) authorized the Federal government to make grants for the purpose of "assisting in the development of any project which will demonstrate a new or improved method of controlling the discharge into any water of untreated or inadequately treated sewage or other waste from sewerage which carry storm water or both storm water and sewage or other waste ..." The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) signaled a heightened national awareness of the degraded state of the nation's surface waters and a Congressional intent that national water quality goals be pursued. The scarcely two-year old Environmental Protection Agency built upon its predecessors' activities by taking up the challenge and implementing this far reaching legislation.

As a result of Section 208 of The Act, State and local water quality management agencies were designated to integrate water quality activities. As point source discharges were increasingly brought under control and funds for the construction and upgrading of municipal sewage treatment plants were granted, the awareness of nonpoint sources (including urban runoff) as potential contributors to water quality degradation was heightened. Uncertainties associated with the local nature and extent of urban runoff water quality problems, the effectiveness of possible management and control measures, and their affordability in terms of benefits to be derived mounted as water quality management plans were developed. The unknowns were so great and certain control cost estimates were so high that the Clean Water Act of 1977 (P.L. 95-217) deleted Federal funding for the treatment of separate stormwater discharges. The Congress stated that there was simply not enough known about urban runoff loads, impacts, and controls to warrant making major investments in physical control systems.

In 1978, EPA Headquarters reviewed the results of work on urban runoff by the technical community and the various 208 Areawide Agencies and determined that additional, consistent data were needed. The NURP program was implemented to build upon pertinent prior work and to provide practical information and insights to guide the planning process, including policy and program development and implementation. The NURP program included 28 projects, conducted separately at the local level, but centrally reviewed, coordinated, and guided. While these projects were separate and distinct, most share certain commonalities. All were involved with one or more of the following elements: characterizing pollutant types, loads, and effects on receiving water quality; determining the need for control; and evaluating various alternatives for the control of stormwater pollution. Their emphasis was on answering the basic questions underlying the NURP program and providing practical information needed for planning.

CHAPTER 2
BACKGROUND

EARLY PERCEPTIONS

As noted earlier, drainage is perhaps the single most important factor of the urban hydrologic cycle. Nuisance flooding, more than anything else, gives Public Works directors concern, as complaints are received from unhappy motorists, residents, and business. Drainage has typically been considered a local responsibility, usually that of the City or County Public Works Department. Rarely does this responsibility go to the State or Federal level, except in cases of catastrophic flooding involving risk to human life and extensive property damage.

By 1964, the U.S. Public Health Service had begun to be concerned about identified pollutants in urban runoff and concluded that there may be significant water quality problems associated with stormwater runoff. In 1969, the Urban Water Resources Research Committee of the American Society of Civil Engineers (directed by M. B. McPherson and sponsored by the U.S. Geological Survey) recognized the potential threat of pollution from urban runoff and described a research program intended to obtain needed information to characterize urban stormwater quality.

In the late 1960's, the Federal Water Quality Administration (FWQA) conducted a study in an area of Tulsa, Oklahoma which was served by separate storm sewers. This first attempt at using regression analysis on urban runoff indicated that there was only a very poor correlation between stormwater runoff quantity and water quality constituents (except for suspended solids). Comparing the concentrations of various pollutants examined by this study (separate storm sewers) with previous data on combined sewer overflows indicated that storm runoff from areas having separate sewers had much lower values for BOD, fecal coliform, and most other pollutant concentrations. The study concluded that the largest portion of pollutants resulted from (1) washoff of material from impervious surfaces and (2) the erosion of drainage channels (caused by high volumes of runoff from the impervious surfaces). Control of urban runoff was recommended to reduce both runoff volume and rates.

Atlanta, Georgia is an example of a city that has both a combined sewer system and a separate system. In 1971, EPA conducted a study which compared the contribution of various sources of pollutants. It was concluded that, on an annual basis, 64 percent of the BOD load came from separate storm sewers, and 19 percent came from combined sewers, the balance coming from treatment plants.

In 1971, EPA also conducted a study in Oakland and Berkeley, California, to assess the infiltration of stormwater into sanitary sewers. While only four percent of the study area had combined sewerage and the remaining 96 percent separate, the study made it clear that infiltration can cause a separate system to function as though it were combined.

Studies in Sacramento, California, which has both combined and separate storm sewers, indicated that the stormwater was comparable to the average strength of domestic wastewater. However, the concentrations for BOD were found to be so unrealistically high, that contamination of the runoff by raw sanitary sewage was considered to be a distinct possibility.

In 1973, the Council on Environmental Quality published a report titled, "Total Urban Pollutant Loads: Sources and Abatement Strategies." The primary conclusion was that much pollution was coming from urban runoff and that, unless it was taken care of, the goals of the Act would not be met.

CONCLUSIONS FROM SECTION 208 EFFORTS

EPA guidance for conducting the early 208 planning efforts designated 17 topic areas (including urban runoff) that were to be addressed by all Water Quality Management agencies in developing their 208-funded plans. Although all topic areas were to be covered, the degree of emphasis to place on each was left to the individual agencies to decide. As a result, the amount of the 208 efforts spent in the area of urban runoff varied greatly (but was rarely a major portion).

Many of the 208 agencies began their studies with the assumption that urban runoff was an important cause of water quality problems. Although the studies developed much information on runoff and receiving waters, not enough basic information was known to assess urban runoff's role as a major cause of problems. This was partly because of interferences by other sources and complex relationships within the receiving waters. It was also due to the difficulties in deciding what constitutes a "problem." In some cases, "problems" were synonymous with criteria violations; in others, "problems" were synonymous with an impairment or denial of beneficial uses. In many cases, "problems" were concluded to exist, simply on the basis of the possible presence of certain contaminants in urban runoff, based solely on values taken from literature regarding studies conducted elsewhere. The practical implication of these differences (which were differences in viewpoints rather than differences in physical conditions, in many cases) was that local agencies were very reluctant to commit to implementing urban runoff controls in the absence of a clear problem definition.

Furthermore, in the early years of the 208 program, EPA's guidance on how to address urban runoff was vague. As a result, local agencies took a wait-and-see attitude on the stormwater portion of their plans. They simply did not know what EPA would eventually do on the issue of stormwater control.

Another major obstacle to implementation resulted from the uncertainties regarding the effectiveness of controls. Many of the measures proposed for controlling urban runoff are either new or special applications of conventional practices developed for other purposes. Little was known about how well they would work in urban runoff applications. Engineers, planners, public works personnel, and other decision makers have been understandably reluctant to invest large amounts of time and money in controls which may not perform as hoped.

Another obstacle to implementation of controls was a lack of basic data on sources, transport mechanisms, and receiving water characteristics (hydrologic and water quality aspects). Some of the more important topic areas where knowledge was lacking are summarized below:

- Sources - Not enough was known about where pollutants originate. Major sources certainly include vehicles, vegetation, erosion, fertilizer and pesticide application, litter, animals, and air pollution. However, a better understanding of source contributions could enhance control opportunities.

- Washoff/transport mechanisms - Not enough was known about how pollutants get from the sources to the receiving waters. Models could be better used for simulating runoff in problem definition and control evaluation, if they more accurately reflected washoff and transport mechanisms.

- Impacts - It was difficult to go beyond speculation in assigning urban runoff its proper share of responsibility for problems in cases where several pollutant sources contribute. In cases where other sources create obvious problems, it was difficult to determine the appropriate degree to which urban runoff should be controlled.

- Relative benefits - Planners had difficulty deciding whether the various benefits of controlling urban runoff quality justify the costs involved. There was considerable controversy over the present dry weather standards' relationship to beneficial uses, given the time and space scales of storm events and their intermittent nature. Many plans failed to be implemented because of uncertainties regarding: How much control is enough? Who benefits? Who should pay? Who should decide?

- Controls - Both cost and effectiveness data on full-scale control programs were lacking. Some of the control measures cited for typical 208 plans were plausible candidates, but their application for the purpose of urban runoff pollution control had not been studied quantitatively.

EPA'S ORD EFFORT

During the past 15 years, EPA's Office of Research and Development (ORD) has conducted over 250 studies on the characterization and control of stormwater discharges and combined sewer overflows, with particular emphasis on the latter due to their greater pollution potential. Consistent with overall Agency policies, ORD has deemphasized studies on receiving water impacts and effects (although it has done some such work). Rather, ORD has focussed principally on multi-purpose analyses and controls, because it is nearly impossible to segregate benefits and strategies of urban stormwater runoff pollution control from drainage, flood, and erosion control. Many significant results have been obtained by ORD's effort, which has dramatically increased the technical literature in the area.

Data from ORD studies indicate the high variability of pollutant concentrations in urban runoff. Based on loading projections, it is safe to conclude that urban stormwater can contribute significant pollutant loads to receiving waters, in many cases having pollutant concentrations on the order of secondary treatment plant effluent for some constituents. Nonetheless, in its efforts to find direct urban runoff generated receiving water impacts (using the conventional dissolved oxygen parameter as the indicator) ORD has been only partly successful. However, this was only one study and was not intended to be the final word. Nonetheless, based on the size of the load coming from urban runoff, a significant pollution potential is there for at least some types of receiving waters. For example, a small urban lake could receive nutrient loads sufficient to increase algal productivity and accelerate the eutrophication process. The existence of heavy metals and certain organics (mostly of petroleum origin) in urban runoff have also been documented by the ORD program.

In addition to studying urban runoff loads, the ORD program has investigated a number of management and control approaches. This effort has been very successful, and many innovative techniques have been proposed and tested. The results of such research, development, and demonstrations have been presented in reports which document many of these potential controls, thereby allowing the technology to be utilized in other programs and at other locations. Included have been such control measures as on-site (upstream) storage; porous pavement; the swirl concentrator, helical bend, tube settler, and fine mesh screens for grit and settleable solids removal; street sweeping; disinfection; and high rate filtration, dissolved air flotation, and microscreening for suspended solids and BOD removal. Most of these controls were developed principally to deal with combined sewer overflow problems. However, some may also have application in urban runoff control, once their effectiveness has been conclusively demonstrated and initial and operating cost data are available to allow the necessary trade-off studies to be made.

The ORD program's reports constitute an invaluable source of data and information that was used to design and guide the development of the emerging NURP program. Also, three of the NURP projects were joint efforts with ORD (i.e., West Roxbury, Massachusetts, Bellevue, Washington, and Lansing, Michigan).

OTHER PRIOR/ONGOING EFFORTS

The Clean Water Act requires EPA to provide Congress with a needs assessment every two years in the six categories of the construction grant funds program. In 1974, the Needs Survey for Separate Storm Sewer Discharges (Category VI) was done by each state. Using the goals of the Act as the criteria to be met, they identified a cost of about $235 billion (June 1973 dollars). One state alone identified $80 billion in needs to control separate storm sewer discharges. In 1976, the Needs Survey was conducted by the Agency, and it was found that Category VI would require $66 billion to meet the goals of the Act. This survey broke the goals into three categories or levels of pollution abatement; (1) aesthetics, (2) fish and wildlife, and (3) recreation. Costs to meet each category were determined.

As noted previously, the ASCE defined a program in 1969 to identify the causes and effects of urban stormwater pollution. The recommendations were not followed, so in 1974 at the Rindge, New Hampshire, Engineering Foundation Conference (jointly sponsored with ASCE's Urban Water Resources Research Council), a similar program was again recommended. A similar scenario occurred at the Easton, Maryland, conference of 1976 sponsored by the same group.

DISCUSSION

In the past (ca 1890), dilution was considered to be the appropriate way to control combined sewer overflows, since the primary concern was odor and related nuisances. Between 1890 and 1960 little concern was shown for stormwater pollution. Stormwater concerns were primarily related to drainage problems. As time progressed, water quality began to be considered, and workers began to characterize problems in terms of concentrations of certain pollutants and loads of these pollutants. In the 1970's, problems were being defined in terms of pounds of pollutants needing to be removed from overflows, in the interest of preventing pollution.

Past work, reported by EPA and published in professional journals, tended to focus on determining (a) the type and amount of pollutants involved and/or (b) methods to reduce the loads. However, such reports and articles did not consider either the level of improvement attainable or the need to improve quality of the receiving water body associated with the study. A conclusion common to all such reports was that not enough was known about stormwater to adequately understand cause and effect relationships. Also common to such reports were recommendations for further study and more data. A tangible result of the lack of belief and uncertain attitude in this area is the fact that stormwater controls for water quality have been implemented in so few places throughout the nation. Thus, there has been a critical need to objectively examine the situation.

Many factors led to the development of NURP, one being a legally-mandated necessity. As implementation of P.L. 92-500 moved into full swing, the lack of progress in the area of urban runoff was becoming apparent. In 1974 EPA lost a court case, which led to the decision that EPA should issue permits for separate storm sewer discharges. In 1976 EPA requested that the Areawide Waste Management Planning Program focus on the three or four most important of the 17 items required by the regulations. Many of the 208 Areawide Agencies cited urban runoff as an important item.

Two years later, EPA reviewed ninety-three 208 Areawide Agencies' work plans to assess their basis for having identified urban runoff as an element upon which they would focus. Review of these projects' methods and findings did not provide much to further our understanding of the pollution aspects of urban runoff. If one reason can be identified, it was the lack of site-specific data to define the local conditions.

As mentioned earlier, the Rindge Conference recommended a candidate program for obtaining the data necessary to provide a good understanding of stormwater pollution (EFC/ASCE, 1974). It is not coincidental that the NURP program is quite similar in design to those recommendations.

THE NATIONWIDE URBAN RUNOFF PROGRAM

Program Design

NURP was not intended to be a research program, per se, and was not designed as such. Rather, the program was intended to be a support function which would provide information and methodologies for water quality planning efforts. Therefore, wherever possible, the projects selected were ones where the work undertaken would complete the urban runoff elements of formal water quality management plans and the results were likely to be incorporated in future plan updates and lead to implementation of management recommendations. Conduct of the program provided direction and assistance to 28 separate and distinct planning projects, whose locations are shown in Figure 2-1 and listed in Table 2-1, but the results will be of value to many other planning efforts. NURP also acted as a clearinghouse and, in that capacity, provided a common communication link to and among the 28 projects.

The NURP effort began with a careful review of what was known about urban runoff mechanisms, problems, and controls, and then built upon this base. The twin objectives of the program were to provide credible information on which Federal, State, and local decision makers could base future urban runoff management decisions and to support both planning and implementation efforts at the 28 project locations.

An early step in implementing the NURP program involved identifying a limited number of locations where intensive data gathering and study could be done. Candidate locations were assessed relative to three basic selection criteria:

- Meeting program objectives;
- Developing implementation plans for those areas; and
- Demonstrating transferability, so that solutions and knowledge gained in the study area could be applied in other areas, without need for intensive, duplicative data gathering efforts.

The program design used for NURP included providing a full range of technical and management assistance to each project as the needs arose. Several forums for the communication of experience and sharing of data were provided through semi-annual meetings involving participants from all projects. The roles and responsibilities of the various State, local, and regional agencies and participating Federal agencies were clearly defined and communicated at the outset. These were reviewed and revised where warranted as the projects progressed.

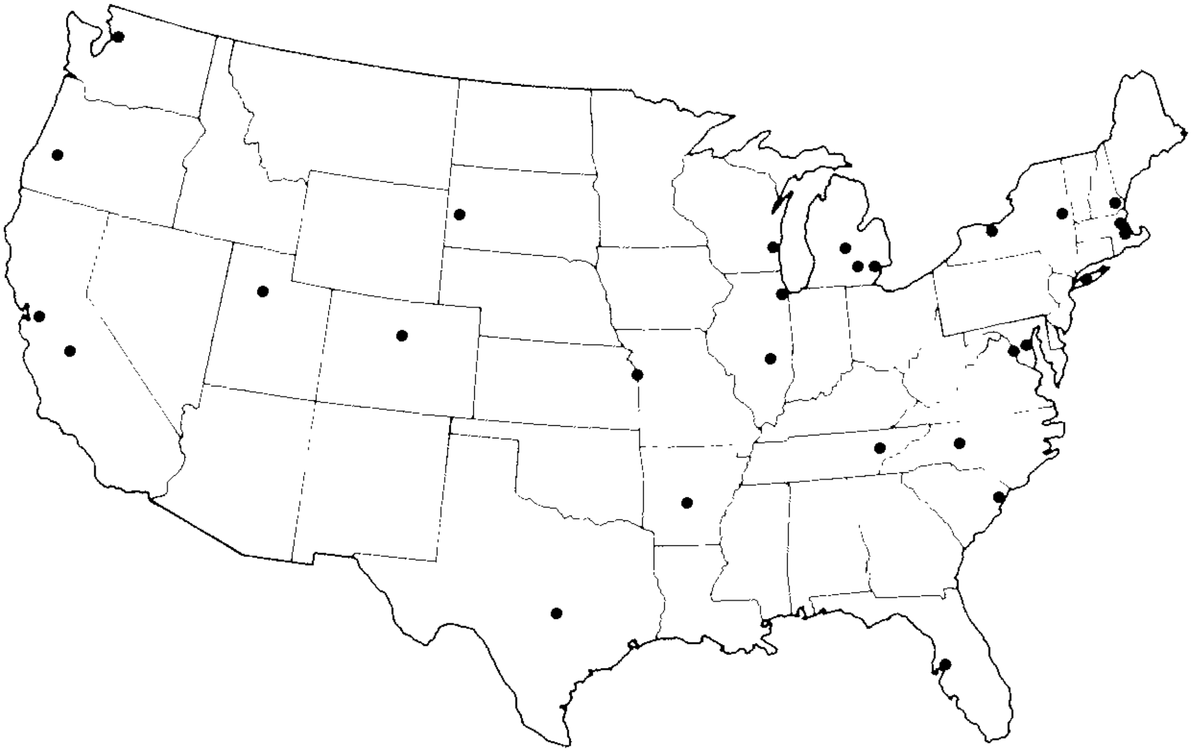

Figure 2-1. Locations of the 28 NURP Projects

TABLE 2-1. NURP PROJECT LOCATIONS

EPA Region	NURP Code	Project Name/Location	EPA Region	NURP Code	Project Name/Location
I	MA1	Lake Quinsigamond (Boston Area)	V	IL1	Champaign-Urbana, Illinois
	MA2	Upper Mystic (Boston Area)		IL2	Lake Ellyn (Chicago Area)
	NH1	Durham, New Hampshire		MI1	Lansing, Michigan
II	NY1	Long Island (Nassau and Suffolk Counties)		MI2	SEMCOG (Detroit Area)
	NY2	Lake George		MI3	Ann Arbor, Michigan
	NY3	Irondequoit Bay (Rochester Area)		WI1	Milwaukee, Wisconsin
III	DC1	WASHCOG (Washington, D.C. Metropolitan Area)	VI	AR1	Little Rock, Arkansas
	MD1	Baltimore, Maryland		TX1	Austin, Texas
IV	FL1	Tampa, Florida	VII	KS1	Kansas City
	NC1	Winston-Salem, North Carolina	VIII	CO1	Denver, Colorado
	SC1	Myrtle Beach, South Carolina		SD1	Rapid City, South Dakota
	TN1	Knoxville, Tennessee		UT1	Salt Lake City, Utah
			IX	CA1	Coyote Creek (San Francisco Area)
				CA2	Fresno, California
			X	OR1	Springfield-Eugene, Oregon
				WA1	Bellevue (Seattle Area)

The 28 NURP projects were managed by designated State, county, city, or regional governmental associations. The U.S. Geological Survey (USGS) was involved with EPA as a cooperator, through an inter-agency agreement, on 11 of the NURP projects. The Tennessee Valley Authority was also involved in one project.

A major objective of the program was the acquisition of data. Because these data will be used for several years to characterize problems, evaluate receiving water impacts from urban runoff, and evaluate management practices, consistent methods of data collection had to be developed and rigorously employed.

Project Selection

Projects were selected from among the 93 Areawide Agencies that had identified urban runoff as one of their significant problems. The intention was to build upon what these agencies had already accomplished in their earlier programs. Also, projects that would be a part of this program were screened to be sure that they represented a broad range of certain characteristics (e.g., hydrologic regimes, land uses, populations, drainage system types). Actual selection of projects was a joint effort among the States, local governments, and Regional EPA offices. The five major criteria used to screen candidate projects were as follows:

1. Problem Identified. Had a problem relative to urban runoff actually been identified? Could that problem be directly related to separate storm sewer discharges? What pollutant or pollutants were thought to be causing the problem? Using the NURP problem identification categories, what was the "problem" (i.e., denying a beneficial use, violating a State water quality standard, or public concern)?

2. Type of Receiving Water. The effects of stormwater runoff on receiving water quality were the NURP program's ultimate concern. Because flowing streams, tidal rivers, estuaries, oceans, impoundments, and lakes all have different hydrologic and water quality responses, the types of receiving waters associated with each candidate project had to be examined to ensure that an appropriately representative mix was included in the overall NURP program.

3. Hydrologic Characteristics. The pattern of rainfall in the study area is perhaps the single most important factor in studying urban runoff phenomena, because it provides the means of conveyance of pollutants from their source to the receiving water. For this reason, projects in locations having in different hydrologic regimes were chosen for the program.

4. Urban Characteristics. Characteristics such as population density, age of community, and land use were considered as

possible indicators of the waste loads and ultimately the rainfall-runoff water quality relationship. The type of sewerage system was another factor considered (e.g., whether it is combined, separate, or mixed; how severe the infiltration and inflow problems may be). Such factors have different effects on the quantity and quality of storm runoff, and were balanced as well as possible in selecting projects.

5. Beneficial Use of Receiving Water. Because this factor greatly affects the type of control measure that would be appropriate, attempts were made to include a wide range in selecting projects.

Although these were the primary criteria used to identify potential projects, other factors also had to be considered (e.g., the applicant agencies' willingness to participate, the State's acceptance of the project, the experience of the proposed project teams). Because the NURP program used planning grants (not research funds) a major consideration was the anticipated working relationships with local public agencies and the applicants' ability to raise local matching funds.

Program Assistance

Technical expertise and resources available for urban runoff planning varied among the various projects participating in NURP. Therefore, the program strategy called for providing a broad spectrum of technical assistance to each project as needed and for intercommunication of experiences and sharing of data in a timely manner.

Assistance was also provided to the applicants in developing their final work plans. This was done to ensure that there would be consistency among methods, especially in the collection of data. If there were to be differences in data from city to city, they must be due to the characteristics of each city and not a result of how the data were obtained.

Assistance with instrumentation was provided during the program in the form of information on available equipment, installation, calibration, etc. Because one of the more important elements of a data collection program is the "goodness" or quality of the data themselves, questionable data would be of little use. Accordingly, a quality assurance and quality control element was required in the plans for each project.

Periodic visits were made to each project site to ensure that the participants were provided opportunities to discuss any problems, technical or administrative. The visiting team typically included an EPA Regional Office representative, an EPA Headquarters representative, and one or two experienced consultants. All interested parties, including representatives from State or local governments, were requested to attend those visits.

As the projects moved farther into their planned activities and the time for data analysis approached, each project was required to describe how they were going to analyze their data. No single method was recommended for each project, because it was believed that a broad diversity of available methods would be suitable, if used properly. Guidance on proper use was provided as a part of technical assistance through project visits and special workshops for this purpose.

Communication

It was intended that the entire group of NURP participants function as a single team. Accordingly, a communication program was developed. National meetings were conducted semi-annually so that key personnel from the individual projects would have an opportunity to discuss their experiences and findings.

Reports were required of each project quarterly. EPA Headquarters also provided composite quarterly reports summarizing the status of each project and discussing problems encountered and solutions found.

CHAPTER 3
URBAN RUNOFF PERSPECTIVES

In evaluating the impacts of urban runoff, one's perspective may be influenced by one's concerns and priorities - and what one defines to be a "problem". Recognizing this, the following discussion covers several such perspectives, including concerns over runoff quantity, water quality, and control possibilities.

RUNOFF QUANTITY

The following discussion covers a major cause and two major effects of runoff problems related to "quantity" (i.e., increased urbanization as a cause; flooding and erosion/sedimentation as effects).

Flooding Problems

As noted earlier, drainage has historically been the principal local-level concern regarding urban runoff. Concerns over quantity can be divided into two basic categories: nuisance flooding and major flooding. Nuisance flooding (e.g., temporary ponding of water on streets, road closings, minor basement flooding), although hardly tolerable to those immediately affected, rarely affects an entire urban populance. Nonetheless, the concerns of the (often vocal) minority of affected citizens commonly reach the point where local action is taken to minimize the recurrence of such events. Such mitigation activities are usually locally determined, funded, and implemented because both the affected public and government decision makers perceive and concur that such flooding constitutes a "problem".

Catastrophic flood events, on the other hand, have to be thought about differently for several reasons:

- They typically affect the majority of the urban populace.

- Mitigation measures often involve engineering improvements extending well beyond local jurisdictions.

- Mitigation measures often cost more than the local community could afford. Historically, the Federal government has become involved, in major flood control efforts through a number of related programs. In such cases, water quantity problems are relatively easy to define because the extent of flooding is readily observable, the degree of damage is easily determined, and the benefits of proposed flood control projects can be estimated. Thus, decision makers face a relatively low risk in prescribing courses of action and justifying the associated costs in light of benefits. As will be discussed later, decision making in the case of water quality concerns is less straightforward.

Erosion and Sedimentation Problems

Erosion results from rainfall and runoff when soil and other particles are removed from the land surface and transported into conveyance systems and water bodies. Since land surface erosion is the principle source of stream sediment, the type of soil, land cover, and hydrologic conditions are major factors in determining the severity and extent of sedimentation problems. Although erosion is a natural process, it is frequently exacerbated by the activities of man, in both urban and rural environments.

When addressing the broad spectrum of receiving water problems which result from sedimentation, it is convenient to divide cases into two categories; (1) those that respond to control measures directed at nuisance flood prevention, and (2) those that are not controlled by such measures. When natural loads are discharged into receiving waters, the effects are primarily physical and only secondarily chemical (because the mineral constituents which make up the primary sediment load are relatively benign in most cases). Among the physical problems imposed upon the receiving waters are:

- Excess turbidity reduces light penetration, thereby interfering with sight feeding and photosynthesis;
- Particulate matter clogs gills and filter systems in aquatic organisms, resulting, for example, in retarded growth, systemic disfunction, or asphyxiation in extreme cases; and
- Benthal deposition can bury bottom dwelling organisms, reduce habitat for juveniles, and interfere with egg deposition and hatching.

Although sedimentation is storm-event related, its resultant problems are not exclusively either "quantity" problems or water "quality" problems. Being hybrid problems, sedimentation control has received a mixed approach. The organizations involved range widely, from Federal agencies (e.g., the Army Corps of Engineers, the Soil Conservation Service) to local drainage and sedimentation control officials, frequently with involvement from State and county governmental agencies.

Urbanization as a Cause of Problems

Urbanization accelerates erosion through alteration of the land surface. Disturbing the land cover, altering natural drainage patterns, and increasing impervious area all increase the quantity and rate of runoff, thereby increasing both erosion and flooding potential. Also, the sedimentation products which result from urban activities are generally not as benign as the natural mineral sediments which result from soil erosion. Atmospheric deposition (associated with industrial, energy, and agricultural production activities) and added surface particulates (resulting from tire wear, auto exhaust, and road surface decomposition) fall in this latter category. Their effects on receiving waters tend to be more "chemical" than "physical". They may contain toxic substances and/or other compounds which can have adverse impacts upon receiving water quality and the associated ecological communities.

WATER QUALITY CONCERNS

The notion that urban runoff can be a significant contributor to the impairment or degradation of the quality of receiving waters has formed only recently and is not universally shared. It is the totality of receiving water characteristics (e.g., flow rate, size or volume, and physical and chemical characteristics) that determines its use, although some characteristics are more important than others (e.g., there must be present an appropriate rate of flow and/or volume in the receiving water to support the desired use).

In addressing the water quality needed to support a designated use, one must consider specific requisite characteristics. For example, in the case of swimming, total dissolved solids and dissolved oxygen levels are far less important than pathogenic organisms. For irrigation, the biochemical oxygen demand of the water is of little concern to the farmer, whereas the total dissolved solids level is of immense concern (to minimize salt buildup). Although high nutrient levels may be detrimental to the quality of impounded waters (by hastening eutrophication processes), a farmer may welcome nutrients in irrigation water.

It is also important to note that it is the concentration, rather than the mere presence of a water quality constituent, that affects use. The relationship between pollutant concentration and resultant impacts on receiving water use are quite non-linear, with plateau effects not uncommon. For example, consider dissolved oxygen and its effect upon fin fish. Down to a certain level below saturation, there are virtually no important effects (upon a given species). As dissolved oxygen levels fall below this threshold, the more sensitive members of the species begin to be affected. As levels continue to fall, the affected percentage of the population will increase until a level is reached at which the entire population can no longer survive. Obviously, any further reduction of dissolved oxygen level would have no further effect upon the community, since it no longer exists. It is important to keep this plateau effect in mind when considering the practical impacts of increased pollution and the practical value of remedial measures to restore beneficial uses, since limited removal of a polluting substance may do nothing to alleviate the problem. In the example given above, if one were to somehow reduce the input of oxygen demanding substances to the receiving water, the result might be that the dissolved oxygen level of the receiving water would rise from 1.0 mg/l to 3 mg/l. If the species of concern were trout, they still could not survive. Even though polluting substances were removed and money was spent, the desired benefit would not be achieved.

WATER QUANTITY AND QUALITY CONTROL

There is no question that excessive urban runoff causes problems. Remedial costs may be high, but the benefits are obvious. Currently, there is a growing national awareness that, if steps are taken during the planning phase of development, excessive stormwater discharges can be prevented, at least from typical events (large infrequent storms will always present a greater threat).

Past And Current Work

During the past two decades attention has been focused on reducing runoff rates and volumes and reducing flood damage. During the early 1970's, a manual of practices was prepared under grants from the Office of Water Research and Technology sponsored by the American Public Works Association stressing detention (Poertner, 1974). The University of Delaware also issued a manual of practices on methods to control rates and volumes of urban runoff (Toubier and Westmacott, 1974).

Work done by the ASCE Urban Water Resources Research Council during the sixties stressed the concept of natural easements for drainage, observing that there were two drainage ways; major routes for large events and minor routes for smaller more frequent events (Jones, 1968). It was claimed that money could be saved by using natural channels, swales, etc., thus reducing the need for more expensive concrete conveyances.

The idea of intentionally using natural runoff courses, green belts, and the like was new to engineers who had long been trying to control runoff through more artificial conveyances. In 1970, EPA's Office of Research and Development initiated work on a development known as the Woodlands project in Texas near Houston. Studies were conducted to determine how storm flows could be managed and water quality could be protected or improved by the use of natural drainage ways, detention facilities, porous pavements, increased infiltration rates, and a decrease in runoff rates (Characklis, 1979).

Federal Involvement

As part of its national effort to control erosion from agricultural lands, the Soil Conservation Service (SCS) (Department of Agriculture) provides technical assistance in developing erosion control plans. During the past decade or so, the methods they have developed have been applied much more widely than just to agricultural situations. SCS has become increasingly involved in erosion control in urban areas and has produced a useful document for assessing urban hydrology in small watersheds (SCS, 1975).

Other Federal agencies that have an interest in urban runoff and its control include the U.S. Geological Survey, the Federal Highway Administration, the ~~Federal Housing Administration, the Tennessee Valley Authority,~~ and others too numerous to mention.

State And Local Involvement

Although some 27 states have adopted floodplain management legislation to protect property, the control of urban drainage has traditionally been a local matter. Some states have some form of erosion control laws in force; however few states have runoff rate/quantity legislation. This situation has begun to change over the last decade, and Maryland is one example where the statewide legislation for stormwater management is implemented at the county level.

The methods used tend to be preventive, wherein erosion is controlled by prescribing certain proven design practices and conventions. Many local agencies are developing control plans along these lines, so this report will not cover this aspect of control.

PROBLEM DEFINITION

As pointed out earlier, water quantity problems are relatively easy to identify and describe. Water quality problems, on the other hand, tend to be more elusive because their definition often involves some subjective considerations, including experiential aspects and expectations of the populace. They are not immediately obvious and are usually less dramatic than, for example, floods. They also tend to vary markedly with locality and geographic regions within the country. For example, a northwestern resident may want to upgrade stream quality to support some highly-prized species of game fish, while a northeastern resident contemplating the river flowing by the local factory might be grateful to see any game fish at all. Thus, a methodological approach to the determination of water quality problems is essential if one is to consider the relative role of urban runoff as a contributor. An important finding of the work conducted during this NURP program has been to learn to avoid the following simplistic logic train: (a) water quality problems are caused by pollutants, (b) there are pollutants in urban runoff, therefore, (c) urban runoff causes "problems". The unspoken implication is that a "problem" by definition requires action, and any type of "problem" warrants equally vigorous action. It becomes clear that a more fundamental and more precise definition of a water quality "problem" from urban runoff is necessary. For this purpose, the NURP has adopted the following three-level definition:

- Impairment or denial of beneficial uses;
- Water quality criterion violation; and
- Local public perception.

The first of these levels refers to cases of impairment or denial of a designated use. An example would be a case where a determination has been made that some specific beneficial use should be attained; however, present water quality characteristics are such that attainment of the use cannot be fully realized.

The second level of problem definition refers to violations of a designated water quality criterion. An example would be a case where some measure or measures of water quality characteristics have been found to violate recommended or mandatory levels for the receiving water classification. Some of the subtle distinctions between this and the preceding problem definition arise in the fact that receiving water classification may not be appropriate, the beneficial use may not be impaired or denied, and the water quality criteria associated with that classification may or may not be overly conservative or directly related to the desired use.

The third level of problem definition involves public perception. This may be expressed in a number of ways, such as telephone calls to public officials complaining about receiving water color, odor, or general aesthetic appearance. Public perception of receiving water body problems is highly variable also. Some people enjoy fishing for carp or gar, children will play in almost any creek, and so on. This level of problem definition can also include one concept of anti-degradation. Here the thought is that no polluting substances of any kind in any quantity should be discharged into the receiving water regardless of its natural assimilative capacity. This concern has its ultimate expression in the "zero discharge" concept. EPA's concept of anti-degradation, on the other hand, refers to degradation of use; a subtle but essential difference.

The foregoing levels of problem definition provide an essential framework within which to discuss water quality problems associated with urban runoff. However, it is important to understand that when one is dealing at a local level all three elements are typically present. Thus, it is up to the local decision makers, influenced by other levels of support and concern, to carefully weigh each, prior to making a final decision about the existence and extent of a problem and how it is to be defined. It follows that, if this step of problem definition is done carelessly, it will be difficult, if not impossible, to plan an effective control strategy and establish a means for assessing its effectiveness.

CHAPTER 4
STORMWATER MANAGEMENT

INTRODUCTION

This chapter is included for those who wish to know more about how to plan and implement stormwater management programs. Most of the information contained herein was developed through several related programs that were proceeding in parallel with the NURP program.

- The Southeast Michigan Council of Governments (SEMCOG), a NURP grantee, was developing stormwater management procedures.
- The Midwest Research Institute (MRI) was collecting cost information on control practices from selected NURP projects.
- A related EPA Water Planning Division program, the Financial Management Assistance Program (FMAP), was developing financial and institutional planning procedures designed to be helpful in the implementation of stormwater management plans.

STORMWATER MANAGEMENT PLANNING[1]

Stormwater management planning develops policies, regulations, and programs for the control of runoff from the land. Stormwater management planning is normally directed toward either or both of two primary goals: the reduction of local flooding and/or the protection of water quality. However, stormwater management planning is also generally used to insure that stormwater programs and regulations provide multiple benefits to the affected communities and do so in a way that does not create additional problems.

Stormwater management planning need not involve expensive technical studies. Available data and maps, the experience of other communities, and advice from experts can be used to develop an effective planning program. Detailed technical studies can then be targeted toward specific issues and problems. Effective local planning can alleviate the need for costly remedial public works projects.

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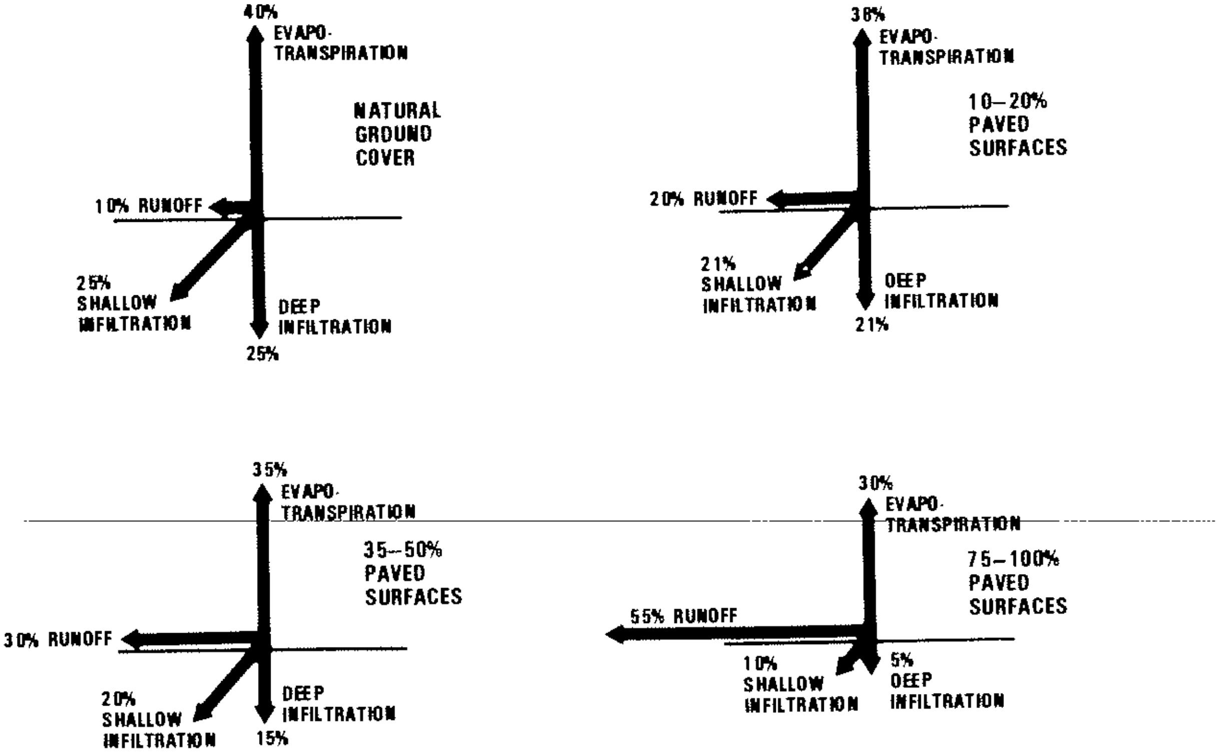
[1] The material in this section of the chapter is largely from Technical Bulletin No. 1: Stormwater Management Planning: Cost-Saving Methods for Program Development, the first of a seven-part bulletin series on water quality management prepared by the Southeast Michigan Council of Governments and available from Information Service, SEMCOG, 8th Floor, Book Building, Detroit, Michigan 48226.

The Need

Stormwater runoff cannot be ignored in developing communities. As urban development occurs, the volume of stormwater and its rate of discharge increase. These increases are caused when pavement and structures cover soils and destroy vegetation which otherwise would slow and absorb runoff. Pollutants, washed from the land surface and carried by runoff into lakes and streams, may add to existing water quality problems.

Figure 4-1 illustrates the effects of paved surfaces on stormwater runoff volumes. When natural ground cover is present over the entire site, normally less than 10 percent of the stormwater runs off the land into nearby creeks, rivers, and lakes. When paved surfaces cover 10 to 30 percent of the site area, approximately 20 percent of the stormwater can be expected to run off. As paved surfaces increase, both the volume and the rate of runoff increase. Furthermore, paved surfaces prevent natural infiltration of stormwater into the ground, and increased runoff volumes and rates increase soil erosion and pollutant runoff. Stormwater management planning can be used to develop programs to reduce adverse affects and even to provide community benefits.



Source: J.T. Tourbier and R. Westmacott, ***Water Resources Protection Technology: A Handbook of Measures to Protect Water Resources in Land Development***, p. 3.

Figure 4-1. Typical Changes in Runoff Flows Resulting from Paved Surfaces

Stormwater management can and should be directed toward two goals: the control of runoff flows (i.e., volumes and rates) and the control of pollutants in stormwater. Control measures which emphasize the storage of runoff rather than the immediate conveyance from the site and from the community often provide benefits which meet both goals. Stormwater storage and conveyance measures, however, affect the community in a variety of ways. Through stormwater management planning the effects of alternative policies, programs, control measures, and financing schemes can be evaluated.

Stormwater management planning is directed toward basic policy questions, such as:

- What should be done with runoff from the land?
- Is the temporary (detention) or permanent (retention) storage of stormwater runoff desirable?
- Under the circumstances, should retention basins, detention basins, natural infiltration areas, or dished parking lots be used to store runoff?
- What requirements should be placed on new developments?
- Do stormwater runoff problems in developed areas warrant special attention?
- Should communal retention or detention facilities be provided by the local jurisdiction? If so, how can such areas be financed?
- Who should pay for retention and detention facilities on private property?
- Are the local jurisdictions already carrying out programs (such as parkland acquisition programs or wetlands regulation) which affect stormwater runoff? Can programs and/or regulations be coordinated to achieve multiple purposes?
- Should enclosed drains or natural channels be used to convey stormwater to and from storage areas?
- Can routing and storage be provided for major storms (e.g., 100-year frequency) as well as minor storms (e.g., 10-year frequency)?
- Who should be responsible for facility maintenance?

The specific questions to be addressed in a local government planning program will vary among local jurisdictions, reflecting varying problems and community objectives. The answers to these questions may take the form of policy statements, changes in regulations or engineering design standards, technical assistance materials for landowners or consulting engineers, revisions to existing programs, or a written plan document.

Because stormwater management planning for quantity and quality control is relatively new, and because community stormwater concerns differ, there are no easy formulas for preparing stormwater management plans.

Stormwater Runoff as a Community Resource

Although, stormwater management programs are typically undertaken to avoid problems (e.g., flooding, pollution, lawsuits), effective planning can also be used to pursue potential community benefits. When effectively managed, stormwater can provide benefits such as:

- Recharge of groundwater supplies;
- Water quality enhancement;
- Recreational opportunities (e.g., use of large retention areas for boating, fishing, or nature study);
- Replenishment of wetlands which serve as wildlife habitats, absorb peak floods, and naturally break down certain pollutants;
- Maintenance of summertime lake levels and stream flows; and
- Enhancement of community appearance and image when facilities are attractively designed.

The Role of Local Governments

In some cases, the institutional systems for stormwater management may need to be complex, largely because State, county, and local agencies' policies, regulations, and procedures may all affect stormwater control within a particular development. For example, in Michigan, the following roles apply:

- County drain commissioners construct and manage county drains and also review subdivision plans to assure adequate drainage.
- County highway departments affect drainage in new developments by regulating connections to roadside drains and ditches.
- The State Department of Natural Resources regulates wetlands, dam construction, and floodplain alterations.
- The State Water Resource Commission issues permits for certain stormwater discharges when known water quality problems can be linked with a particular activity, (e.g., certain storm drains, animal feeding operations, industrial parking lots).
- Both the State Department of Public Health and county drain commissioners regulate drainage in proposed mobile home parks.
- County agencies and certain local governments issue erosion and sediment control permits for certain development sites.

Furthermore, there has been increasing emphasis upon the consideration of environmental factors in land use decisions. Recent amendments to the City or Village Zoning Act and the Township Rural Zoning Act have clarified the legal authority of local governments to complete site plan reviews for environmental management purposes. Standards for the review of land uses must be included in local ordinances and take natural resource preservation into account. The Michigan Environmental Protection Act (MEPA) (Act 127, P.A. of 1970) places a duty on all government agencies to prevent or minimize water pollution and other environmental problems while carrying on regular activities. Section 5(2) of MEPA addresses the actions of local officials in the following terms:

> In any ... administrative, licensing or other proceedings, and in any judicial review thereof, any alleged pollution impairment or destruction of the air, water or other natural resources or the public trust therein, shall be determined, and no conduct shall be authorized or approved which does, or is likely to have such effect so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety and welfare.

Environmental aspects of stormwater runoff may be addressed by local officials in response to MEPA.

None of the above laws specifically require local governments to undertake stormwater management programs. Instead, local governments have a wide range of possible roles available to them. Stormwater management planning programs can be directed toward the review of existing State and county programs affecting stormwater runoff and toward the evaluation of alternative roles for the local government.

Possible roles for local governments in stormwater management include the following:

- Planning - The term "stormwater management planning" refers to the process of developing policies, programs, regulations, and other recommendations to chart the future course of the community in terms of stormwater management. Such planning can address existing problems or help to avoid future problems and community expenses.

- Regulations - Stormwater runoff control for each site plan and subdivision plan can be reviewed and approved by the local government.

- Design and Construction - Storm drainage facilities (e.g., pipes, basins, areas for retention) can be designed and constructed by the local government. Purchase of lands to serve as community stormwater retention areas may also be undertaken.

- Inspection and Maintenance - Requirements for regular inspection and maintenance of stormwater facilities, including drains and retention or detention basins, may be enforced by local governments. Requirements for easements are usually part of maintenance programs. Local governments may choose to undertake maintenance as a community service (such as a utility) or may require maintenance through contractual agreements with property owners.

The types of programs developed and the role assumed by a local government should, of course, reflect available financing options as well as program needs and management gaps.

FINANCIAL AND INSTITUTIONAL CONSIDERATIONS[2]

The traditional planning approach would ideally culminate in the successful implementation of a detailed design. In many cases, however, this objective is not accomplished due to financial and institutional constraints. Often a study team will fail to adequately consider such institutional and financial issues as who will manage the system and how will it be financed, thus creating a gap between technical planning and implementation. This omission is illustrated in Figure 4-2.

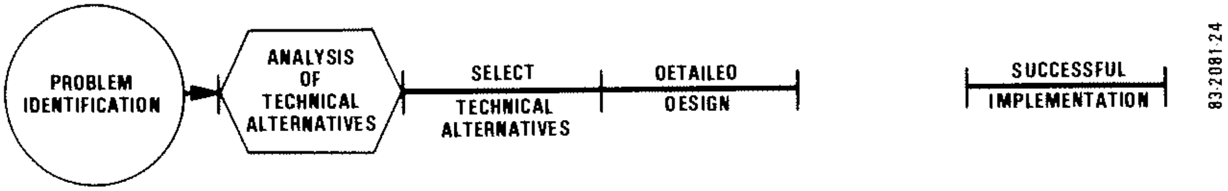


Figure 4-2. Incomplete Water Quality Planning

The implementation gap that results from the traditional planning approach has occurred all too often in attempts to control urban runoff.

As an illustration of the need to integrate financial and technical planning, consider the traditional process for developing a program to control construction runoff. A typical outcome of the process is a new ordinance. To reach this outcome, some of the issues that are normally considered from the technical perspective include:

- What are the technical construction requirements to be set out in the ordinance?
- What control measures will be required?
- How will compliance be monitored?

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[2] This material is largely from the draft document, Planning for Urban Runoff Control: Financial and Institutional Issues, December 1981, prepared for FMAP by the Government Finance Research Center of the Municipal Finance Officers Association, Washington, D.C.

To balance the planning process, this technical analysis should be expanded to include financial and institutional issues such as:

- Does the city have legal authority to implement each requirement in an ordinance?
- How much will each cost, and who will pay for implementation of the control measures?
- Who will conduct compliance review, and who will pay for the reviews?

Numerous additional factors increase the need for financial and institutional analysis in all water quality management planning. Examples might include:

- Implementation of control programs occurs at the local level, and local budgets are being tightened as water quality expenditures compete with other local demands.
- Benefits from water quality projects are difficult to quantify and often accrue to people living downstream.
- It is becoming more difficult to obtain municipal funds through the bond market because of high interest rates.
- The cost of pollution controls is often sizable and difficult to allocate to specific polluters or beneficiaries.

These problems affect most areas of water quality management, but they are especially important in identifying and implementing solutions to urban runoff pollution.

Integrated Approach

An integrated planning approach helps water quality planners make the best control decisions in light of many complex issues. This approach takes the traditional planning process and adds to it financial and institutional elements at each step along the way. This integration is shown in Figure 4-3, with the traditional approach illustrated along the upper track and the financial and institutional elements added along the lower track.

During the early planning stages, financial and institutional issues are reviewed on a preliminary basis. This information becomes more detailed and refined as planning proceeds. Ultimately, the information forms the basis for a financial and institutional plan that supports the detailed design of a control alternative.

When very complex problems are being evaluated, it may be advisable to use a preliminary matrix early in the evaluation process for screening-out unacceptable alternatives. This approach permits a more detailed evaluation of issues surrounding the two or three best alternatives before a final selection is made. An example of a preliminary matrix is given in Figure 4-4.

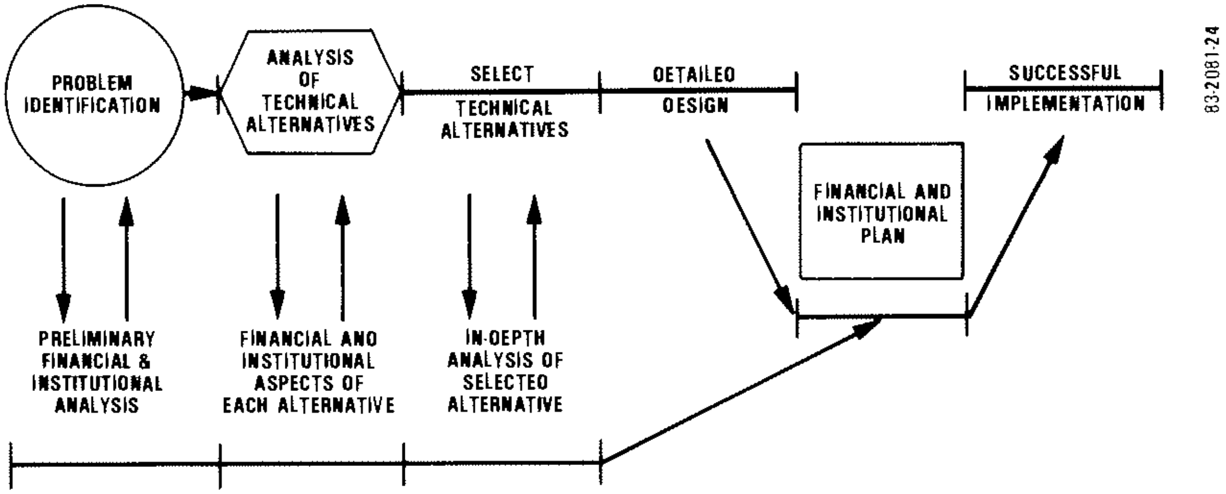

Figure 4-3. Integrated Water Quality Planning

CONTROL APPROACH	TECHNICAL DESCRIPTION	EFFECTIVENESS IN CONTROLLING POLLUTION	FINANCIAL ISSUES		INSTITUTIONAL ISSUES
			NET PRESENT VALUE	ABILITY TO PAY	
• SEPARATE SEWERS	CONSTRUCT NEW STORM SEWERS IN COMBINED AREAS	100% EFFECTIVE IN ELIMINATING CSOs	$1 BILLION	EXCEEDS CITY'S BONDING CAPACITY	EXISTING INSTITUTIONS COULD HANDLE THE PROJECT
• SELECTIVE EXPANSION OF UNDERSIZED TRUNK SEWERS	REMOVE BOTTLENECKS, REDUCE NUMBER OF OVERFLOW EVENTS	50% EFFECTIVE	$200 MILLION	IF STAGED OVER 10 YEARS, COULD BE FINANCED BUT WOULD RESTRICT OTHER PROGRAMS	EXISTING INSTITUTIONS COULD HANDLE THE PROJECT
• CONSTRUCTION OF DETENTION BASINS	CONSTRUCT 10 DETENTION BASINS SIZED TO HOLD THE FIRST FLUSH FROM A STORM	30% EFFECTIVE	$50 MILLION	IF STAGED OVER 5 YEARS, COULD BE FINANCED; COULD RESTRICT OTHER PROGRAMS	NEW ORGANIZATION MIGHT BE NEEDED TO MAINTAIN AND AND OPERATE BASINS

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Figure 4-4. Preliminary Matrix for Selection of a Control Approach (Combined Sewer Overflows)

Once a control approach is selected, a detailed design and a financial and institutional plan can be prepared. Figure 4-5 illustrates the major features of a financial and institutional plan. Key features of the detailed analysis required to prepare this plan are discussed in the following section.

INSTITUTIONAL SECTION

- RESPONSIBLE AGENCY
  - OPERATING PLAN
  - STAFFING NEEDS
  - ORGANIZATIONAL STRUCTURE
- LEGISLATIVE NEEDS
  - LEGAL ANALYSIS
  - DRAFT ORDINANCES
  - ASSISTANCE NEEDED

FINANCIAL SECTION

- PROGRAM COST
  - OPERATING BUDGET
  - CAPITAL REQUIREMENTS
- PROGRAM REVENUE
  - FUNDING SOURCES
  - FLOW OF FUNDS
  - PROGRAM CASH FLOW
  - COST ALLOCATION FORMULA
- OTHER FACTORS
  - FINANCIAL BURDEN ON PARTIES PAYING FOR THE PROGRAM
  - SENSITIVITY OF COST AND REVENUE ESTIMATES TO CHANGES IN FINANCIAL ASSUMPTIONS
  - INDIRECT IMPACTS

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Figure 4-5. Major Components of a Financial and Institutional Plan

Key Financial and Institutional Elements

There are six essential elements[3] of financial and institutional analysis which provide a structure for the integrated planning process;

- institutional assessment,
- cost analysis,
- revenue analysis,
- ability-to-pay analysis,
- sensitivity analysis, and
- indirect impact analysis.

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[3] These elements were first defined in Planning for Clean Water Programs: The Role of Financial Analysis, U.S. EPA's Financial Management Assistance Program by the Government Finance Research Center of the Municipal Finance Officers Association, September 1981.

Each of these elements threads through the planning process and becomes more definitive as the process proceeds. The following discussion defines each element and identifies its major features.

Institutional Assessment

The institutional assessment identifies the organizations or participating agencies that would be affected or involved in implementing a particular control program. The role of each entity in a program is evaluated with respect to its interest in solving the problem and its planning, management, operating, and regulatory capabilities. If the study team identifies an urban runoff problem, a preliminary institutional analysis can provide insight into capabilities of agencies that may be asked to play a role in the implementation and can, in some cases, aid in determining the types of technical alternatives that are analyzed.

The key factors to consider in evaluating an agency's capabilities are its statutory authority and organizational ability. In order to control urban runoff, an agency must have or be able to obtain the authority to implement a control measure. The authority of an agency can be assessed by thoroughly reviewing applicable federal, state, and local legislation. This review helps to determine which agency can best manage a given problem and highlights areas where additional legislation or local ordinances are needed.

Cost Analysis[4]

A cost analysis is performed to identify the additional capital, operational, maintenance, and administrative costs of each activity that is part of a control program. These costs are estimated for each agency responsible for an activity. Cost estimates are prepared in uninflated dollars (using today's cost for all projections into the future) and brought back to their present value (or present worth) for comparison among alternatives. The interest rate to be used in the present value analysis is the agency's current interest rate for borrowing funds minus the expected rate of inflation.[5]

Cost analysis of control alternatives is included in increasing detail in each step of the planning process. It begins with "ball park" estimates in early stages which are refined as the process progresses and finalized in the detailed financial plan.

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[4] A substantial part of this material is from a report, Collection of Economic Data from Nationwide Urban Runoff Program Projects, prepared for EPA by the Midwest Research Institute, 425 Volker Boulevard, Kansas City, MO 64110.

[5] For a further discussion of present value analysis, see pp 36 to 42 of Facilities Planning 1981, U.S. Environmental Protection Agency, FRD-20, 1981.

Cost estimates cannot be static. They are prepared on a preliminary basis when an alternative is first considered and detail is added as an alternative becomes more feasible. As the planning process progresses, estimates are updated on a regular basis to account for changing costs.

To update and improve available data on the costs of specific urban runoff BMPs, EPA conducted a program to guide, assist, and coordinate the efforts of selected NURP projects in gathering cost data on the BMPs and BMP systems which they were evaluating as part of the NURP national workplan. A report[6] was prepared to summarize the preliminary economic data submitted by the NURP projects. Economic data were submitted for street sweeping, detention basins, catch basin cleaning, ocean discharge control systems, and a public education/information program by nine projects. The data must be considered preliminary and subject to change, particularly annual operating cost data. Most of the capital cost data are well documented and represent the actual cost of the BMP control and will not change. The annual operating cost data, however, range from detailed analyses to estimates, and some of the data reported are incomplete. Since most of the projects were still in progress, incomplete operating cost data were to be expected.

The capital costs of street sweepers varied from $21,988 (in 1975) to $40,000 in 1981. The annual operating costs of street sweeping programs varied from $53,445 to $1,138,097. The unit cost varied from $16.80 to $45.45 per hour of operation, and from $5.95 to $23.36 per curb-mile swept. This wide range indicates that many variables affect the actual cost of operating a street sweeper.

The installed capital costs of recharge basins in Fresno, California, ranged from $933,750 to $5,587,000. BMP modifications to three detention basins in Oakland County, Michigan, cost $2,345 to $8,442. The installed capital cost of the modifications to the wet pond in the Lansing, Michigan project was $50,149. Construction of the wet pond in the Salt Lake County, Utah project cost $41,138; modifications to the dry pond included placing aluminum plates in an existing underdrain and installing a redwood outlet skimmer at a nominal cost of $371.

The annual operating costs of the Fresno, California, basins range from $1,625 to $7,975. The annual cost for the basin in Lansing, Michigan is incomplete and includes only the interest cost on a 7 percent, $38,500 bond used to help finance the project. The annual operating costs for the ponds in the Salt Lake County, Utah project were estimated at $560 for the wet pond and $200 for the dry pond.

The costs of the structural control alternatives to control discharge to the ocean in Myrtle Beach, South Carolina, were presented in detail and are valid estimates of the costs that will be incurred if one of them is constructed.

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[6] Collection of Economic Data From Nationwide Urban Runoff Program Projects - Final Report, April 7, 1982, EPA Contract No. 68-01-5052. Detailed cost data provided by the projects are included in the appendices of this Report to show how the various projects prepared the data for submission.

The 1980 construction cost estimates ranged from $32,849,200 to $50,973,500, and the annual operating cost estimates ranged from $3,735,400 to $5,301,900. The cost of the public education program at Salt Lake County, Utah, was estimated at $1,550. The project will report the actual cost of the program upon its completion.

Revenue Analysis

The revenue analysis identifies the funding sources needed to match the estimated cost for control activities by participating agencies. This analysis is important because it ensures adequate funding to implement the technical solution to an urban runoff problem.

There are three categories of funding that are typically used to pay for runoff control: Federal and State funds, local public funds, and private funds. These sources include a variety of different financing mechanisms, each with advantages and disadvantages. The use of any or a combination of these sources requires consideration regarding:

- Revenue adequacy - Will funds be available in the long- and short-term?
- Equity - Are the beneficiaries of the control program paying their full share?
- Economic efficiency - Is the charge that is assessed equal to the social cost of the program?
- Administrative simplicity - Can the funds be managed and directed to the control program without significant administrative problems?

Ability-to-Pay Analysis

The ability-to-pay analysis evaluates the implementing agencies' and the individual user's ability to pay for the proposed program by determining how reasonable a proposed revenue program is in terms of its overall impact on the community as a whole as well as on individual residents.

For a given revenue source, the additional burden of the program is expressed as a percentage of the base costs. For example, if the proposed program is to be financed by property taxes and it adds $.50 to a $1,000 tax bill, the additional tax burden is .05 percent. In this instance, it would appear that the homeowner's ability to pay is quite high.

An important factor to remember is that programs to control urban runoff are not the only programs that are placing a burden on the people or institutions who must support them. Hence, the cost of a control program may not be excessive but cannot be imposed because ability to pay has already been exceeded due to other projects.

Sensitivity Analysis

The sensitivity analysis identifies the extent to which local ability to pay varies with changes in the assumptions used to estimate costs and revenues. Major assumptions that influence costs and revenues are: phasing of capital improvement, anticipated local funding requirements, rate of inflation, growth rate, and local fee policies.

The first step in this analysis is to determine a range of values for key cost and revenue assumptions that could occur during the program. (For example, inflation may vary between 5 percent and 15 percent.) The ability-to-pay analysis is then repeated using the high and low values for these assumptions. The final step is to evaluate the changes in burden with "best-" and "worst-" case situations in comparison with burden under the "most likely" assumption.

The purpose of this analysis is to identify control programs that are least vulnerable to changing conditions. It also helps to make the planner aware of best- and worst-case scenarios so that contingency plans can be developed to cope with such events.

Indirect Impact Analysis

The indirect impact analysis is an assessment of the costs and benefits that are not directly attributable to a proposed program. These costs and benefits can be economic, social, and/or environmental. Quantifying the indirect impacts of a program is usually quite difficult, so the planner generally resorts to qualitative measurement.

An Example: Planning an Educational Program

To illustrate further the process of identifying and resolving the financial and institutional issues connected with implementation of an urban runoff control program, the following spells out the steps involved in evaluating one control approach applicable in already developed areas. The example chosen is an educational program to inform citizens, industry, and public agencies of the problems caused by runoff-borne lawn and garden chemicals, oil and chemical residuals from industrial yards, and pesticides, herbicides, and fertilizer from parks and golf courses.

In this example, the activities would include: development of an informational brochure, including printing and distribution, and maintenance of an information center. In Figure 4-6, the institutional characteristics needed to accomplish these activities are compared with the capabilities of existing agencies. The matrix shows that the County Department of Pollution Control could provide the technical input to the Public Information Center to write the brochure. The Council of Governments might coordinate the effort and assume overall responsibilities for getting the job done.

INSTITUTIONAL CHARACTERISTICS NEEDED	AGENCIES					
	STATE	COUNCIL OF GOVERNMENTS	DEPARTMENT OF POLLUTION CONTROL	DEPARTMENT OF PLANNING	PUBLIC INFORMATION CENTER	CHAMBER OF COMMERCE
• COMMITMENT TO PROGRAM GOALS	*	*	*	*	*	*
• WORKING KNOWLEDGE OF EACH WASTE CONTRIBUTION TO THE RUNOFF PROBLEM	*	*	*	*		
• ABILITY TO WRITE CLEAR AND CONCISE INFORMATION FOR THE PUBLIC					*	
• ABILITY TO PRINT AND AND DISTRIBUTE BROCHURE				*		* DISTRIBUTE TO INDUSTRY
• STAFF TO RECEIVE FOLLOWUP CALLS		*				
• ABILITY TO ACCEPT FUNDS FROM SEVERAL AGENCIES TO PAY FOR THE PROGRAM		*				

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Figure 4-6. Institutional Assessment for Educational Program to Control Chemical Substances

Cost Analysis. Cost analysis determines the additional funds needed to implement a control alternative, including capital improvements and operation and maintenance. Additional administrative costs are less significant because most of these projects are undertaken by a public agency that is already performing the function to some extent.

Capital cost estimates are best prepared by the water quality planner with the assistance of the municipal engineer and in some cases his/her outside engineering advisor. These estimates identify all costs related to the purchase of a new facility or piece of equipment for a project and may require some research into vendor prices and bids on similar projects around the country. For programs which require changes to existing practices (street sweeping, etc.), the cost attributable to the water quality program is the incremental cost of the program.

Ultimately, the cost analysis is used to identify the least-cost method(s) for reducing pollution problems. It is important to remember that all costs associated with a given program must be considered. It is incorrect to assume that educational efforts, for example, are provided at no additional cost.

As an example of a cost analysis, a possible budget sheet for the educational program for the current year is presented in Figure 4-7.

ACTIVITIES	AGENCIES					
	STATE	COUNCIL OF GOVERNMENTS	DEPARTMENT OF POLLUTION CONTROL	DEPARTMENT OF PLANNING	PUBLIC INFORMATION CENTER	TOTAL
1. DEVELOP BROCHURE					$13,000	$13,000
2. PRINT BROCHURE				$1,500		$ 1,500
3 DISTRIBUTE BROCHURE				$ 800		$ 800
4. CONDUCT INFORMATIONAL MEETINGS	$2,000	$ 5,500	$2,000			$ 9,500
5. STAFF FOLLOWUP FOR PROGRAM		$24,000				$24,000
TOTAL	$2,000	$29,500	$2,000	$2,300	$13,000	$48,800

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Figure 4-7. Cost Analysis for Educational Program to Control Chemical, Herbicide, Fertilizer and Pesticide Runoff

Revenue Analysis. After the program cost estimate is prepared, the potential sources of revenue are analyzed. There are several critical factors in analyzing revenue for urban runoff programs including:

- Cost/Revenue Balance - Will the revenues be sufficient to cover the costs on an annual basis?
- Equitable Allocation of Costs to Different Groups - Do those who contribute to the problem pay their fair share? Do those who benefit from the program pay their fair share?
- Revenue Agreement - Do groups understand their participation in a program and its revenue formula? Have written agreements which define the cost allocation procedure been prepared ?

Revenue analysis will vary with the type of control approach selected. The critical factor in the revenue analysis is the identification of each entity that will provide revenues and the development of an understanding by that entity of the problem, the control approach, and its share of the cost.

Ability-to-Pay Analysis. Most of the costs to control runoff from developed areas are imposed on the general public or the benefiting population as a new and additional governmental expense. The ability-to-pay analysis evaluates this increased burden on the local community as a percentage of property taxes, average income, property evaluation, or other appropriate measures.

Figure 4-8 illustrates an ability-to-pay analysis for the educational program example. The key parameters to determine homeowners' ability to pay in this case are the cost of the program per household, cost as a percentage of average annual household income, and cost as a percentage of property taxes.

A. TOTAL PROGRAM COST (ONE-YEAR PROGRAM)	$48,000	
B. NUMBER OF HOUSEHOLDS AFFECTED	19,000	
C. COST PER HOUSEHOLD (A DIVIDED BY B)		$2.57
D. MEDIAN HOUSEHOLD INCOME	$14,700	
E. COST AS A % OF MEDIAN HOUSEHOLD INCOME (C DIVIDED BY D TIMES 100)		.02%
F. AVERAGE ANNUAL PROPERTY TAXES	$ 1,200	
G. COST AS A % OF PROPERTY TAXES (C DIVIDED BY F TIMES 100)		.21%

CONCLUSION: PROGRAM APPEARS TO NOT PLACE EXCESSIVE BURDEN ON LOCAL HOMEOWNERS

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Figure 4-8. Ability to Pay Analysis for Educational Program to Control Chemical, Herbicide, Fertilizer and Pesticide Runoff

Sensitivity Analysis. The sensitivity analysis will vary depending upon the revenue mechanism and program selected for implementing a proposed program. The most common revenue mechanisms for programs controlling runoff from developed areas are general funds and fees. Analyzing the sensitivity of general revenues requires a review of past collections relative to key parameters--inflation, housing starts, collection rates, capital improvements, and so on. Collections are then projected for worst and best case scenarios.

An additional consideration in the sensitivity analysis is revenue requirements. This relates to phasing a program, either handling capital improvements or starting a program on a limited basis with expansion to come in later years. For any one program, numerous options exist for staggering cash flows, and different scenarios should be developed to assess their impact on the program as part of the sensitivity analysis.

Indirect Impact. The indirect impact of a runoff control program for developed areas are extremely difficult to quantify. Educational programs will raise community awareness regarding the impacts of local activities on water pollution. Other indirect impacts from control programs may relate to recreational benefits, local improvements in quality of life, and increased tourism.

RELATIONSHIP BETWEEN NURP AND WQM PLANS

Of the locations selected for projects under the NURP effort, some 80 percent had state-approved (i.e., certified by the Governor) water quality management (WQM) plans with elements which addressed urban runoff. For 5 of these locations, the NURP project constituted the urban runoff element of the plan. For the other locations, however, the original 208 effort was unable to develop the necessary information on either water quality effects or performance of best management practices (BMPs) to justify structuring formal implementation plans for urban runoff control. Consequently, the typical WQM plan elements dealing with urban runoff identified the need for further study, usually specifying problem assessment and BMP performance evaluation. These elements became the focal points of the activities funded by NURP.

The WQM plans for the remaining 20 percent of the locations which participated in the NURP program did not contain a specific urban runoff element. Presumably this was due to time and resource constraints in relation to other issues which were assigned higher priorities in planning efforts. In these cases, the NURP projects provided the opportunity to address a water quality issue not adequately addressed in the original 208 planning studies.

Over two-thirds of the NURP project locations reported that NURP findings and recommendations have or will be incorporated in the next annual update of their formal WQM plans. The remainder generally indicate that they expect the planning issues to be addressed at the local level or that NURP results will support planning and implementation activities, even though they do not anticipate formal incorporation in WQM plans at this time.

Over half of the NURP project locations report either active or planned implementation efforts based on the results of NURP. Thirty percent indicated that no implementation is being planned because the need for or value of urban runoff control was not demonstrated. The balance (20 percent) of the NURP locations suggest that while implementation activities are not currently planned, they expect NURP results to influence future deliberations on this issue.

CHAPTER 5
METHODS OF ANALYSIS

INTRODUCTION

This chapter identifies and briefly discusses the methods adopted to assemble and analyze the large data base developed by the NURP projects and also provides the methods employed to develop and interpret results. The chapter is structured according to the three prime areas of program emphasis; (1) characteristics of pollutants in urban runoff, (2) water quality effects of urban runoff discharges including water quality criteria/standards violations and impairment or denial of beneficial uses of receiving water bodies, and (3) the effectiveness of control measures to reduce pollutant loads.

The procedures employed in this assessment were designed to provide generalized results and findings about urban runoff issues of interest for nationwide use. This national perspective, and the need to consider the fundamental variability of urban runoff processes, has prompted some significant advancements in the application of statistical methods and models. The basic methods used were, however, largely developed under different EPA efforts, many under the sponsorship of the Office of Research and Development, or other programs. In some cases, similar or equivalent procedures were applied in individual NURP projects; in other cases, methods adopted by individual projects in response to local needs and interests were different. Where possible, comparisons have been made between either detailed results, or conclusions drawn from such results, as derived from both local and national perspectives.

The descriptions provided in this chapter are brief and intended to communicate the technical framework upon which the results and conclusions are based. More detailed information on the methods and techniques are contained in other documents developed by NURP. Pertinent NURP reports cover, in separate volumes, probabilistic methods for analyzing water quality effects, detention and recharge basins for control of urban stormwater quality, and street sweeping for control of urban stormwater quality. The Data Management Procedures Manual, another of the project documents, is an additional source of information on details of the analysis methods utilized.

Because field measurements and sampling formed one of the most important information sources, it was essential that the monitoring and analysis programs produce consistent and sound data. Accordingly, NURP required that all projects adopt Quality Assurance/Quality Control elements as integral parts of their work plans. Key components of these plans include the following:

- Program Coordination. Projects were required to designate a QA/QC coordinator, responsible for the entire QA/QC effort.

- Field Quality Assurance. Guidance was provided to the projects for all key aspects of the data collection process.

- Laboratory Quality Assurance. A manual prepared by EPA's Environmental Monitoring and Support Laboratory was provided to all projects and contained analytical quality control information.

- Data Management. A manual entitled "Data Management Procedures" was provided to all projects and covered such topics as data formatting, data reduction, and some analysis.

- Data Analysis. To encourage innovative approaches and responsiveness to local conditions, uniform methods of data analysis were not stressed. Technical guidance and mandatory review of analytical procedures were provided.

RUNOFF POLLUTANT CHARACTERISTICS

al

stantial component of the individual NURP projects was the acquisition subsequent analysis) of a data base for a number of storm events, con- ng of precipitation and the resulting quantity and quality of runoff a number of local urban catchments. One of the principal EPA objectives e analysis of these data has been to develop a concise summary of the teristics of urban runoff. There are a number of questions concerning runoff characteristics which need to be addressed for water quality ing purposes, including what are the appropriate measures of the statis- characteristics of urban runoff (e.g., population distribution, central ncy, variability, etc.)? Do distinct subpopulations exist and what are characteristics? Are there significant differences in data sets ed according to locations around the county (geographic zones), land season, rainfall amount, etc.? How may these variations be recognized? s the most appropriate manner in which to extrapolate the existing data to locations for which there are no or limited measurements? Though questions cannot be fully answered given the current state of knowledge rning urban runoff, these are the types of issues addressed by the is described in this chapter and the results presented in Chapter 6.

rincipal thrust of the individual NURP projects, and thus this nation- assessment report, was the characterization of what has been adopted as dard Pollutants" of primary concern in urban runoff. These include , oxygen consuming constituents, nutrients, and a number of the more ly encountered heavy metals. The methods used to characterize these rd pollutants are described under a separate heading below.

roximately two-thirds of the NURP projects the occurrence of compounds s list of "Priority Pollutants" was investigated. This program element so described under a separate heading below. A number of additional have also been addressed in the program. These are briefly discussed below because they relate closely to the general issue of pollutant characteristics. These include the following:

- *Soluble vs Particulate Pollutant Forms*. The distribution of soluble and particulate forms of a pollutant in urban runoff (particularly metals and nutrients) was examined in both the standard conventional pollutant and priority pollutant aspects of the study because certain beneficial use effects depend strongly on the form in which the contaminant is present. The priority pollutant program additionally determined "Total Recoverable" fractions, corresponding to contaminant forms used in EPA's published toxic criteria guidelines.

- *Coliform Bacteria*. Fecal coliform bacteria counts (and in some cases total coliform and fecal streptococcus as well) in urban runoff were monitored during a significant number of storms by seven of the NURP projects. Though the data base for bacteria is restricted, useful results are provided in Chapter 6.

- *Wetfall/Dryfall*. As part of program elements designed to examine sources of pollutants in urban runoff, a number of projects operated atmospheric monitoring stations for characterizing pollutant contributions from precipitation (wetfall) and from dry weather deposition (dryfall). Results of this work are reported in individual project reports and not included herein.

Standard Pollutants

The following constituents were adopted as standard pollutants characterizing urban runoff:

TSS - Total Suspended Solids
BOD - Biochemical Oxygen Demand
COD - Chemical Oxygen Demand
TP - Total Phosphorus (as P)
SP - Soluble Phosphorus (as P)
TKN - Total Kjeldahl Nitrogen (as N)
NO_{2+3}-N - Nitrite + Nitrate (as N)
Cu - Total Copper
Pb - Total Lead
Zn - Total Zinc

The list includes pollutants of general interest which are usually examined in both point and nonpoint source studies and includes representatives of important categories of pollutants--namely solids, oxygen consuming constituents, nutrients, and heavy metals.

The pollutant concentrations found in urban runoff vary considerably, both during a storm event, as well as from event to event at a given site and from site to site within a given city and across the country. This variability is the natural result of high variations in rainfall intensity and occurrence, geographic features that affect runoff quantity and quality, and so on. Considering this situation, a measure of the magnitude of the urban runoff pollution level and methods for characterizing its variability were needed. The event mean concentration (EMC), defined as the total constituent mass discharge divided by the total runoff volume, was chosen as the primary measure of the pollutant load. The rationale for adopting the EMC for characterizing urban runoff is discussed in the receiving water effects section of this chapter as well as in subsequent chapters. Event mean concentrations were calculated for each event at each site in the accessible data base. If a flow-weighted composite sample was taken, its concentration was used to represent the event mean concentration. Where sequential discrete samples were taken over the hydrograph, the event mean concentration was determined by calculating the area under the loadograph (the curve of concentration times discharge rate over time) and dividing it by the area under the hydrograph (the curve of runoff volume over time). Details of the calculation procedure have been described in the Data Management Procedures Manual. For the purpose of determining event mean concentrations, rainfall events were defined to be separate precipitation events when there was an intervening time period of at least six hours without rain.

A statistical approach was adopted for characterizing the properties of EMCs for standard pollutants. Standard statistical procedures were used to define the probability distribution, central tendency (a mean or median) and spread (standard deviation or coefficient of variation) of EMC data. EMC data for each pollutant from all storms and monitoring sites were complied in a central data base management system at the National Computer Center. The SAS computer statistical routines and other standard statistical methods were used to explore and characterize the data. The statistical methods used are, for the most part, not explained in this report since these are readily available in the literature. Nor are the operations of the SAS routines, which are available at most computer centers.

The underlying probability distribution of the EMC data was examined and tested by both visual and statistical methods. With relatively few isolated exceptions, the probability distribution of EMCs at individual sites can be characterized by lognormal distributions. Given this, concise characterization of the variable urban runoff characteristics at each of the sites is defined by only two values, the mean or median and the coefficient of variation (standard deviation divided by mean). Because the underlying distributions are lognormal, the appropriate statistic to employ for comparisons between individual sites or groups of sites is the median value, because it is less influenced by the small number of large values typical of lognormal distributions and, hence, is a more robust measure of central tendency. However, for comparisons with other published data which usually report average values and for certain computations and analyses (e.g., annual mass loads), the mean value is more appropriate.

Relationships among a number of statistical properties of interest are easily determined when distributions are lognormal. Figure 5-1 illustrates some relationships for lognormal distributions. In (a) the frequency distributions of two variable data sets which are log-normal and have the same median are shown. The log transforms of the data result in normal bell

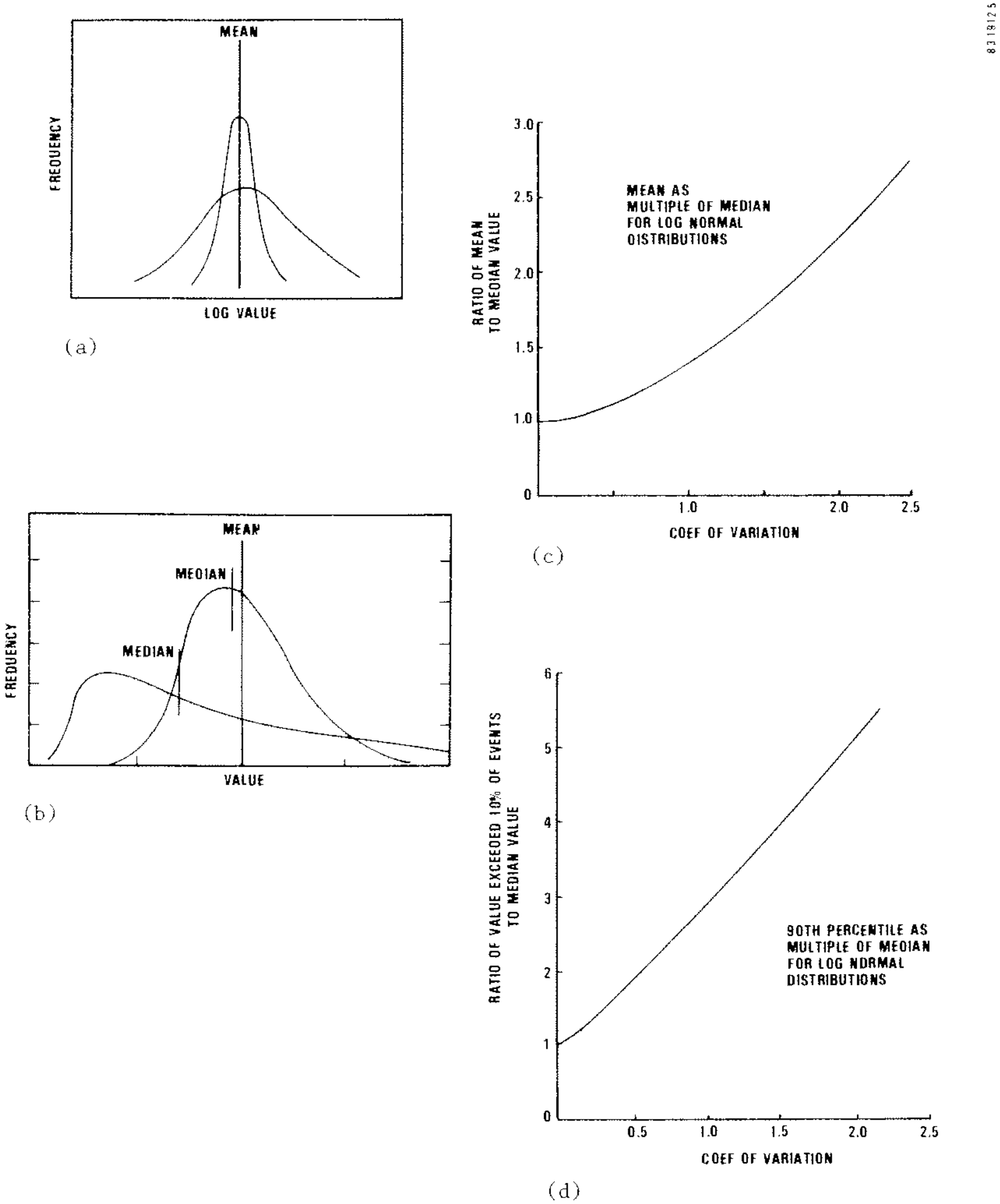

Figure 5-1. Lognormal Distribution Relationships

shaped distributions; more variable data (higher coefficient of variation) result in a greater spread. Frequency histograms prepared using untransformed data values produce skewed distributions, as shown by (b) which illustrates two data sets which have the same arithmetic mean. The effect of coefficient of variation is shown as well as the relation between mean and median for lognormal distributions. An established relationship exists between median and mean, as shown by (c) and described by:

$$\frac{\text{Mean}}{\text{Median}} = \sqrt{1 + (\text{Coef Var})^2}$$

When a distribution is known to be lognormal the best estimate of the population mean is that derived from the lognormal relationships. For small samples it can be expected to be different than the result of a straight arithmetic averaging of sample data; the two estimates of the mean will give similar values when the number of samples is very large.

In addition, the expected value at any probability or frequency of occurrence (X_α) can be determined by:

$$X_\alpha = \exp\left(\mu_{\ln x} + Z_\alpha\ \sigma_{\ln x}\right)$$

where:

Z_α = the standard normal probability

$\mu_{\ln x}$ = mean of log-transformed data

$\sigma_{\ln x}$ = standard deviation of log-transformed data

X_α can be expressed as a ratio to the median value by the following equation which defines the ratio in terms of the coefficient of variation

$$\frac{X_\alpha}{\text{Median}} = \exp\left(Z_\alpha \sqrt{\ln\left(1 + (\text{Coef Var})^2\right)}\right).$$

This relationship is shown by (d) for 90th percentile values (10 percent exceedance, $Z_\alpha = 1.2817$).

The establishment of the fundamental distribution as lognormal, and the availability of a sufficiently large sample population of EMCs to provide reliable derived statistics, has a number of benefits:

- Concise summaries of highly variable data can be developed.
- Comparisons of results from different sites, events, etc., are convenient and are more easily understood.

- Statements can be made concerning frequency of occurrence. One can express how often values will exceed various magnitudes of interest.

- A more useful method of reporting data than the use of ranges is provided; one which is less subject to misinterpretation.

- A framework is provided for examining "transferability" of data in a quantitative manner.

Priority Pollutants

In cooperation with EPA's Monitoring and Data Support Division (MDSD), a special study element was built into two-thirds of the NURP projects (20 of 28) to identify which of the compounds on EPA's list of "Priority Pollutants" are found in urban runoff, and the concentrations at which they occur. The base effort collected 121 samples of urban runoff which were analyzed for priority pollutants. A supplementary special metals study secured 147 samples. Methods utilized in this study element are described in the following report which covers this activity:

> "NURP Priority Pollutant Monitoring Project: Summary of Findings", December 1983; EPA Monitoring and Data Support Division, Office of Water Regulations and Standards, Washington, D.C.

In addition to the above special study, as previously mentioned, most NURP projects monitored selected heavy metals (principally total copper, total lead, and total zinc) in their routine monitoring programs. Summaries of these data are presented in Chapter 6.

Hydrometeorological Statistics

Consistent with the adoption of a storm "event" as the fundamental time scale used in the analysis of data and the interpretation of effects, rainfall data were analyzed to define "event" statistics for a significant number of locations throughout the country. The SYNOP program was employed for developing the statistical parameters of rainfall intensity, duration, volume, and interval between storm events. This program has been detailed in the NURP "Data Management Procedures Manual."

In addition to rainfall, rainfall-runoff relationships were characterized for monitored storm events. The runoff coefficient, defined as the ratio of runoff volume to rainfall volume, was computed, and effects of such catchment characteristics as land use and imperviousness were investigated. Long-term streamflow records for numerous stations across the country were also analyzed to characterize regional trends.

RECEIVING WATER QUALITY EFFECTS

General

A number of individual NURP projects examined the site-specific impacts of urban runoff on water quality for a variety of beneficial uses and receiving water types. These results provide important information on the extent to which urban runoff constitutes a "problem" as well as "ground truth" measurements against which more generalized techniques can be compared. Methodologies employed in these local studies vary and are described in the individual project reports. Relevant site-specific project results are cited in Chapter 9.

Receiving water impact analyses cannot be readily generalized because there is a high degree of site-specificity to the important factors. The type of beneficial use dictates the pollutants which are of principal concern; the type of water body (e.g., stream, lake, estuary) determines how receiving water quality responds to loads; and physical characteristics (e.g., size, geometry, flows) have a major influence on the magnitude of response to a particular load.

Despite the inherent limitations of a set of generalized receiving water impact analyses, a screening level analysis was considered a necessary element for a nationwide assessment of the general significance of urban runoff in terms of water quality problems, especially adverse effects on beneficial uses. Accordingly, a set of analysis methodologies were adopted and utilized as screening techniques for characterizing water quality effects of urban runoff loads on receiving water bodies. A key requirement was to delineate the severity of water quality problems by quantifying the magnitude, and in the case of intermittent loads, the frequency of occurrence of water quality impacts of significance. These procedures are identified and described briefly below. Significant technical aspects are detailed further in the supplementary NURP report which addresses the receiving water impact analysis methodology.

It was not possible to perform a "National Assessment" in the usual sense of the term. NURP has determined that it is not realistic (if the basis is effect on beneficial use of a water body) to estimate the total number of water quality problem situations in the nation which result from urban stormwater runoff or the cost of control which would ultimately result. The available analysis methods do permit an assessment of a different kind. NURP applied the analysis procedures as a screening type analysis to define the conditions under which problems of different types are likely or unlikely to occur. From the results of these screening analyses, NURP has drawn inferences and made general statements (Chapters 7 and 9) on the significance of urban runoff. Where it has been possible or practical to do so, these general screening analyses were applied to local situations which exist within certain of the individual NURP projects. Comparisons were made between specific water quality effects or broader conclusions relative to problems derived from both local analysis and general screening methods.

Time Scales of Water Quality Impacts

There are three types of water quality impacts associated with urban runoff. The first type is characterized by rapid, short-term changes in water quality during and shortly after storm events. Examples of this water quality impact include periodic dissolved oxygen depressions due to oxidation of contaminants, or short-term increases in the receiving water concentrations of one or more toxic contaminants. These short-term effects are believed to be an important concern and were the prime focus of the NURP analysis.

Long-term water quality impacts, on the other hand, may be caused by contaminants associated with suspended solids that settle in receiving waters and by nutrients which enter receiving water systems with long retention times. In both instances, long-term water quality impacts are caused by increased residence times of pollutants in receiving waters. Other examples of the long-term water quality impacts include depressed dissolved oxygen caused by the oxidation of organics in bottom sediments, biological accumulation of toxics as a result of up-take by organisms in the food chain, and increased lake entrophication as a result of the recycling of nutrients contributed by urban runoff discharges. The long-term water quality impacts of urban runoff are manifested during critical periods normally considered in point source pollution studies, such as summer, low stream flow conditions, and/or during sensitive life cycle stages of organisms. Since long-term water quality impacts occur during normal critical periods, it is necessary to distinguish between the relative contribution of urban runoff and the contribution from other sources, such as treatment plant discharges and other nonpoint sources. A site-specific analysis is required to determine the impact of various types of pollutants during critical periods, and this aspect of urban runoff effects was not addressed in detail in NURP.

A third type of receiving water impact is related to the quantity or physical aspects of flow and includes short-term water quality effects caused by scour and resuspension of pollutants previously deposited in the sediments. This category of impact was not addressed by NURP, in general, although one project provides some information.

As indicated previously, the first type of change in water quality associated with discharges from urban runoff is characterized by short-term degradation during and shortly after storm events. The rainfall process is highly variable in both time and space. The intensity of rainfall at a location can vary from minute to minute and from location to location. Phenomena which are driven by rainfall such as urban runoff and associated pollutant loadings are at least as variable. Short term measurements, on a time scale of minutes, to define rainfall, the runoff flow hydrograph, and concentrations of contaminants (pollutographs) feasibly can be taken at only a rather limited number of locations. These measurements have usually been employed in an attempt to refine or calibrate calculation procedures for estimating runoff flows and loads. Most urban areas contain a network of drainage systems which collect and discharge urban runoff into one or more receiving water bodies. Since the rainfall, runoff, and pollutant loads vary in both time and space, it is impossible to determine by calculation or measurement the very short time scale (minute-to-minute) changes in water quality of a receiving water and assign the changes to specific sources of runoff. Although very short duration exposures (on the order of minutes) to very high concentrations of toxics can produce environmental damage (mortality or sublethal effects) to aquatic organisms, it is likely that exposures on the order of hours have the highest possibility of causing adverse environmental impacts. This results, in part, from the smoothing obtained by mixing numerous sources which have high frequency (short-term) variability.

In view of the above discussion, the time scale used by NURP for analysis of short-term receiving water impacts is the rainfall event time scale which is on the order of hours. To represent the average concentration of pollutants in urban runoff produced during such an event, NURP used the event mean concentration.

Criteria/Standards and Beneficial Use Effects

As discussed in previous chapters, three definitions have been adopted to assess receiving water problems associated with urban runoff; (1) impairment or denial of beneficial use, (2) violation of numerical criteria/standards, and (3) local perception of a problem. The procedures and methods employed in the NURP assessment focus on the first two problem definitions. A framework for identifying target receiving water concentrations associated with the criteria standards and beneficial use problems are provided below. The third problem type, local perception of a problem and degree of concern cannot be addressed by these quantitative procedures.

The analysis methods employed make it possible to project water quality effects caused by intermittent, short-term urban runoff discharges. Where appropriate, these effects are expressed in terms of the frequency at which a pollutant concentration in the water body is equalled or exceeded. However, if the basis for determining the significance of such water quality impacts (and hence the need for control) is taken to be the effect such receiving water concentrations have on the impairment or denial of a specific beneficial use, then it is necessary to go one step further. A basis is required for judging the degree to which a particular water quality impact constitutes an impairment of a beneficial use. With intermittent pollutant discharges, effects are variable and are best expressed in terms of a probability distribution from which estimates can be made of the frequency with which effects of various magnitude occur.

There is a rather broad consensus that existing water quality criteria, and water uses based on such criteria, are most relevant when considered in terms of continuous exposures (ambient conditions). Even where continuous discharges are involved, there has been discussion and debate as to whether a particular criterion should be interpreted as some appropriate "average" condition or a "never-to-exceed" limit. The basic issue is whether the more liberal interpretation will provide acceptable protection to the beneficial use for which the criterion in question has been developed. The only reason such distinctions become an issue is because the practical feasibility or relative economics, or both, are sufficiently different that one is encouraged to question whether the more restrictive interpretation is overly (or even excessively) conservative in terms of providing protection for the associated beneficial use.

The issue (i.e., whether traditional ambient criteria are excessively conservative measures of conditions which provide reasonable assurances of protection for a beneficial use when exceeded only intermittently) is particularly appropriate in the case of urban storm runoff. Analysis of rainfall records for a wide distribution of locations in the nation indicates that, even in the wetter parts of the country, urban runoff events occur only about 10 percent of the time. There are regional and seasonal differenc but typical values for annual average storm characteristics in the easte half of the United States are:

	Average (Hours)	Median (Hours)	90th Percentile (Hours)
Storm Duration	6	4.5	15
Interval Between Storm Mid-Points	80	60	200

These estimates are based on results from an analysis of long-term rainfa records for 40 cities throughout the country. Median and 90th percenti values are derived from data mean and variance based on a gamma distributic which has been shown to characterize the underlying distribution of stc event parameters quite well.

In the semi-arid regions of the western half of the country, average stc durations tend to be comparable to the above, but average intervals betwe successive storms increase substantially (two to four fold) and are high seasonal. With urban storm runoff, therefore, one is dealing with polluta discharges which occur over a period of a few hours every several days more or after long dry periods. In advective rivers and streams, the wat mass influenced by urban runoff tends to move downstream in relatively di crete pulses. Because of the variability in the magnitude of the pollut loads from different storm events, only a small percentage of these puls have high pollutant concentrations.

There are currently no formal "wet weather" criteria and, thus, no genera accepted way intermittent exposures having time scale characteristics typic of urban runoff can be related to use impairment. In the belief that would be inappropriate to ignore such considerations in a general evaluati of urban runoff, NURP has developed estimates for concentration levels whi result in adverse impacts on beneficial use when exposures occur intermi tently at intervals/durations typical of urban runoff. These "effec levels" were used to interpret the significance of the variable, intermitte water quality impacts of urban runoff. It should be understood that the effects levels do not represent any formal position taken by EPA, but simply the most reasonable yardsticks available to meet the immediate nee of the evaluation of urban runoff. As used in the screening analysis proc dures, alternative values for "effects levels" may be readily substitut when either more accurate estimates can be made, or more (or less) conser tive approaches are indicated in view of the importance of a particular wat body or beneficial use.

Table 5-1 summarizes information on water quality criteria for a number contaminants routinely found in urban storm runoff. The data present include:

- Water quality criteria for substances on EPA's priority pollutant list (45 FR No. 79318, 11/28/80). These criteria provide

TABLE 5-1. SUMMARY OF RECEIVING WATER TARGET CONCENTRATIONS USED IN SCREENING ANALYSIS - TOXIC SUBSTANCES
(ALL CONCENTRATIONS IN MICROGRAMS/LITER, μg/ℓ)

Contaminant	Water Hardness mg/l (as Ca CO_3)	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Ingestion	Estimated Effect Level For Intermittent Exposure	
		24 Hour	Max	24 Hour	Max	(1)	Thresh-hold	Significant Mortality
Copper	50	5.6	12	4.0	23	NP	20	50 - 90
	100	5.6	22	4.0	23		35	90 - 150
	200	5.6	42	4.0	23		80	120 - 350
	300	5.6	62	4.0	23		115	265 - 500
Zinc	50	47	180	58	170	NP	380	870 - 3,200
	100	47	321	58	170		680	1,550 - 4,500
	200	47	520	58	170		1,200	2,750 - 8,000
	300	47	800	58	170		1,700	3,850 - 11,000
Lead	50	0.75	74				150	350 - 3,200
	100	3.8	172	(25)	(670)	50.0	360	820 - 7,500
	200	12.5	400				850	1,950 - 17,850
	300	50.0	660	(C)	(A)		1,400	3,100 - 29,000
Chrome (+3)	50		2,200					
	100	(44)	4,700	N.P.	(10,300)	170.00	8,650	
	300	(C)	15,000		(A)			
Chrome (+6)	-	0.29	21.0	18	1260	50.0		
Cadmium	50	0.01	1.5				3	7 - 160
	100	0.02	3.0	4.5	59.0	10	6.6	15 - 350
	300	0.08	9.6				20	45 - 1,070
Nickel	50	56	1,090					
	100	96	1,800	7.1	140.0	13.4		
	300	220	4,250					

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<u>NOTES:</u>

- NP = No criteria proposed.
- Some toxic criteria are related to Total Hardness of receiving water. Where this applies, several values are shown. Other values may be calculated from equations presented in EPA's Criteria Document (Federal Register, 45,231, November 28, 1980). Where a single value is shown, water hardness does not influence toxic criteria.
- Concentration values shown within parentheses ( ) are not formal criteria values. They reflect either chronic (C) or acute (A) toxicity concentrations which the EPA toxic criteria document indicated have been observed. Values of this type were reported where the data base was insufficient (according to the formally adopted guidelines which were used in developing the criteria) for EPA to develop 24 hour and Max values.
- Note (1): The "Human Ingestion" criteria developed by the EPA Toxic Criteria documents are indicated to relate to ambient receiving water quality. The Drinking Water Criteria relate to finished water quality at the point of delivery for consumption.
- Estimated Effects levels reflect estimates of the concentration levels which would impair beneficial uses under the kind of exposure conditions which would be produced by Urban Runoff. They are an estimate of the relationship between continuous exposure and intermittent, short duration exposures (several hours once every several days). Threshold concentrations are those estimated to cause mortality of the most sensitive individual of the most sensitive species.

  Significant Mortality concentrations are shown as a range which reflects 50 percent of the most sensitive species and mortality of the most sensitive individual of the 25th percentile species sensitivity.

an extensive set of numerical values derived from bioassay studies.

- Estimates of "effects levels" which are suggested by NURP analysis to be relevant for the intermittent exposures characteristic of urban runoff.

By incorporating the numerical values for EPA's ambient water quality criteria and the concentration levels suggested by NURP for intermittent effects in the same table (or on the same graph in Chapter 7), a convenient, concise comparison is provided of the practical implications of applying one or the other as the yardstick for judging the protection or impairment of water use. The two sets of numerical values thus provide measures for two of the three options for defining a problem: violation of criteria or actual impairment of a beneficial use.

Comparison of the pollutant concentrations in urban runoff showing the frequency and magnitude of exceedance of ambient criteria and intermittent effects levels provides a qualitative sense of the control requirements (and implications regarding costs) attendant on the adoption of either problem definition as the operative one.

Rivers and Streams

The approach adopted to quantify the water quality effects of urban runoff for rivers and streams focuses on the inherent variability of the runoff process. What occurs during an individual storm event is considered secondary to the overall effect of a continuous spectrum of storms from very small to very large. Of basic concern is the probability of occurrence of water quality effects of some relevant magnitude.

To consider the intermittent and variable nature of urban runoff, a stochastic approach was adopted. The method involves a direct calculation of receiving water quality statistics using the statistical properties of the urban runoff quality and other relevant variables. The approach uses a relatively simple model of the physical behavior of the stream or river (as compared to many of the deterministic simulation models). The results are therefore an approximation, but appropriate as a screening tool.

The theoretical basis of the technique is quite powerful as it permits the stochastic nature of runoff process to be explicitly considered. Application is relatively straightforward, and the procedure is relevant to a wide variety of cases. These attributes are particularly advantageous given the national scope of the NURP assessment. The details of the stochastic method are summarized and presented below.

Figure 5-2 contains an idealized representation of urban runoff discharges entering a stream. The discharges usually enter the stream at several locations but are considered here to be adequately represented by an equivalent discharge flow which enters the system at a single point.

Receiving water concentration (CO) is the resulting concentration after complete mixing of the runoff and stream flows and is interpreted as the mean

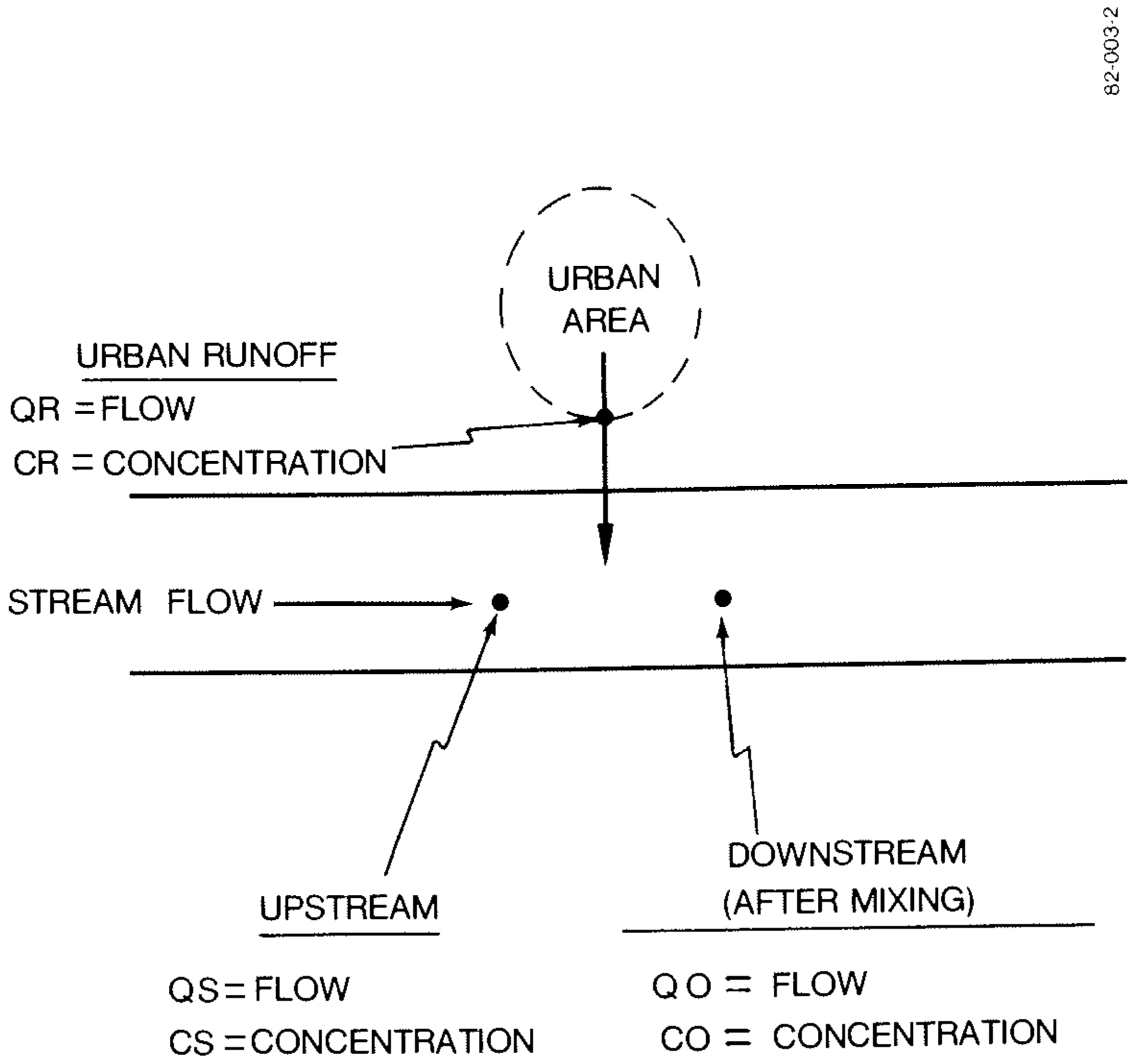

Figure 5-2. Idealized Representation of Urban Runoff Discharges Entering a Stream

stream concentration just downstream of all of the discharges as shown in Figure 5-2. The four input variables considered are:

- Urban runoff flow (QR)
- Urban runoff concentration (CR)
- Stream flow (QS)
- Stream concentration (CS)

Each is considered to be a stochastic random variable, which together combine to determine downstream flow and concentration. In addition, all variables are assumed to be independent, except urban runoff flow and streamflow where correlation effects can be incorporated as warranted.

An essential condition of the current computational structure is that each of the four variables which contribute to downstream receiving water quality can be adequately represented by a lognormal probability distribution; from analysis of data or other estimating procedures, the statistical properties of each of the input parameter distributions are defined. Examination of a reasonably broad cross-section of data indicates that lognormal probability distributions can adequately represent discharges from the rainfall/runoff process, the concentration of contaminants in the discharge, and the daily flow record of many rivers and streams, particularly for a national scale screening approach. It should be noted, however, that modifications of the computation techniques could be made to accommodate the use of other distributions (e.g., gamma, exponential) for some or all of the parameters.

The analysis procedure is described in more detail in the supplementary NURP report cited earlier. It essentially operates as follows:

- Downstream Concentrations. Stream concentrations of a pollutant are considered to result from the combination of upstream flow at background concentration and runoff flow at its concentration. Variations in stream concentrations below the urban runoff discharge result from variations in each of these inputs; the most significant source of variation being whether or not an event is occurring (i.e., whether runoff flows and loads are present). Stream flows must be considered because of the major effect of dilution on the resulting concentrations. Upstream concentrations can, however, be set at zero for the calculations; in which case, the result obtained is the exclusive effect of urban runoff discharges, and not the overall expected stream concentration. Effects of urban runoff can be evaluated by considering only the periods during which runoff occurs.

- Parameter Estimates. Estimates for runoff flows and concentrations are developed from information derived from the NURP monitoring programs. Information on stream flow can be obtained from analysis of local stream gage records. Upstream concentrations tend to be very site-specific; for this reason, the screening analysis calculated only the effect of urban runoff discharges.

- Statistical Calculations. From the statistical properties (specifically, the means and standard deviations) of the flows and concentrations, properties of the dilution ratio can be defined, and the statistical properties of the resulting instream concentrations are calculated directly. The frequency with which any particular target concentration is exceeded during wet weather can be calculated from the statistical properties of stream concentration, using formulas or scaled directly from a standard plot of cumulative (lognormal) probability distributions.

  The frequency with which the target concentration is exceeded during all periods -- wet and dry -- is simply the product of the wet weather frequency and the probability (frequency) that it is raining. The probability that it is raining at any time is defined by the ratio of mean storm duration to mean interstorm period, derived from the rainfall statistics.

$$\frac{D = \text{mean duration of storms}}{\Delta = \text{mean interval between storm midpoints}} = \text{fraction of time it is wet}$$

- Mean Recurrence Interval. In the presentation of results in Chapter 7, the probability distribution of event mean stream concentrations of an urban runoff pollutant during runoff periods is converted to a Mean Recurrence Interval (MRI) as a device to assist in the interpretation of results. The recurrence interval is defined as the reciprocal of probability. Because the basic calculation is based on storm events, this definition yields the overall average number of storms between specific event occurrences. Event recurrence is converted to what is believed to be a more meaningful time recurrence by dividing by the average number of storms per year, which is developed from analysis of rainfall records and defined as

$$\frac{\text{Hours/year} = 8760}{\text{Average interval between storm midpoints}} = \text{average \# storms per year}$$

  As an example of the MRI calculations consider a stream concentration which has an exceedance probability of 1.0 percent (Pr = 0.01)

$$\text{Recurrence Interval} = 1/\text{Pr} = 1/0.01 = 100$$

  The analysis is in terms of storm events, not time. Therefore this result is interpreted as one storm in every 100 events on average, will produce concentrations greater than the selected value. For an area where rainfall patterns produce an average of 100 storms per year, the average recurrence interval expressed in time units rather than events, is:

$$\begin{array}{l}\text{Recurrence}\\ \text{Interval}\\ \text{(time)}\end{array} = \frac{\text{event recurrence}}{\text{\# events/year}} = \frac{100 \text{ events}}{100 \text{ events/year}} = 1 \text{ year}$$

Currently, the primary use of the above procedure is as a screening tool in which approximate results and relative values are of interest. In this regard, NURP believes the Mean Recurrence Interval is a very useful definition. It should be interpreted as the long-term average interval between occurrences.

When results of this nature are interpreted, the following factors should be noted. The recurrence intervals of most interest relate to very low probabilities of occurrence. The tails of distributions may have appreciable uncertainty, and in the natural water systems, distributions may be lognormal over the bulk of the range but may deviate from the assigned distribution at the extremes. Computed stream concentrations at long recurrence intervals are likely to be conservative, that is, overstated because there are likely to be practical upper limits for runoff concentrations and lower limits to stream flow.

It also should be noted that serial correlations of streamflows or the tendency of wet and dry years to occur in clusters, though not a general behavior, may be significant in some cases. This situation would cause the average one year condition, for example, not to repeat itself every year but rather to occur several times per year, at intervals greater than one year.

Other Receiving Waters

Other receiving waters of general interest in assessing urban runoff effects include lakes, estuaries, embayments, and coastal zones. The methods adopted for lakes are briefly described below. The other receiving waters generally require site-specific and often complex analysis techniques (numerical methods, multi-dimensional modeling, etc.). Given this, a generalized screening-level assessment was not believed to be appropriate for this report. A number of the individual NURP projects consider these coastal water bodies and report on the specific methods adopted and results obtained.

For lake eutrophication problems, the time scale for analysis is considerably longer than the short (event scale) periods necessary for estuaries and rivers. For this case, annual average loads were used in a steady-state analysis performed using the type of empirical model advanced by Vollenweider and others. The EMC data developed from NURP monitoring programs can be readily converted to annual loads directly from annual flows or indirectly based on annual rainfall.

For total phosphorus, typically the limiting nutrient of concern, average concentrations are calculated using the following formula:

$$P = \frac{W'}{H/\tau \cdot \upsilon_s} \cdot 1000$$

The input values include pollutant mass loading (W'), lake physical characteristics of depth (H) and residence time (τ) and reaction rate coefficients (υ_s). The relative contribution of all load sources to lake total P concentrations can be defined by solving this equation for each of the sources. By comparing results in terms of lake concentrations for initial conditions (no control), and then modifying loads to reflect various levels of control, alternative control operations can be compared directly to effect on lake water quality.

Some judgement is involved in defining acceptable lake water quality concentrations, which depend in part on water use and on regional norms and expectations.

EVALUATION OF CONTROLS

General

The evaluation of controls has two elements: (a) characterizing the controls' performance capabilities and (b) defining costs. For this report, only the characterization of performance is emphasized; cost relationships are addressed to a more limited extent. EPA's Economic Analyses Staff, Office of Analysis and Evaluation, has prepared the following report under contract:

> "Collection of Economic Data from Nationwide Urban Runoff Program Projects," EPA Office of Water Regulations and Standards, April 7, 1982.

This report, issued at an early stage in the NURP program, assembled and analyzed cost information on potential control measures. Useful cost information for detention basins was developed by the Washington, D.C. area NURP project and is discussed further in Chapter 8.

Detention Basins

There are a number of procedures which can be adopted for evaluation of detention basin control devices. Procedures adopted by individual NURP projects are described in project reports. The procedure adopted by NURP to generalize the analysis of detention basins, and provide a planning level basis for estimating capabilities and requirements, is detailed in a detention basin handbook being issued by NURP as a supplementary report.

Results presented in Chapter 8 provide a summary of observed performance characteristics of the detention devices monitored under the NURP program and a projection of long-term performance expected on the basis of basin size and regional rainfall characteristics. The latter result is based on the probabalistic analysis methodology described in the supplementary report. Planning level cost estimates for control of urban runoff using this technique are also presented.

Street Sweeping

A number of the individual NURP projects adopted street sweeping as a principal subject of investigation. Procedures and results are described in individual project reports and are consolidated and summarized in Chapter 8. The adopted procedure and detailed results are presented in the supplementary NURP report, which was cited earlier.

Recharge Devices

Recharge devices include impoundments or other structures such as pits, trenches, retention basins, percolating catch basins, in-line percolation chambers or perforated pipes, which function by intercepting some portion of storm runoff and allowing it to percolate into the ground.

One of the basic questions which arises when controls of this type are considered is whether the percolation encouraged will produce undesirable degradation of groundwater quality. This aspect was examined by two NURP projects, and is discussed in Chapter 7 of this report.

Evaluation of percolating basins of any size is readily accomplished using the standard storage/treatment routines of stormwater models such as STORM or SWMM. In such cases the local soil permeability (the percolation rate) is applied as the treatment rate. In addition, statistical analysis procedures described in "A Statistical Method for the Assessment of Urban Stormwater" (EPA 440/3-79-023, May 1979) have been developed. A probabalistic analysis methodology adapted from the latter approach has been used by NURP to provide estimates of performance capabilities of recharge devices, which are presented in Chapter 8. A detailed discussion of the methodology is provided in the supplementary NURP report on detention/recharge devices cited earlier.

CHAPTER 6
CHARACTERISTICS OF URBAN RUNOFF

INTRODUCTION

This chapter presents a condensed summary of data developed by the individual NURP projects together with analysis results and interpretations based on the aggregated data from all projects.

Both the format for the summaries and the evaluations performed were selected to best serve the NURP objective of developing a national perspective. The results presented do not exhaust the useful information and insights which can be derived from the extensive data base that has been assembled. Individual project reports and a substantial number of articles published in a variety of technical journals independently examine specific aspects of urban runoff, often from the perspective of local issues.

Comprehensive tabulations of NURP data have been assembled and will be made available to interested parties for use in local planning or continuing research or engineering activities. As noted below, only a portion of the entire data base generated by the 28 NURP projects has been made generally accessible at this time. Under an ongoing effort, the entire data base is being subjected to final quality assurance checks and placed into a separate file, copies of which will be made available to interested parties upon request. In addition, a summary of the event averaged data, used for the analyses presented in this chapter, is reproduced in a Data Appendix issued with this report.

Field monitoring was conducted to characterize urban runoff flows and pollutant concentrations and mass loadings. This was done for a variety of pollutants at a substantial number of sites distributed throughout the country. The resultant data represent a cross-section of regional climatology, land use types, slopes, and soil conditions and thereby provide a basis for identifying patterns of similarities or differences and testing for their significance. To meet the objective of maximizing the degree of transferability of urban runoff data, the NURP approach involved covering a spectrum of regional and land use characteristics, requiring consistent quality assurance programs among all projects, and encouraging each of the projects to obtain data for a statistically significant number of storm events at a site.

The portion of the NURP data base used in the characterization of urban runoff presented in this section excludes monitoring sites which are downstream of devices which modify runoff (e.g., detention basins). The data base of acceptable "loading sites" consists of 81 sites in 22 different cities, and includes more than 2300 separate storm events. The actual number of events for specific pollutants varies, and is somewhat smaller than the total number of storms monitored because all pollutants were not measured for all storms at all sites.

Data summaries and analyses were performed using storm event average values; within-event fluctuations are not considered. An event mean concentration (EMC) for pollutants of interest has been determined for each monitored storm. Preliminary results presented in an earlier NURP report were based on analysis of "pooled" EMCs which were available at the time regardless of site. This provided a useful start, a reference for individual NURP project activities, and established the order of magnitude of concentrations of various pollutants in urban runoff. With the substantially larger data set now available, a more useful approach is possible. For the analyses and comparisons presented in this chapter, the storm event average data were aggregated by site to describe site characteristics. Site mean values were then aggregated or compared.

Summaries, comparisons, and evaluations were restricted to concentrations and runoff-rainfall ratios. Although loading data (Kg/Ha) are also available for all monitored storms, they have not been used in comparisons for the following reason. Mass load is very strongly influenced by the size (volume) of the monitored storm event. Monitored events usually represent a very small sample of all storms for an area, are generally biased toward larger events, and are different from site to site. Therefore comparisons between sites or locations using loading data derived from monitored storms are quite likely to present a distorted picture.

Event mean concentrations, on the other hand, have been determined to be essentially uncorrelated with runoff volume, as discussed further later in this chapter. Site comparisons can be made with high confidence levels using concentration data, and the most meaningful load comparisons would be those developed by using concentrations, area rainfall volumes, and runoff-rainfall relationships.

Separate summaries of results are provided below for standard pollutants, coliform bacteria, pollutant loads, and priority pollutants.

LOGNORMALITY

As was pointed out in Chapter 5, the key to the mathematical tractability of the NURP methodologies is that the data can be well represented by a known probability density function (pdf). There are actually two issues involved; (1) the adequacy of the assumed pdf in terms of representing the essential characteristics of the data set in question, and (2) the estimation of the parameters of the population pdf that the observed data set is presumed to represent. These will be discussed in turn.

Adequacy of Representation

One can fit a polynomial of order (n-1) exactly to any data set of n numerical items, but its utility in predicting the probability of realizing a given value on a subsequent trial (either within or outside the original data set, i.e., the interpolation or extrapolation problem) is likely to be very limited. The number of parameters involved and the need to investigate its properties on an individual basis are further deterrents to such a practice. There is no dearth of pdf's that have been the subject of intensive investigation. However, the selection of a pdf is an objective choice that is best made based on professional knowledge of the processes deemed important to the desired probability model and the use to be made of it. For example, if the data are known to result from the product of many small effects, their logs will be the sum of the logs of these effects. By appeal to the central limit theorem, it is known that this sum is asymptotically normal and, therefore, that the data will be lognormally distributed. Based upon such natural expectations and prior experience (of a growing body of other workers in the field as well), the lognormal pdf was chosen. The fact that the variables of interest can assume only positive values with a finite mean and a finite nonzero lower bound (even in a standardized form) leads to the rejection of any pdf defined over the entire real domain, such as the normal distribution for instance.

There are a number of statistical procedures for evaluating the normality of a complete sample; at least nine can be found in the current literature. Some are origin and scale invariant (e.g., the Shapiro-Wilk, standard third moment, standard fourth moment, and studentized range) and thus are appropriate for testing the composite hypothesis of normality. Others require the complete specification of the null distribution (e.g., Kolmogorov-Smirnoff, Cramer-Von Mises, weighted Cramer-Von Mises, modified Kolmogorov-Smirnoff-D, and chi-squared), and typically, the mean and variance of the specified normal hypothesis are taken to be the known mean and variance of the complete sample. Some procedures (e.g., chi-squared) utilize the specified theoretical pdf, while others (e.g., the modified Kolmogorov-Smirnoff D-test) utilize the cumulative frequency distribution.

In testing for normality (in the logorithmic domain in our case), one specifies the level of significance (α), i.e., the probability of rejecting the null hypothesis when it is in fact true (Type I error). The choice of α requires tempered judgement, however. The power of a test (β) is the probability of rejecting the null hypothesis when it is in fact false. The probability of accepting the null hypothesis when it is in fact false (Type II error) is $1-\beta$. For a given sample size and test, fixing a value for α also determines a value for β (i.e., they are not independent). The smaller the α level, the less powerful the test. Thus one is forced to make a trade-off between the consequences of a Type I or II error when selecting an α value.

The median EMC values for each constituent at each site were calculated, and these sample sets were examined for lognormality using the Kolmogorov-Smirnoff D test. The α levels for TSS, Total P, TKN, Total Pb, and Total Zn were all greater than 0.15, indicating a high power level. In other words, these sample sets are extremely well represented by a lognormal distribution. For COD and nitrate + nitrite the α levels were 0.059 and 0.057 respectively, indicating a lower power level but suggesting that even for these constituents the lognormal distribution quite well describes the data. Because BOD, Soluble P, and Total Cu were measured at fewer than half of the project sites, the D-test could not meaningfully be used (i.e., n is too small). Stated another way, at the $\alpha = 0.05$ level, the hypothesis that the samples were drawn from a population with a lognormal distribution cannot be rejected for any of the constituents examined.

Turning to the individual sites, there were very few instances where n was large enough to support the meaningful use of the D-test, and so a different approach for examining the appropriateness of the lognormal distribution was used. Essentially it consisted of examining the cumulative frequency distributions (in log space) and third and fourth moment based statistics for adequacy of representation. Taking into account detection limit phenomenon, uncertainties associated with sampling and analytical determination errors (especially at low concentration levels), and an occasional outlier, well over 90 percent of the constituent distribution at all NURP sites were quite well represented by the lognormal distribution. For the few remaining data sets, the lognormal distribution, although not perfect, was adequate for our purposes.

Estimation of Parameters

As noted in Chapter 5, the lognormal distribution is completely specified by two parameters, the mean and the coefficient of variation. The values of these two parameters as calculated from the sample data set are the best estimates of the parameters of the underlying population in the maximum likelihood sense. For this reason, they were used in the NURP analysis. However, due to the existence of detection limit problems and sampling/ analytical determination errors, the reasonableness of this decision was examined in general for all constituents and in great detail for Total Cu, the results of which will be described below.

For each of the 49 NURP sites where at least five Total Cu determinations were made, data were plotted (in logarithmic form) on probability paper. A line of best fit was drawn in, using professional judgement where detection limit or outlier problems existed, and the values of the median and standard deviation were read from the plot and converted into arithmetic space. These were then compared with those values calculated from the data themselves. One example is given in Figure 6-1 (the 116th and Claude Street site in Denver). Here the median and coefficient of variation from the plot (20 µg/l and 0.75) compare very well with those calculated directly from the data (22 µg/l and 0.74).

An example of an outlier plot is given in Figure 6-2 (the strip commercial site in Knoxville, TN). The one very low value (1 µg/l) is one-twentieth the typical detection limit (20 µg/l) and clearly does not belong to the same distribution that the other values do. Ignoring it, a very good fit exists and the parameters of the plot are 30 µg/l and 0.37 for the median and coefficient of variation as compared with the 25 µg/l and 1.35 values calculated from the data. The difference in medians is not too great, but the difference in coefficients of variation is quite large (over a factor of 3.5). This means that the upper end of the tail of the pdf is quite overestimated by the parameters estimated from the data and, consequently, that

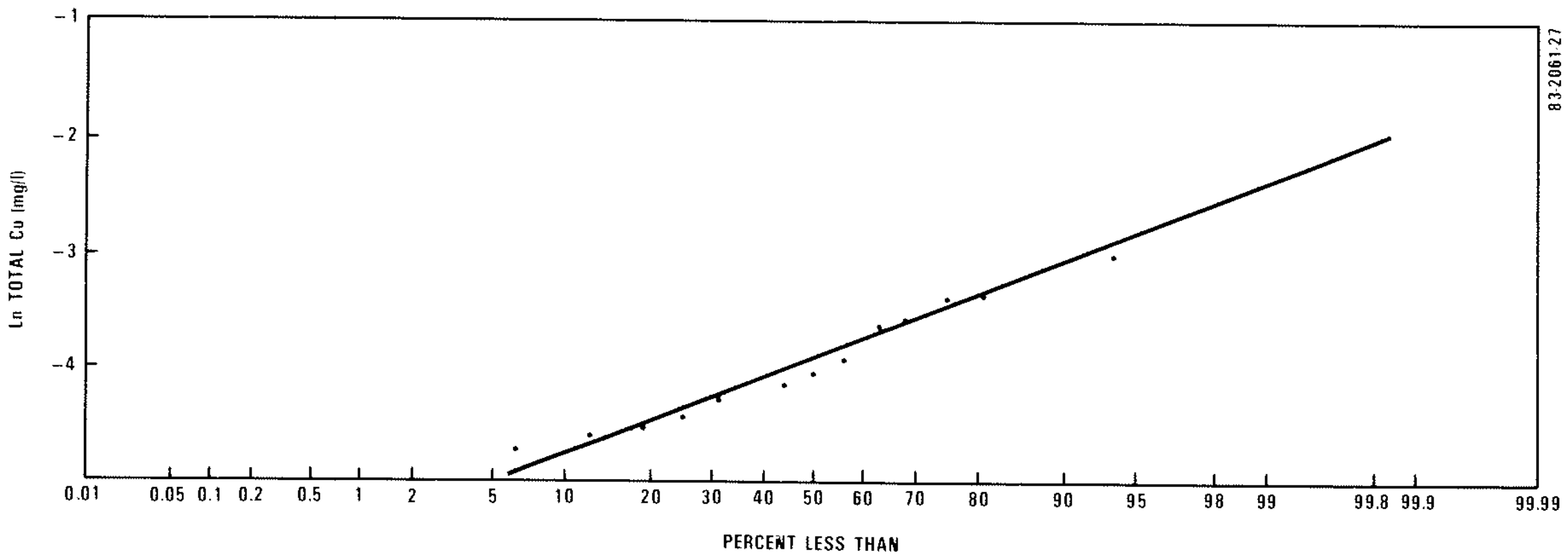

Figure 6-1. Cumulative Probability Distribution of Total Cu at C01 116 and Claude Site

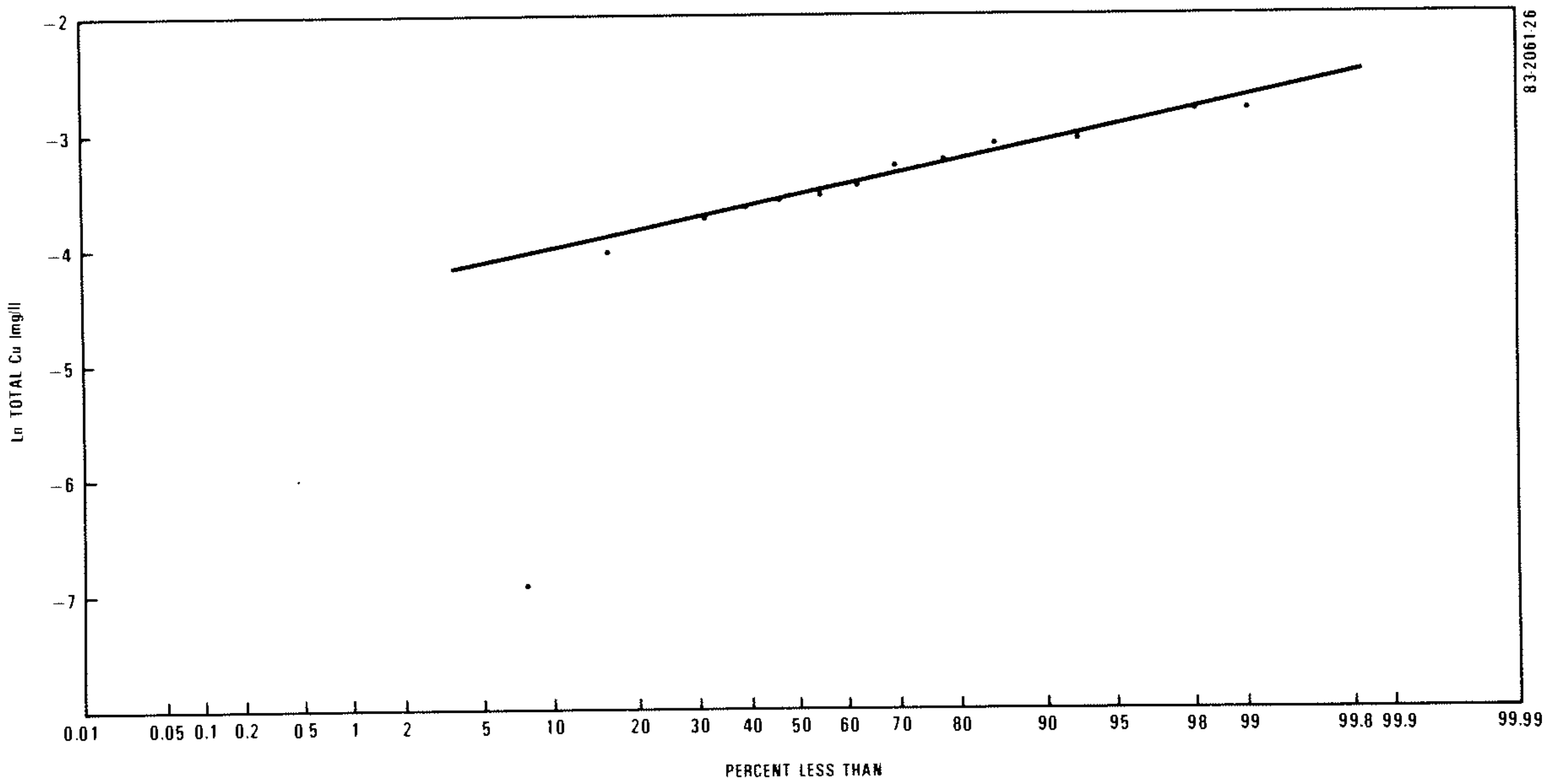

Figure 6-2. Cumulative Probability Distribution of Total Cu at TN1 SC Site

subsequent analyses will be extremely conservative, i.e., higher values of copper concentrations will occur less often than predicted. In general, the effect of an outlier is to increase or decrease the estimate of the median, depending upon whether the outlier is high or low, and to increase the estimate of the coefficient of variation as compared to those obtained from the remainder of the data.

An example of a detection limit problem is given in Figure 6-3, the plot of copper data of the Durham, NH parking lot site. Although only four points appear on the plot, actually n = 31, meaning that 27 points are represented by the first plotting position (90.6 percent). These values (all reported at 100 µg/l) are presumably the detection limit of the analytical laboratory. Of course in reality not all 27 values are 100 µg/l; they are simply equal to or less than this value. Fitting a line to the remaining four data points merely assigns appropriate plotting positions to these "less than" values. The estimates of the median and coefficient of variation from the plot are 63 µg/l and 0.36 respectively, as compared to the estimates from the data of 103 µg/l and 0.13. In this case, the latter significantly overestimates the median and significantly underestimates the coefficient of variation, and this is the general effect when a detection limit problem is present. In terms of the effect on prediction of rare occurrences of high copper levels (the upper tail of the pdf) these effects are somewhat counterbalancing. To the extent that the increase in the coefficient of variation dominates, the results of subsequent analyses will not be conservative, since larger concentrations will occur somewhat more frequently than would be predicted.

When the results of this exercise are compared for all 49 sites, the median as estimated from the plot was found to be higher than that estimated from all the data at only six sites, was equal at five sites, and was less at 38 sites. However, at only three sites was the change greater than 10 µg/l. Considering the population of all copper sites, the average median is 47 µg/l and the coefficient of variation is 0.84 when the estimates are based on all the data. If the estimates are based upon the plots, the respective values are 42 µg/l and 0.24 respectively. The significant reduction in the coefficient of variation in this latter case deserves comment, because it suggests that much of the apparent variability from site to site is due to data artifacts such as detection limit phenomena, outliers, and/or sampling/analytical errors. Similar comparisons of the coefficients of variation for each site showed increases at 21 sites, 6 unchanged, and decreases at 22 sites. Considering all sites, the average coefficient of variation is essentially unchanged (0.61 vs 0.63) as is its variability (0.47 vs 0.49).

Based on the results of the analyses which have been performed, the NURP findings are as follows:

- Lognormal distributions adequately represent both the storm-to-storm variations in pollutant EMC's at an urban site, and site-to-site variations in the median EMC's which characterize individual sites.

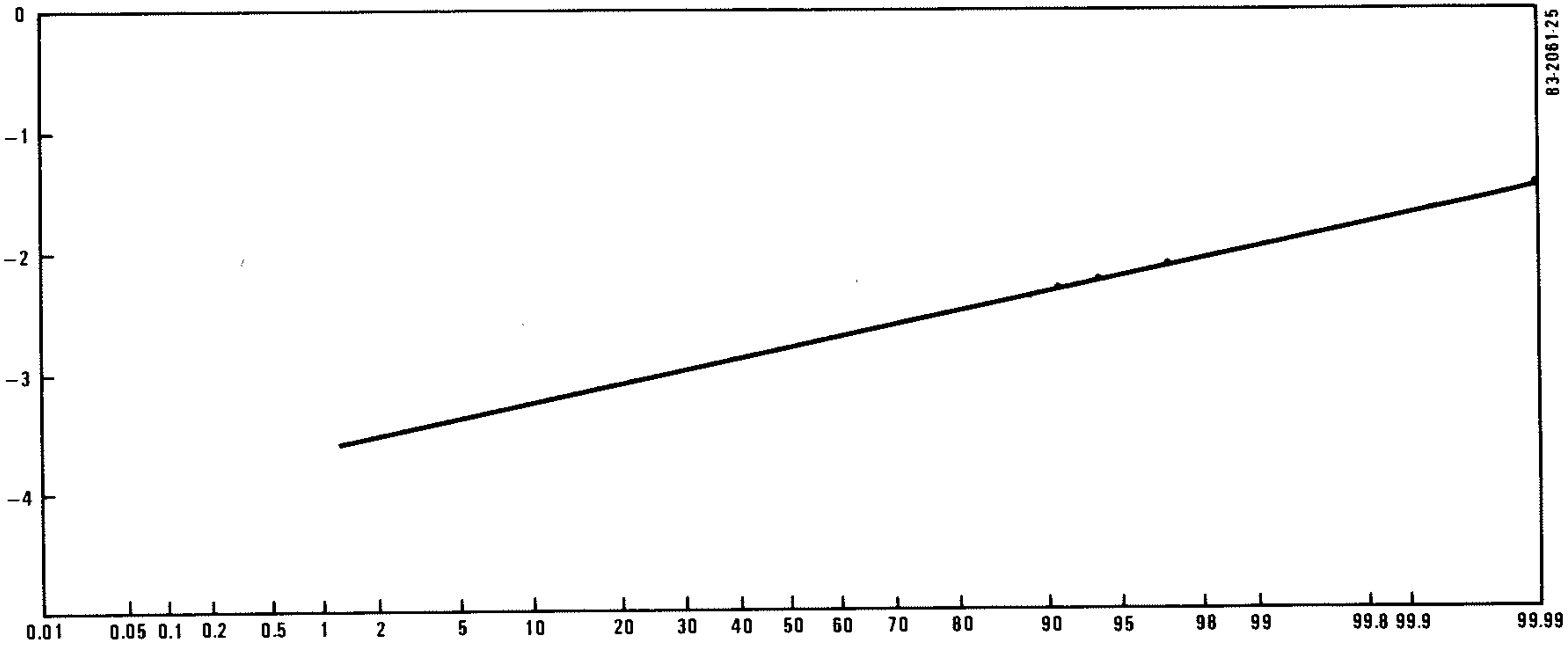

Figure 6-3. Cumulative Probability Distribution of Total Cu at NH1 Pkg. Site

- More detailed analysis to compensate for sampling errors (e.g., outliers and detection limit problems) would result in some adjustments in the statistical parameters tabulated later on in this chapter. The data summaries presented are based on statistics computed directly from the log transforms of the data.

- Such adjustments would not have any significant effect on overall results nor on the general conclusions reached. However, at a small percentage of sites, the parameter estimates for some pollutants would change significantly.

- In general, estimates of the site median EMC would be least affected; estimates of variability more so. It is likely that the very high or very low values for coefficient of variation (storm-to-storm variability) would be adjusted to more central values.

STANDARD POLLUTANTS

This grouping includes the following pollutants:

TSS - Total Suspended Solids
BOD - Biochemical Oxygen Demand
COD - Chemical Oxygen Demand
TP - Total Phosphorus (as P)
SP - Soluble Phosphorus (as P)
TKN - Total Kjeldahl Nitrogen (as N)
NO_{2+3}-N - Nitrite + Nitrate (as N)
Cu - Total Copper
Pb - Total Lead
Zn - Total Zinc

It includes pollutants of general interest which are usually examined in other studies (both point and nonpoint sources) and includes representatives of important categories of pollutants, namely solids, oxygen consuming constituents, nutrients, and heavy metals.

Condensed Data Summary

Tables 6-1 through 6-10 summarize the NURP results for these pollutants. Monitoring sites are grouped in each of the tables according to dominant land use. Broad categories have been used; residential, commercial, industrial, urban open/nonurban (other), and mixed, this latter category being used for sites which had no predominant land use. It should be noted that the industrial category does not include heavy industry sites, but more typically reflects an industrial park type of use. As a result, most of these sites are more closely related to a commercial use than to the typical image called up by the term industrial site. For subsequent comparisons, the data shown in Tables 6-1 through 6-10 for the commercial and industrial sites, are combined and designated as commercial land use.

TABLE 6-1. SITE MEAN TSS EMCs (mg/ℓ)

Residential										
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TSS			
							Mean	COV	Median	90 Confidence Limits
1	CO1 Big Dry Cr	100	11	19	41	14	333	1.04	265	182-385
2	CO1 Cherry	100	57	24	18	14	160	.98	129	87-190
3	CO1 116 & Claude	100	167	14	29	16	365	1.17	232	154-349
4	DC1 Dufief	100	12	-	-	8	56	1.02	39	51-74
5	DC1 Lakeridge	100	68	21	37	49	175	1.47	98	76-127
6	DC1 Stratton	100	8	-	-	31	54	1.11	38	30-49
7	IL1 John N	100	54	18	19	51	2115	1.36	127	96-155
8	KS1 Overland	100	58	8	38	15	2216	1.42	1243	166-2037
9	MA2 Hemlock	100	55	5	18	5	78	2.49	29	8-111
10	MD1 Baltun Hill	100	14	10	51	19	74	1.32	45	30-68
11	MD1 Homeland	100	23	9	29	13	50	1.05	26	15-46
12	MD1 Mt Wash	100	17	12	29	20	95	1.17	62	94-89
13	MD1 Res Hill	100	10	35	76	13	121	1.05	85	57-135
14	NY1 Carll's R.	100	71	13	20	23	42	.85	32	25-47
15	NH1 Dugua	100	-	-	-	8	65	.53	57	41-81
16	MI1 Lravilon	100	160	5	22	10	114	1.15	98	57-150
17	MI3 E. Roch.	100	546	18	19	7	294	1.12	198	101-380
18	TN1 Collingwood	100	60	3	21	9	227	1.13	150	85-761
19	WA1 Surrey	100	95	9	29	117	111	.51	101	94-106
20	WI1 Burbank	100	61	15	50	45	266	.44	297	219-370
21	WI1 Hastings	100	13	17	51	35	170	.68	141	117-169
22	FL1 Yhyne Apts	100	9	-	6	17	51	1.23	34	21-56
23	TX1 Hart	99	378	9	40	35	155	1.51	82	49-137
24	WI1 Lincoln	97	36	18	57	23	251	.89	206	165-358
25	TN1 R7	96	89	4	13	11	61	1.13	42	25-68
26	DC1 Westleigh	93	41	7	21	41	75	1.45	43	33-57
27	KS1 JC - 92nd	92	63	-	27	11	156	.84	119	83-171
28	IL1 John S.	93	39	19	18	49	248	1.50	176	106-178
29	IN1 F1	91	159	31	33	11	611	.72	492	345-704
30	WA1 Lake Hills	91	102	12	37	126	127	.80	100	90-110
31	IL1 Mattis S.	90	28	22	17	59	111	1.08	211	174-256
32	FL1 Charter Hdq	89	42	-	16	12	31	1.76	10	9-10
33	DC1 Fairidge	88	19	-	14	47	25	1.55	14	10-18
34	CO1 Asbury	88	127	9	22	9	493	.82	380	244-593
35	IL7 Comb Inlets	85	598	8	17	27	250	.75	200	161-249
36	MA1 Locust	95	154	31	16	6	257	1.75	128	48-339
37	NC1 #3013	84	324	6	27	66	291	1.92	115	104-174
38	MA1 Jordan	79	110	10	21	6	79	1.74	39	19-81
39	DC1 Stedwick	78	27	15	34	47	54	1.02	38	11-47

Mixed										
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TSS			
							Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	30	7	69	16	290	.91	208	145-292
2	MD3 Hampden	-	12	40	72	20	52	1.62	41	29-47
3	IL1 Mayfair N	-	17	2	58	58	281	1.61	179	165-279
4	MI1 Waverly	-	10	11	68	15	85	1.28	52	39-69
5	IN1 SC	-	187	3	93	13	71	1.07	45	31-74
6	WI1 Wood Ctr	-	45	12	51	47	363	.78	282	255-351
7	MA1 Rt 9	-	318	7	25	7	151	2.05	154	60-315
8	MA1 Convent	-	180	5	33	4	59	1.53	30	18-43
9	MI1 Grand P Gt	-	453	5	38	21	159	1.26	98	45-110
10	MI2 Pitt AA-S	-	2001	7	21	6	46	.77	43	[illegible]
11	MI2 Cedar	-	76	-	5	27	293	1.92	139	99-202
12	MA1 Anna	-	601	9	12	6	150	2.95	[illegible]	19-156
13	MI1 Pitt AA-H	-	2871	7	26	6	68	.47	61	42-65
14	MI1 Grace N	-	164	5	25	23	172	.95	141	101-171
15	MI3 Swift Run	-	3707	3	4	5	56	.93	59	26-124
16	SD1 Meade	-	2030	-	-	15	3091	1.39	1804	1126-2897
17	CA1 Knox	-	1542	12	-	16	283	1.12	111	115-255
18	FL1 N. Jaluit	-	30	-	13	15	87	1.39	25	11-49
19	FL1 Wilder	-	194	-	97	19	43	.71	27	20-37
20	CO1 North Ave	-	69	9	50	32	492	.96	354	278-451

Commercial										
	Site	Land Use % Coml	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TSS			
							Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	91	27	260	1.89	122	61-182
1	NC1 1013 (CBD)	100	23	0	69	60	163	1.15	107	68-111
3	NI3 Southgate	100	179	2	21	12	141	.76	112	79-159
4	WI1 Post Office	100	12	0	100	56	212	.90	161	131-197
5	NH1 Pkg Lot	100	1	0	91	12	74	1.68	18	27-54
6	IN1 CBD	100	26	0	99	15	121	.73	99	74-133
7	WI1 Rustler	100	12	0	100	42	202	.68	167	142-196
8	KS1 JC Metcalf	96	58	-	97	32	80	2.12	34	21-55
9	FL1 Norma Pk	91	47	-	95	17	22	1.13	14	9-27
10	WI1 State Fair	74	29	10	77	29	412	.97	296	279-362

Industrial										
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TSS			
							Mean	COV	Median	90% Confidence Limits
1	MA2 Addition	100	19	0	69	5	40	.81	11	14-73
2	MI1 Indus Drain	100	63	0	64	18	92	.87	71	53-95
1	KS1 Lenexa	56	72	-	44	18	102	1.33	63	40-92
4	MI1 Grace S.	52	15	5	19	20	188	.94	137	101-186

Urban Open and Nonurban										
	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TSS			
							Mean	COV	Median	90% Confidence Limits
1	CA1 Seaview	100	632	-	-	11	298	.63	551	185-188
2	CO1 Rooney Gulch	100	405	0	3	7	411	.63	341	223-921
3	NY2 Zourcell	100	28,416	-	4	11	154	.92	131	74-113
4	NY2 English Br	98	5,748	-	1	29	17	2.45	6	4-10
5	NI2 West Br	97	6,038	-	1	28	64	2.77	22	14-35
6	NY3 Thomas Lr	91	17,728	1	11	9	63	.74	51	14-77
7	MI3 Traver Cr	96	2,103	-	6	5	13	.37	26	14-50
8	MI2 Sheriff Dacl	80	562	-	7	32	178	2.35	149	09-224

TABLE 6-2. SITE MEAN BOD EMCs (mg/ℓ)

Residential							BOD			
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	31	19	41	0	-	-	-	-
2	CO1 Cherry	100	57	24	98	0	-	-	-	-
3	CO1 1162Claude	100	167	14	24	0	-	-	-	-
4	DC1 Dufief	100	12	-	-	0	-	-	-	-
5	DC1 Lakeridge	100	68	23	33	0	-	-	-	-
6	DC1 Stratton	100	8	-	-	4	-	-	-	-
7	IL1 John N	100	54	16	19	0	-	-	-	-
8	KS1 Overton	100	58	8	38	5	12	.59	11	6-18
9	MA2 Hemlock	100	50	5	16	0	-	-	-	-
10	MD1 Bolton Hill	100	14	30	53	0	-	-	-	-
11	MD1 Homeland	100	23	9	29	0	-	-	-	-
12	MD1 Mt Wash	100	17	12	19	0	-	-	-	-
13	MN1 Res Hill	100	10	55	76	0	-	-	-	-
14	NH1 Cahill Pl.	100	31	13	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	0	-	-	-	-
16	NY3 Cranston	100	106	5	22	0	-	-	-	-
17	NY1 E. Roch.	100	348	18	38	0	-	-	-	-
18	IL1 Rollingwood	100	60	3	21	0	-	-	-	-
19	WA1 Surrey	100	95	9	29	0	-	-	-	-
20	WI1 Burbank	100	61	15	50	28	1	.64	6	5-1
21	WI1 Hastings	100	15	17	51	20	9	.62	8	6-10
22	TX1 Young Acres	100	9	-	6	12	16	1.10	11	1-12
23	TX1 Rapi	99	328	0	40	4	-	-	-	-
24	WI1 Lincoln	97	36	18	67	11	18	1.21	12	7-20
25	TN1 R2	96	95	4	13	10	9	.66	7	5-10
26	DC1 Westleigh	93	41	1	21	2	-	-	-	-
27	KS1 IC - 92nd	92	63	-	17	5	29	.60	23	13-41
28	IL1 John S.	92	39	18	14	0	-	-	-	-
29	TN1 R1	91	69	13	33	9	14	.87	11	7-18
30	WA1 Lake Hills	91	102	12	37	0	-	-	-	-
31	IL1 Mallis S.	90	19	17	37	0	-	-	-	-
32	IL1 Charter Nou	89	42	-	15	12	11	1.24	6	5-33
33	DC1 Fairidge	68	19	-	34	6	5	.64	4	2-7
34	CO1 Asbury	86	123	9	22	0	-	-	-	-
35	IL2 Comb Inlets	85	524	8	17	0	-	-	-	-
36	MA1 Locust	85	154	11	16	0	-	-	-	-
37	KS1 #JL23	84	314	6	27	7	11	.13	10	6-35
38	MD1 Jordan	79	110	11	21	0	-	-	-	-
39	DC1 Stedwick	78	27	15	34	0	-	-	-	-

Urban Open and Nonurban							BOD			
	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	LA1 Seaview	100	C1*	-	-	0	-	-	-	-
2	CO1 Rooney Gulch	100	405	0	1	0	-	-	-	-
3	NY1 Ingernoll	100	68,414	-	4	0	-	-	-	-
4	NY? English Br	98	5,249	-	1	0	-	-	-	-
5	NY1 West Br	97	6,338	-	1	0	-	-	-	-
6	NY3 Tholds Cr	91	17,718	1	11	9	-	-	-	-
7	NY3 Beaver Cr	90	2,303	-	6	5	3	.41	7	-
8	NY2 Sheriff Duck	81	552	-	7	0	-	-	-	-

Mixed							BOD			
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	KS1 Nyland	-	36	7	68	5	-	-	-	-
2	MD1 Hampden	-	11	40	72	0	-	-	-	-
3	IL1 Mallis N	-	17	3	58	0	-	-	-	-
4	MI1 Waverly	-	10	11	68	21	9	.64	7	6-9
5	TN1 SC	-	187	3	43	12	14	.87	11	7-16
6	WI1 Wood Ctr	-	45	12	61	11	14	.54	11	11-15
7	MA1 Rt 9	-	138	1	21	0	-	-	-	-
8	MA1 Chevenl	-	100	7	33	0	-	-	-	-
9	MI1 Grand R Ot	-	453	5	38	13	8	.61	7	5-9
10	MI3 Pitt AA-S	-	2401	2	21	6	5	.49	5	3-7
11	NY2 Cedar	-	76	-	5	0	-	-	-	-
12	MA1 Anno	-	601	9	12	0	-	-	-	-
13	MI3 Pitt AA-N	-	2871	1	26	6	6	.76	5	3-9
14	MI1 Grace N	-	364	6	28	11	8	.78	7	5-17
15	MI3 Swift Run	-	1202	2	4	6	3	.41	3	3-4
16	SD1 Meade	-	2030	-	-	14	19	.75	15	13-24
17	CA1 Knox	-	1542	13	-	0	-	-	-	-
18	FL1 M. Jesuit	-	30	-	13	15	16	.95	12	9-17
19	FL1 Wilder	-	194	-	97	15	15	1.18	14	[illegible]
20	CO1 North Ave	-	69	9	50	12	-	-	-	-

Commercial							BOD			
	Site	Land Use % Coml	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	93	0	-	-	-	-
2	MC1 [illegible] (CBD)	100	21	0	69	23	18	.80	13	[illegible]
3	NY1 Southgate	100	179	2	21	0	-	-	-	-
4	WI1 Post Office	100	12	0	100	15	9	.50	8	7-11
5	NH1 Pkg Lot	100	1	0	40	11	17	.86	13	10-16
6	TN1 CBD	100	26	6	99	11	11	.46	13	10-15
7	WI1 Austler	100	12	4	-	27	13	.79	10	8-13
8	KS1 IC Metcalf	96	58	-	92	13	9	.48	7	6-9
9	FL1 Norma St	97	47	-	45	12	12	.88	9	6-13
10	WI1 State Fair	74	29	10	77	15	19	.73	15	11-20

Industrial							BOD			
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	MA1 Addison	100	18	0	65	0	-	-	-	-
2	MI1 Lugus Drain	100	61	0	64	9	10	.58	9	6-13
3	KS1 Lenexa	56	13	-	44	8	14	.77	13	7-17
4	MI1 Grace S.	63	15	5	39	9	5	.34	5	4-6

	Site	Land Use %	Area (A)	Pop. Den (P/A)	% IMP.	No. of OBS	COD			
							Mean	COV	Median	90% Confidence Limits
1	TP1 Big Oak Tr	100	33	19	41	16	129	.72	105	19-139
2	CO1 Cherry	100	57	14	38	18	122	.60	102	71-136
3	TN1 Ste Claude	100	163	14	24	15	137	.14	103	16-139
4	TN1 Pullef	100	32	-	-	7	54	.20	62	51-74
5	DC1 Lakeridge	100	62	31	13	44	60	.56	50	43-58
6	NC1 Stratton	100	8	-	-	31	51	.55	45	39-63
7	TN1 Table H	100	54	18	10	31	126	.80	94	79-122
8	KS1 Overtub	100	58	8	18	14	162	.67	135	101-180
9	MA2 Hemlock	100	50	5	10	11	-	-	-	-
10	MP1 Baltimore Hill	100	14	30	51	15	218	1.36	128	85-193
11	MD1 Homeland	100	93	9	29	13	172	.13	139	101-192
12	MP1 Mt Wash	100	17	12	29	10	166	.65	136	96-170
13	MD1 Res Hill	100	11	55	76	13	271	.85	115	94-194
14	NY1 Carll's R.	100	71	33	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	0	-	-	-	-
16	NY3 Pralston	100	106	5	22	8	33	.43	31	24-41
17	NY3 E. Roch	100	346	18	35	7	86	.11	82	66-102
18	TN1 Collingwood	100	60	3	31	9	70	.05	64	44-84
19	WA1 Surrey	100	95	9	34	118	46	.54	42	39-46
20	WI1 Burbank	100	53	15	50	27	39	.29	30	24-38
21	WI1 Hastings	100	33	17	51	21	41	.55	36	30-44
22	FL1 Young Apts	100	9	-	0	12	73	.96	52	34-79
23	TN1 Marl	98	278	9	40	11	82	.83	61	49-94
24	WI1 Lincoln	97	30	15	57	16	91	.95	66	46-94
25	TN1 RC	96	89	4	13	11	45	.39	42	34-53
26	DC1 Westleigh	93	41	3	21	39	51	.40	46	41-52
27	LS1 U. + 92nd	92	67	-	37	11	176	.98	126	80-147
28	IL1 John S.	91	39	16	18	29	111	.80	87	69-108
29	TN1 A1	91	69	11	33	11	120	.96	87	66-135
30	WA1 Lake Hills	91	102	12	37	127	44	.54	38	16-41
31	IL1 Mattis S.	90	28	22	37	10	180	.72	140	119-178
32	FL1 Charter Rdg	89	42	-	16	12	56	.64	47	35-64
33	DC1 Fairidgr	88	19	-	14	48	53	.46	47	42-52
34	CO1 Asbury	86	127	9	32	9	234	1.12	155	49-273
35	IL3 Comb Inlets	85	524	8	17	24	108	.90	102	78-134
36	MA1 Lesure	85	154	11	16	6	104	.45	95	67-115
37	MD3 11D23	84	324	4	36	34	90	.97	64	51-82
38	MA1 Jordan	79	110	10	21	9	79	.53	70	51-95
39	DC1 Gledwild	78	27	15	34	45	45	.60	19	34-45

	Site	Land Use % Open	Area (A)	Pop. Den (Pr/A)	% IMP.	No. of OBS	COD			
	Rural Open and Nonurban									
							Mean	COV	Median	90% Confidence Limits
1	CO1 Skyview	100	631	-	-	14	111	.43	107	90-123
2	CO1 Rooney Gulch	100	405	0	1	3	73	.33	69	54-87
3	NY1 Thornell	100	25,416	-	4	8	25	.10	21	18-24
4	NY2 English Rd	98	6,248	-	1	11	-	-	-	-
5	NY2 West Br	97	5,338	-	1	0	-	-	-	-
6	NY3 Thomas Cr	91	17,728	1	11	6	26	.20	25	21-32
7	NY3 River Cr	90	2,303	-	6	5	25	.10	15	21-36
8	NY2 Shellit Dorl	60	552	-	7	0	-	-	-	-

	Site	Land Use %	Area (A)	Pop. Den (P/A)	% IMP.	No. of OBS	COD			
							Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	16	3	66	12	106	.56	89	55-122
2	MO1 Hampden	-	12	40	72	30	111	.33	99	69-115
3	IL1 Mattis N	-	17	3	55	35	195	.56	154	130-196
4	MI1 Waverly	-	30	11	68	27	64	.30	60	40-61
5	TN1 SC	-	147	3	41	13	40	.70	49	36-67
6	WI1 Wood Ctr	-	45	12	81	39	92	.57	80	49-92
7	MA1 Rt 9	-	318	7	23	6	107	.62	89	51-146
8	MA1 Convent	-	100	1	73	8	72	.62	61	40-89
9	MI1 Grall R O1	-	453	5	38	16	71	.47	65	55-74
10	MI3 Pitt AA-S	-	2001	2	21	4	-	-	-	-
11	NY2 Cedar	-	76	-	5	0	-	-	-	-
12	MA1 Anna	-	601	9	12	6	89	.61	76	53-116
13	MI3 Pitt AA-N	-	2871	7	26	3	-	-	-	-
14	MI3 Grace N	-	164	5	28	17	72	.43	68	55-79
15	MI3 Swift Run	-	1307	2	4	5	39	.10	39	26-73
16	SD1 Meade	-	2030	-	-	14	179	.39	167	140-206
17	CA1 Knox	-	1540	12	-	21	93	.60	80	65-99
18	FL1 N. Jenusl	-	31	-	13	15	51	1.18	33	22-51
19	FL2 Wilder	-	194	-	97	11	51	.38	48	41-57
20	DC1 North Ave	-	59	9	50	32	289	.74	276	186-276

	Site	Land Use % Coml	Area (A)	Pop. Den (P/A)	% IMP.	No. of OBS	COD			
	Commercial									
							Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	14	0	91	27	184	.67	139	109-178
2	NC1 Still Creek	100	21	0	69	40	120	.79	84	78-113
3	NY1 Southgate	100	179	2	21	9	41	.14	35	31-47
4	MI1 Post Office	100	12	0	100	41	52	.12	48	41-55
5	NH1 Pkg Lot	100	3	0	90	33	96	.78	19	75-98
6	TN2 CBD	100	26	0	98	15	71	.52	55	63-81
7	WI1 Hustler	100	10	0	-	26	59	.76	47	37-64
8	LS1 IC Metcalf	96	59	-	97	36	35	.84	41	11-55
9	FL1 Norma Pl	91	47	-	45	12	41	.43	37	39-47
10	WI1 State Fair	74	29	10	77	21	113	.96	94	64-112

	Site	Land Use % Ind	Area (A)	Pop. Den (P/A)	% IMP.	No. of OBS	COD			
	Industrial									
							Mean	COV	Median	90% Confidence Limits
1	MA2 Addition	100	18	0	69	0	-	-	-	-
2	WI1 Indus Drain	100	53	0	64	17	61	.46	53	43-77
3	KS1 Lenexa	56	32	-	44	16	58	.60	50	39-64
4	WI1 Grace S.	57	75	5	39	11	60	.79	47	37-64

TABLE 6-4. SITE MEAN TOTAL P EMCs (μg/ℓ)

	Residential						Total P			
	Site	Land Use % Res	Area (A)	Pop. Den (1/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	31	19	41	16	693	.94	508	356-716
2	CO1 Cherry	100	57	24	18	14	479	.54	312	291-479
3	CO1 Ste Claude	100	107	14	24	15	630	.65	513	392-672
4	DC1 Dufief	100	12	-	-	5	499	.12	485	353-640
5	DC1 Lakeridge	100	68	21	13	48	321	.18	256	217-302
6	DC1 Stratton	100	8	-	-	28	340	.54	300	258-351
7	IL1 John N	100	54	18	19	13	750	.62	616	518-753
8	KS1 Overton	100	58	8	38	8	1636	.91	1207	717-2031
9	MA2 Hemlock	100	50	6	16	8	314	1.05	236	95-493
10	MD1 Bolton Hill	100	34	30	53	19	912	1.15	613	425-883
11	MD1 Homeland	100	23	9	29	13	421	.70	345	253-471
12	MD1 Mt Wash	100	11	12	29	20	556	.83	428	324-566
13	MD1 Res Hill	100	10	55	76	13	4090	1.05	2825	1845-4326
14	NY1 Carll's R.	100	73	13	26	24	221	.54	195	163-233
15	NY1 Unqua	100	-	-	-	8	229	.61	196	114-285
16	NY1 Kingston	100	166	5	22	10	301	.54	265	206-340
17	N13 E. Poeh.	100	346	18	18	8	448	.47	405	300-546
18	TX1 Rollingwood	100	60	3	21	9	268	.56	233	169-322
19	WA1 Surrey	100	95	9	29	118	239	.83	184	164-205
20	WI1 Burbank	100	63	16	30	45	229	.45	209	188-233
21	WI1 Hastings	100	31	17	51	15	258	.51	230	203-264
22	IL1 Young Apts	100	9	-	6	12	333	.65	279	205-380
23	TX1 Hart	99	178	9	40	14	333	.80	260	179-349
24	WI1 Lincoln	97	36	18	57	23	453	.59	373	298-466
25	TN1 RC	98	81	4	11	11	246	.41	222	180-287
26	IL1 Westleigh	93	41	3	21	41	397	.75	319	268-380
27	KS1 IC - 92nd	92	63	-	37	10	1797	1.11	782	441-1405
28	IL1 John S.	91	35	18	38	32	732	.65	604	502-727
29	TN1 PL	93	69	11	33	11	705	.15	665	552-803
30	WA1 Lake Hills	91	102	12	37	127	264	.81	204	184-227
31	IL1 Maltys S.	90	28	22	37	32	587	.69	483	401-582
32	FL1 Charter Oak	89	42	-	16	36	395	1.61	208	116-314
33	DC1 Fairidge	98	19	-	34	37	151	.13	254	242-334
34	CO1 Asbury	66	127	9	23	9	1025	.71	834	561-1239
35	IL2 Comb Inlet	88	524	8	17	26	506	.19	297	314-501
36	MD1 Locust	85	154	31	16	6	1228	.79	961	545-1711
37	NC1 11023	84	124	6	27	57	529	.99	125	117-444
38	MA1 Jordan	79	110	10	21	8	448	.98	324	190-565
39	DC1 Stedwick	76	21	15	34	44	388	.65	326	281-379

	Mixed						Total P			
	Site	Land Use %	Area (A)	Pop. Den (1/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	16	3	68	7	588	.34	528	413-671
2	MD1 Hampden	-	17	40	72	20	750	1.41	436	291-652
3	IL1 Maltys N	-	12	3	58	15	498	.56	431	371-507
4	MI1 Waverly	-	30	11	68	15	198	.64	167	141-197
5	IN3 SC	-	187	3	43	13	352	.64	296	221-399
6	WI1 Wood Ctr	-	48	12	81	47	289	.69	240	212-284
7	MA1 RI 9	-	339	7	23	8	1176	.63	995	[illegible]
9	MA1 Convent	-	109	1	31	8	859	1.99	706	87-437
9	MI1 Grand R St	-	453	5	38	23	458	.55	184	309-477
10	MI3 Pill AA-5	-	2001	2	21	6	103	.50	91	67-137
11	NI2 Cedar	-	76	-	5	12	163	1.20	231	176-101
12	MA1 Rona	-	601	9	13	8	534	.83	409	215-749
13	MI3 Pitt 4A-N	-	2871	7	26	6	268	.47	243	[illegible]
14	MI1 Grace N	-	164	5	28	23	394	.54	361	325-410
15	MI3 Swift Run	-	1207	2	4	5	134	.56	117	71-193
16	SD3 Meadp	-	2030	-	-	15	1685	1.29	1163	743-1621
17	CP1 Knox	-	3542	12	-	19	418	.50	374	310-481
18	FL1 N. Detuit	-	30	-	13	15	196	.71	151	120-214
19	FL1 Wilder	-	194	-	97	15	229	.52	204	163-255
20	CO1 North Ave	-	89	9	50	38	784	.69	673	570-795

	Commercial						Total P			
	Site	Land Use % Coml	Area (A)	Pop. Den (1/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	24	0	91	27	704	1.25	438	316-601
2	NC1 1913 (CBD)	100	13	0	69	51	395	.56	342	304-323
3	N13 Southgate	100	173	3	21	12	216	.26	209	193-239
4	WI1 Post Office	100	12	0	100	30	118	.56	94	84-108
5	NH1 Pkg Lot	100	1	0	46	27	173	1.21	114	137-208
6	IN1 C&O	100	26	0	99	15	212	.43	195	162-235
7	WI1 Rustler	100	12	0	-	44	105	.79	86	69-98
8	KS1 U. Metcalf	96	69	-	97	20	246	.98	176	126-241
9	FL1 Norma Fk	91	47	-	45	12	151	.50	135	106-172
10	WI1 State Fair	79	64	10	[illegible]	19	313	1.19	306	245-443

	Urban Open and Nonurban						Total P			
	Site	Land Use % Open	Area (A)	Pop. Den (1/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	[illegible]	100	633	-	-	10	690	.82	455	319-549
2	IO1 Grouper Gulch	100	405	0	1	7	420	.41	380	224-528
3	N13 Linnwell	100	26,415	-	4	33	191	.46	175	141-217
4	NI2 English Br	95	5,248	-	1	30	27	1.10	17	[illegible]
5	NI2 West Br	97	5,138	-	1	31	52	1.27	32	24-41
6	N13 Thomas Cr	91	17,728	3	11	16	195	.42	177	140-221
7	NI1 Traver Cr	90	7,303	-	6	5	91	.36	85	60-121
8	NI2 Sheriff Cool	88	551	-	7	12	264	1.01	186	145-238

	Industrial						Total P			
	Site	Land Use % Ind	Area (A)	Pop. Den (1/A)	% IMP	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	18	3	69	5	114	.89	85	41-176
2	WI1 Index Drain	100	63	0	64	18	545	.58	472	375-589
3	KS1 Lenexa	98	72	-	44	16	591	.87	452	315-616
4	NC1 Grape S.	62	75	5	19	37	438	.11	385	271-455

Residential

	Site	Land Use % Res	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	SOL P			
							Mean	COV	Median	90% Confidence limits
1	CO1 Big Dry Cr	100	33	19	41	15	193	.64	163	125-213
2	CO1 Cherry	100	52	24	38	14	212	.47	192	155-237
3	CO1 116/Claude	100	167	14	24	16	196	.35	179	154-208
4	DC1 Dufief	100	12	-	-	6	448	.55	392	257-598
5	DC1 Lakeridge	100	68	21	33	47	69	.62	59	51-68
6	DC1 Stratton	100	8	-	-	27	251	.65	210	173-256
7	IL1 John N	100	54	18	19	0	-	-	-	-
8	KS1 Overton	100	58	8	38	8	313	.41	290	223-378
9	MA2 Hemlock	100	50	5	16	5	16[illegible]	.89	120	58-249
10	MD1 Bolton Hill	100	14	30	51	4	-	-	-	-
11	MD1 Homeland	100	23	9	29	0	-	-	-	-
12	MD1 Mt Wash	100	17	12	29	0	-	-	-	-
13	MD1 Res Hill	100	10	55	76	0	-	-	-	-
14	NY1 Carll's R.	100	73	13	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	0	-	-	-	-
16	NY3 Cranston	100	166	5	22	0	-	-	-	-
17	NY1 E. Roch.	100	346	18	38	0	-	-	-	-
18	TX1 Rollingwood	100	60	3	21	0	-	-	-	-
19	WA1 Surrey	100	95	9	29	0	-	-	-	-
20	WI1 Burbank	100	63	15	50	0	-	-	-	-
21	WI1 Hastings	100	33	17	51	0	-	-	-	-
22	FL1 Young Apts	100	9	-	6	0	-	-	-	-
23	TX1 Hart	99	178	9	40	0	-	-	-	-
24	WI1 Lincoln	97	36	18	57	0	-	-	-	-
25	TN1 P2	96	89	4	13	11	132	.63	112	82-154
26	DC1 Westleigh	93	41	3	21	41	223	.71	182	154-215
27	KS1 IC - 92nd	92	63	-	37	10	241	.62	205	147-285
28	IL1 John S.	91	19	18	18	0	-	-	-	-
29	TN1 R1	91	69	11	33	11	136	.94	99	64-153
30	WA1 Lake Hills	91	102	12	37	0	-	-	-	-
31	IL1 Mattis S.	90	28	22	37	0	-	-	-	-
32	FL1 Charter Mdg	89	42	-	16	0	-	-	-	-
33	DC1 Fairidge	88	19	-	34	46	297	.87	224	186-270
14	CO1 Asbury	86	127	9	22	9	212	.22	207	181-232
15	IL2 Comb Inlets	85	524	8	17	24	98	1.21	63	95-88
36	NH1 Locust	85	154	11	16	6	184	.42	169	121-235
37	NY1 #1123	84	324	6	22	0	-	-	-	-
18	MA1 Jordan	79	110	10	21	7	202	1.13	136	70-262
39	DC1 Stedwick	78	22	15	34	41	251	.70	206	174-243

Urban Open and Nonurban

	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	SOL P			
							Mean	COV	Median	90% Confidence Limits
1	CA1 Sraview	100	633	-	-	12	145	1.20	91	55-150
2	CO1 Rooney Gulch	100	405	0	1	7	137	.46	124	90-171
3	NY3 Thornell	100	28,416	-	4	0	-	-	-	-
4	NY2 English Br	98	5,248	-	1	18	5	.35	5	4-6
5	NY2 West Br	93	5,138	-	1	26	8	.56	7	6-8
5	NY1 Thomas Cr	91	17,728	1	11	0	-	-	-	-
7	MI3 Travel Cr	90	2,301	-	6	5	31	.55	29	18-47
8	NY2 Sheriff Duck	80	552	-	7	12	39	1.11	25	20-14

Mixed

	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	SOL P			
							Mean	COV	Median	90% Confidence limits
1	KS1 Noland	-	36	3	68	8	165	.52	146	105-203
2	MD1 Hampden	-	17	40	72	0	-	-	-	-
3	IL1 Mattis N	-	17	3	58	0	-	-	-	-
4	MI1 Waverly	-	30	11	68	32	43	.76	34	28-42
5	TN1 SC	-	187	3	43	13	192	1.17	128	81-203
6	WI1 Wood Ctr	-	45	12	81	0	-	-	-	-
7	MA1 Rt 9	-	338	7	23	5	160	.38	150	106-213
8	MA1 Convent	-	100	1	33	6	106	1.83	51	19-138
9	MI1 Grand R Ot	-	453	5	38	20	68	.68	56	44-71
10	MI3 Pitt AA-S	-	2001	2	21	6	13	.32	13	10-17
11	NY2 Cedar	-	76	-	5	26	49	1.16	32	23-44
12	MA1 Anna	-	601	9	12	4	-	-	-	-
13	MI3 Pitt AA-N	-	2871	7	26	6	59	.88	44	24-82
14	MI1 Grace N	-	164	5	28	21	47	.47	42	35-50
15	MI3 Swift Run	-	1207	2	4	5	39	.46	35	23-53
16	SD1 Meade	-	2030	-	-	14	87	.61	74	57-97
17	CA1 Knox	-	1542	12	-	18	169	.99	120	85-168
18	FL1 N. Jesuit	-	30	-	13	0	-	-	-	-
19	FL1 Wilder	-	194	-	97	0	-	-	-	-
20	CO1 North Ave	-	69	9	50	30	228	.95	165	179-212

Commercial

	Site	Land Use % Coml	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	SOL P			
							Mean	COV	Median	90% Confidence limits
1	CO1 Villa Italia	100	24	0	91	26	293	1.09	198	147-266
2	NC1 1013 (CBD)	100	23	0	69	0	-	-	-	-
3	NY3 Southgate	100	179	2	21	0	-	-	-	-
4	WI1 Post Office	100	12	0	100	0	-	-	-	-
5	NH1 Pkg Lot	100	1	0	90	0	-	-	-	-
6	TN1 CBD	100	26	0	99	15	46	.72	17	28-50
7	WI1 Rustler	100	12	0	-	0	-	-	-	-
8	KS1 IC Metcalf	96	58	-	97	21	116	1.06	80	58-111
9	FL1 Norma Pt	91	42	-	45	0	-	-	-	-
10	WI1 State Fair	74	29	10	77	1	-	-	-	-

Industrial

	Site	Land Use % Ind	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	SOL P			
							Mean	COV	Median	90% Confidence limits
1	MA2 Addison	100	18	0	69	5	75	.92	55	26-116
2	MI2 Indus Drain	100	63	0	64	14	127	.72	103	76-140
3	KS1 Lenaxa	56	72	-	44	16	346	1.66	179	108-296
4	MI1 Grace S.	52	75	5	39	16	59	1.24	37	24-56

TABLE 6-6. SITE MEAN TKN EMCs (μg/ℓ)

Residential

	Site	Land Use % Res	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TKN Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	31	19	41	16	2,169	.58	2041	1617-2584
2	CO1 Cherry	100	57	24	38	14	2,609	.39	2430	2014-2904
3	CO1 116/Claude	100	167	14	74	15	2,891	.51	2501	2010-1112
4	DC1 Dufief	100	17	-	-	6	2,066	.11	2048	1841-2278
5	DE1 Lakeridge	100	68	21	33	48	1,774	.64	1450	1259-1670
6	DC1 Stratton	100	8	-	-	28	1,811	.34	1696	1494-1904
7	IL1 John N	100	54	18	19	13	1,994	.81	1107	7520-3811
8	KS1 Overton	100	58	8	38	5	-	-	-	-
9	MA2 Hemlock	100	50	5	16	5	1,679	.55	1217	1971-5252
10	MD1 Bolton Hill	100	14	30	51	18	6,067	.17	4815	1640-6170
11	MD1 Homeland	100	21	9	79	13	6,505	.40	6044	4996-7112
12	MD1 Mt Wash	100	17	12	29	70	6,915	.41	6408	5502-7461
13	MD1 Res Hill	100	10	55	76	13	10,803	.41	9915	9089-12154
14	NY1 Carll's R.	100	71	11	20	24	1,487	.71	1201	955-1509
15	NY1 Unqua	100	-	-	-	8	1,408	.26	1161	1148-1618
16	NH1 Cranston	100	166	5	77	11	1,492	.45	1358	1098-1679
17	NH3 E. Poch.	100	346	18	18	7	3,246	.90	7411	1369-4245
18	IL1 Rollingwood	100	60	1	71	9	5,004	2.37	1942	828-4554
19	WA1 Surrey	100	95	9	29	118	1,007	.62	857	785-915
20	WI1 Burbank	100	61	15	50		1,260	.50	1125	908-1195
21	WI1 Hastings	100	13	17	51	15	1,102	.54	969	801-1173
22	FL1 Young Apts	100	9	-	6	12	1,139	.70	1097	791-1522
23	FX1 Mart	99	178	9	40	11	1,016	.75	2412	1674-3474
24	WI1 Lincoln	97	16	18	57	1	-	-	-	-
25	TN1 P2	96	84	4	11	11	476	.11	452	379-519
26	DC1 Westleigh	93	41	3	21	41	1,901	.56	1660	1447-1904
27	KS1 JC - 47nd	92	61	-	17	8	4,187	.94	3051	1793-5200
28	IL1 John S.	41	19	18	18	12	1,527	1.04	2441	1886-1155
29	FN1 P1	91	69	11	11	11	1,131	.14	1071	894-1281
30	WP1 Lake Hills	91	102	12	37	127	1,056	.71	852	774-438
31	IL1 Mattis S.	90	28	77	37	37	1,440	.69	2825	2343-3406
32	FL1 Charter Hdg	89	42	-	16	12	1,704	.83	1309	899-1905
33	DC1 Fairidge	88	19	-	34	46	2,712	.51	1958	1711-2215
34	CO1 Asbury	86	127	9	72	t	3,735	.56	3761	2774-4788
35	IL2 Comb Inlets	85	524	6	17	0	-	-	-	-
36	MP1 Locust	85	154	11	16	6	2,695	.38	2522	1864-3412
37	NC1 #1021	84	324	F	71	67	1,498	.94	1086	921-1277
38	MA1 Jordan	79	110	10	21	9	1,191	.60	1194	845-1681
39	DC1 Stedwick	78	27	15	34	43	1,895	.57	1543	1435-1881

Urban Open and Nonurban

	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TKN Mean	COV	Median	90% Confidence Limits
1	EA1 Seaview	100	613	-	-	13	3674	.59	1159	7411-4139
2	CO1 Rooney Gulch	105	405	0	1	7	7954	.57	7615	1815-3768
3	NY1 Hornell	100	28,416	-	4	11	1099	.50	482	778-1240
4	NY2 English Br	98	5,248	-	1	15	340	.50	305	246-178
5	NY2 West Br	97	5,338	-	1	24	392	.57	147	792-412
6	NH1 Thomas Cr	91	17,728	1	11	10	1111	.16	1045	854-1279
7	MI3 Fraser Cr	90	2,101	-	6	5	889	.11	883	796-981
8	NY7 Sheriff Dock	80	552	-	7	13	963	.76	765	628-937

Mixed

	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TKN Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	36	3	68	0	-	-	-	-
2	MD1 Hampden	-	17	40	72	19	6994	.55	6140	5004-7531
3	IL1 Mattis N	-	17	3	58	15	2872	.64	2172	7006-7805
4	WI1 Waverly	-	10	11	68	15	1490	.51	1116	1142-1516
5	TN1 SC	-	187	1	41	11	623	.50	558	442-705
6	WI1 Wood Ctr	-	45	12	81	16	1452	.35	1369	1180-1589
7	MA1 Rt 9	-	338	7	23	5	2446	.50	2188	1194-1412
8	MA1 Convent	-	100	1	33	8	1080	.64	910	615-1147
9	WI1 Grand R Ot	-	451	5	18	21	1631	.47	1506	1104-1740
10	WI1 Pitt AA-5	-	7001	2	21	6	845	.79	811	647-1025
11	NY2 Cedar	-	76	-	5	21	1237	.81	951	724-1749
12	MA1 Anna	-	601	9	12	6	1888	.70	1547	920-7601
13	MI3 Pitt AA-N	-	2821	7	76	6	1056	.22	1011	867-1213
14	WI1 Grace N	-	164	5	28	21	1988	.87	1807	1536-2115
15	MI3 Swift Run	-	1707	2	4	5	1116	.15	1104	958-1773
16	SD1 Meade	-	2010	-	-	11	4741	.50	1807	3010-4807
17	CA1 Knox	-	1542	17	-	70	2770	.75	1775	1171-2298
18	FL1 N. Jesuit	-	30	-	11	15	1388	.49	1244	1011-1542
19	FL1 Wilder	-	194	-	47	15	1107	.11	1056	970-1212
20	CO1 North Ave	-	69	4	50	71	4196	.65	1522	2847-4166

Commercial

	Site	Land Use % Comm	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TKN Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	91	77	1657	.85	2785	2186-3548
2	NC1 1031 (CBD)	100	71	0	64	61	1611	.10	1118	1152-1609
3	NY1 Southgate	100	174	2	21	13	1256	.45	1144	975-1414
4	WI1 Post Office	100	12	0	100	27	1021	.44	916	915-1035
5	NH1 Pkg Lot	100	1	0	47	18	7110	.66	1761	1116-7754
6	TN1 EBO	100	26	0	99	15	646	.41	597	499-714
7	WI1 Rustler	100	12	0	-	75	1073	.61	916	754-1110
8	KS1 JC Metcalf	96	58	-	47	37	1175	.71	949	720-1252
9	FL1 Norma Pk	91	47	-	45	12	876	.84	633	437-925
10	WI1 State Fair	74	29	10	77	8	1656	.65	1189	913-2068

Industrial

	Site	Land Use % Ind	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	TKN Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	18	0	69	5	7042	.49	1879	1277-2974
2	WI1 Indus Drain	100	63	0	64	18	1274	.57	1107	891-1376
3	KS1 Lenexa	56	72	-	44	17	1385	.71	1117	796-1568
4	WI1 Grace S.	52	75	5	39	18	1711	.56	1491	1205-1850

TABLE 6-7. SITE MEAN NITRITE PLUS NITRATE EMCs $(\mu g/\ell)$

Residential							NO_{2+3}-N			
	Site	Land Use % Res	Area (A)	Pop. Den. (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	33	19	41	15	527	.34	499	429-580
2	CO1 Cherry	100	57	24	38	14	709	.40	657	542-288
3	CO1 116/Claude	100	167	14	24	16	670	.51	529	469-715
4	DC1 Dufief	100	12	-	-	8	420	.35	445	354-558
5	DC1 Lakeridge	100	68	21	33	49	246	.62	633	552-725
6	DC1 Stratton	100	8	-	-	33	418	.86	312	254-395
7	IL1 John K	100	54	18	14	-	-	-	-	-
8	KS1 Overlon	100	58	8	38	-	-	-	-	-
9	MA2 Hemlock	100	50	5	16	4	-	-	-	-
10	MD1 Bolton Hill	100	14	10	52	19	9535	1.59	5073	3246-7930
11	MD1 Homeland	100	23	9	29	13	6343	4.56	1358	570-3234
12	MD1 Ml Wash	100	17	12	29	20	7822	1.56	4229	2253-6492
13	MD1 Res Mill	100	10	55	26	13	6938	1.08	4207	1048-2269
14	NY1 Carll's P.	100	73	13	20	24	230	1.38	442	318-627
15	NY1 Pnqua	100	-	-	-	8	1593	-	-	1020-1872
16	NY3 Cranston	100	166	5	22	0	-	-	-	-
12	NY3 E. Roch.	100	346	18	38	0	-	-	-	-
18	TX1 Rollingwood	100	60	3	21	9	829	.51	283	581-1055
19	WA1 Surrey	100	95	9	79	0	-	-	-	-
20	WI1 Burbank	100	63	15	50	18	275	.48	699	580-843
21	WI1 Hastings	100	13	17	51	24	625	.39	582	510-664
22	FL1 Young Apls	100	9	-	6	12	311	.64	262	193-355
23	TX1 Hart	99	328	9	40	10	1625	.54	1430	1062-1912
24	WS1 Lincoln	97	36	18	57	3	-	-	-	-
25	TN1 R2	96	89	4	19	11	997	1.34	232	136-412
26	DC1 Westleigh	93	41	9	71	41	202	.59	606	525-700
22	KS1 1C - 92rd	92	63	-	37	0	-	-	-	-
28	IL1 John S.	91	39	18	18	0	-	-	-	-
29	TN1 R1	91	69	11	33	11	578	.72	458	315-665
30	WA1 Lake Hills	91	102	12	37	0	-	-	-	-
31	IL1 Mallbs S.	90	28	22	37	0	-	-	-	-
32	FL1 Charter Mdg	89	42	-	16	12	610	.77	483	139-688
33	DC1 Fairidge	88	19	-	34	48	927	.66	772	667-893
34	CO1 Asbury	86	122	9	22	9	881	.21	862	258-980
35	IL2 Comb Inlets	85	524	8	12	21	296	.55	699	526-848
36	MA1 Locust	65	154	11	16	5	1705	.69	1406	726-2549
37	NC1 41023	84	324	6	27	67	716	.68	591	521-620
18	MA1 Jordnr	79	110	10	21	9	1747	.55	1094	295-1505
39	DC1 Sledwick	78	27	15	34	47	837	.70	686	588-800

Urban Open and Nonurban							NO_{2+3}-N			
	Site	Land Use % Open	Area (A)	Pop. Den. (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CA1 Seaview	100	611	-	-	12	1542	.49	1381	1087-1759
2	OR1 Rooney Gulch	100	405	51	1	7	581	1.03	405	717-756
3	NY3 Thornell	100	28,416	-	4	5	-	-	-	-
4	NY2 English Br	98	5,248	-	1	30	240	.60	206	173-245
5	NY2 West Br	97	5,338	-	1	11	862	.53	761	656-868
6	NY3 Thomas Cr	91	17,278	5	11	0	-	-	-	-
7	MI3 Trayer Cr	90	2,303	-	6	5	1108	.17	1092	930-1283
8	NY2 Sheriff Gocy	85	552	-	7	33	383	1.42	268	209-143

Mixed							NO_{2+3}-N			
	Site	Land Use %	Area (A)	Pop. Den. (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	36	3	68	0	-	-	-	-
2	MD1 Hampden	-	17	40	72	20	11,529	4.00	2293	1457-5355
1	IL1 Mallis N	-	17	3	58	0	-	-	-	-
4	WI1 Waverly	-	30	11	68	35	725	.49	696	610-794
5	TN1 5C	-	187	3	43	13	582	1.49	327	192-558
6	WI1 Wood Cir	-	45	12	81	17	251	.69	618	474-805
2	MA1 R1 9	-	338	7	23	5	1,789	.48	1613	1045-2490
8	MA1 Convent	-	100	1	13	6	960	.39	894	656-1218
9	MI1 Grand R Ot	-	453	5	38	23	883	.44	807	694-938
10	MI3 Pitt AA-S	-	2001	2	21	6	284	.48	256	276-322
11	NY2 Cedar	-	26	-	5	32	248	.72	201	-
12	MA1 Anna	-	601	9	52	6	1,268	.60	1086	688-1218
13	MI3 Pitt AA-N	-	2821	7	26	5	469	.24	456	364-571
14	WI1 Grace N	-	164	5	28	21	825	.43	803	693-931
15	MI3 Swift Run	-	1202	7	4	5	1,033	.26	821	431-1563
16	SD1 Meade	-	2030	-	-	15	616	.40	521	429-680
12	CA1 Knoa	-	1542	12	-	17	1,111	.36	1044	901-1210
18	FL1 W. Jasoll	-	30	-	13	14	126	.54	392	261-422
19	FL1 Wilder	-	194	-	92	15	456	.42	412	336-505
20	CO1 North Ave	-	69	9	50	32	1,744	.92	1286	1012-1626

Commercial							NO_{2+3}-N			
	Site	Land Use % Coml	Area (A)	Pop. Den. (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	91	27	1180	.86	895	709-1143
2	NC1 1013 (CBD)	100	23	0	69	61	1518	.55	980	878-1098
3	NY3 Southgate	100	129	2	21	0	-	-	-	-
4	WS1 Post Office	100	12	0	100	28	708	.68	584	479-712
5	NH1 Pkg Lot	100	15	0	90	28	801	.84	615	486-778
6	TN1 TBD	100	26	0	99	15	662	.62	562	434-778
7	WI1 Rustler	100	12	0	-	25	781	.69	642	527-791
8	KS1 1C Metcalf	96	58	-	97	0	-	-	-	-
9	FL1 Norma Pk	91	42	-	45	12	356	.46	323	257-405
10	WI1 State Fair	74	29	10	72	12	781	.50	702	540-897

Industrial							NO_{2+3}-N			
	Site	Land Use % Ind	Area (A)	Pop. Den. (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	18	5	69	5	1355	.79	1301	997-1706
2	WI1 Indus Drain	100	63	0	64	18	686	.40	637	588-746
3	KS1 Lenexa	56	72	-	44	0	-	-	-	-
4	WI1 Grace S.	52	75	5	39	12	742	.52	657	534-808

TABLE 6-8. SITE MEAN TOTAL COPPER EMCs (µg/ℓ)

Residential										
Site		Land Use % Res	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Total Copper			
							Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	33	19	41	16	32	.82	25	18-34
2	CO1 Cherry	100	57	24	38	14	35	1.48	20	12-33
3	CO1 116/Claude	100	157	14	24	16	28	.74	22	16-29
4	DC1 Dufief	100	12	-	-	21	-	-	-	-
5	DC1 Laterldgr	100	68	21	33	14	18	.55	33	26-42
6	DE1 Stratton	100	8	-	-	10	28	.18	21	23-32
7	IL1 John N	100	54	18	19	36	83	.85	63	51-78
8	KS1 Overton	100	58	8	38	12	91	.50	81	93-103
9	MA1 Hemlock	100	50	5	16	0	-	-	-	-
10	MD1 Bolton Hill	100	14	10	51	19	107	.70	88	68-112
11	MD1 Homeland	100	23	9	79	33	112	.14	296	252-349
12	MD1 Mt Wash	100	12	12	29	20	26	.78	20	15-25
13	MI1 Les Hill	100	10	65	76	13	42	.69	38	25-46
14	NY1 Carll's R.	100	71	13	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	0	-	-	-	-
16	NJ3 Cranston	100	166	5	22	0	-	-	-	-
17	NJ3 E. Apin.	150	246	18	38	0	-	-	-	-
18	TX1 Rollingwood	100	60	1	21	0	-	-	-	-
19	WA1 Surrey	100	95	9	29	0	-	-	-	-
20	WI1 Burbank	100	63	15	50	0	-	-	-	-
21	WI1 Mastings	100	31	17	51	0	-	-	-	-
22	FL1 Young Apts	100	4	-	6	12	6	.36	6	5-7
23	TX1 Marl	99	328	9	40	0	-	-	-	-
24	WI1 Lincoln	93	16	18	53	0	-	-	-	-
25	TN1 P2	96	89	4	13	13	28	1.54	15	8-22
26	DC1 Westleigh	93	41	3	21	6	31	.43	34	24-48
27	KS1 [illegible] - 9Pna	92	61	-	17	2	-	-	-	-
28	IL1 John S.	91	39	18	18	16	43	.84	33	26-40
29	TN1 P1	91	69	11	13	11	51	.60	52	30-70
30	WA1 Lake Hills	91	102	12	37	3	22	.34	21	15-29
31	IL1 Mailis S.	90	28	22	33	36	45	.76	36	30-44
32	IL1 Charter Ndg	89	42	-	16	12	13	.94	1	6-11
33	DC1 Fairridge	88	19	-	34	9	26	.39	26	17-31
34	CO1 Asbury	86	127	9	22	9	59	.84	45	29-71
35	IL2 Emb Inlets	85	124	8	17	26	49	.53	43	36-51
36	MA1 Locust	85	154	11	16	6	107	.21	104	80-135
37	NC1 #1021	84	134	6	27	65	39	.60	33	29-10
38	MA1 Jordan	19	110	10	31	8	74	.24	72	-
39	DC1 Stedwick	78	27	15	34	9	111	.15	25	21-25

Urban Uben and Nonurban										
Site		Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Total Copper			
							Mean	COV	Median	90% Confidence Limits
1	LA1 Seaview	100	633	-	-	12	59	.31	55	46-65
2	CO1 Rooney Gulch	100	405	0	1	7	37	1.09	25	11-48
3	NJ3 Thornell	100	28,416	-	4	0	-	-	-	-
4	NY2 English Cr	98	6,249	-	1	0	-	-	-	-
5	NC2 West Br	97	5,338	-	1	0	-	-	-	-
6	NJ3 Thomas Ct	91	17,126	1	11	0	-	-	-	-
7	NJ3 Teague Cr	90	7,303	-	6	0	-	-	-	-
8	NJ1 Sheriff [illegible]	90	557	-	7	0	-	-	-	-

Mixed										
Site		Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Total Copper			
							Mean	COV	Median	90% Confidence Limits
1	KS1 Naland	-	36	1	68	9	48	.38	45	16-57
2	MD1 Hampden	-	13	40	78	30	81	.96	51	45-92
3	IL1 Mattis N	-	17	3	58	17	48	.51	17	31-45
4	MI1 Waverly	-	30	13	69	16	15	.50	13	10-16
5	TN1 SC	-	181	3	41	13	42	1.15	25	15-41
6	WI1 Wood Ctr	-	45	12	81	11	-	-	-	-
7	MA1 Pi 9	-	119	7	23	7	112	.49	100	71-141
8	MA1 Tonring	-	110	1	31	7	205	.41	90	71-170
9	MI1 Grand R Ol	-	453	5	38	33	101	.53	76	20-35
10	MI3 Pitt AA-S	-	2003	2	25	0	-	-	-	-
11	NY2 Cedar	-	76	-	5	0	-	-	-	-
12	MA1 Anna	-	601	9	12	5	54	.91	46	30-71
13	MI3 Pitt AA-N	-	2811	7	26	0	-	-	-	-
14	MI1 Grand N	-	184	5	29	9	14	.31	17	11-35
15	MI3 Swift Run	-	1203	2	4	0	-	-	-	-
16	SD1 Meade	-	2030	-	-	0	-	-	-	-
17	CA1 Knox	-	1542	12	-	17	95	1.14	65	44-96
18	FL1 N. Jesuit	-	30	-	13	15	7	.61	5	5-8
19	FL1 Wilder	-	394	-	67	15	6	.84	5	4-7
20	CO1 North Ave	-	69	9	51	12	71	.83	54	42-74

Commercial										
Site		Land Use % Coml	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Total Copper			
							Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	91	27	31	.87	35	20-32
2	NC1 TOll (CBD)	100	23	0	49	61	70	.54	61	52-89
3	NJ3 Suntogate	100	179	0	21	0	-	-	-	-
4	WI1 Post Office	100	12	2	100	0	-	-	-	-
5	NH1 Pkg lot	100	3	0	95	11	106	.13	101	-
6	TN1 CBD	100	26	0	99	15	42	.60	36	28-46
7	WI1 Rustler	100	12	0	-	0	-	-	-	-
8	KS1 11 Metcalf	96	58	-	97	6	31	.33	19	10-51
9	IL1 Norma 2k	93	48	-	65	12	11	.37	10	8-13
10	WI1 State Fair	74	24	10	77	0	-	-	-	-

Industrial										
Site		Land Use % Ind	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Total Copper			
							Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	18	0	19	0	-	-	-	-
2	MI1 Inghm Drain	100	53	0	64	6	30	.55	37	[illegible]
3	KS1 Lenexa	58	72	-	44	5	35	.24	35	28-41
4	MI1 [illegible] S.	58	15	5	3[illegible]	[illegible]	25	.05	21	14-[illegible]

TABLE 6-9. SITE MEAN TOTAL LEAD EMCs (μg/ℓ)

Residential							Total lead			
	Site	Land Use % Res	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr	100	13	19	41	16	183	.88	117	98-191
2	CO1 Cherry	100	51	24	18	14	194	.92	143	99-207
3	CO1 116rClande	100	167	14	24	16	292	.87	210	153-292
4	DC1 Dufief	100	12	-	-	1	-	-	-	-
5	DC1 Lakeridge	100	68	21	33	18	227	.54	201	164-245
6	DC3 Stratton	100	8	-	-	0	-	-	-	-
7	IL1 John N	100	94	18	19	16	717	.71	191	158-211
8	KS1 Overton	100	58	8	16	11	118	.19	128	104-157
9	MA2 Hemlock	100	55	5	16	0	-	-	-	-
10	MD1 Dolling Brl	100	14	30	51	19	2345	4.53	592	295-1188
11	MD1 Homeland	100	21	9	29	19	76	.48	69	56-86
12	MD1 Mt Wash	100	17	12	29	20	86	.48	77	65-92
13	MD1 Res Hill	100	10	55	76	17	461	1.86	218	119-399
14	NY1 Carll's P	100	71	13	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	8	88	1.16	52	26-103
16	MI1 Gransame	100	166	5	22	31	34	.77	27	19-38
17	NY3 E. Roch.	100	146	18	38	8	191	.89	144	86-240
18	TN1 Rollingwood	100	60	3	21	0	-	-	-	-
19	WA1 Surrey	100	99	9	29	138	152	.51	136	126-146
20	WI1 Burbank	100	63	15	58	44	95	.72	77	65-91
21	WI1 Hastings	100	33	17	51	15	108	.67	90	75-107
22	IL1 Young Apts	100	9	-	6	12	36	1.03	51	14-82
21	TN1 Mars	99	178	9	40	0	-	-	-	-
24	WI1 Lincoln	91	16	16	57	22	303	1.39	200	141-280
25	TN1 42	96	89	4	13	11	111	.41	123	99-151
26	DC1 Westleigh	97	41	1	21	5	186	.37	184	157-236
27	KS1 IL - 52nd	92	61	-	37	1	-	-	-	-
28	IL1 John S.	91	39	18	18	13	217	.80	169	138-208
29	TN1 41	91	69	11	11	11	440	.61	776	277-511
30	WA1 Lake Hills	91	102	17	39	126	192	.67	159	146-374
31	IL1 Mall's S.	90	28	21	17	37	595	1.12	196	308-508
32	IL1 Charter Hdg	89	92	-	16	12	49	1.60	26	14-47
33	DC1 Fairidge	68	19	-	14	1	-	-	-	-
34	LB1 Asbury	86	127	9	22	9	431	.12	151	251-524
35	IL2 Lamb Inlets	85	524	6	17	24	122	1.01	277	169-304
36	MA1 Locust	85	154	11	14	6	213	.67	225	116-171
37	MI1 #1023	44	129	6	27	56	254	.98	182	151-215
38	MA1 Jordan	79	110	10	21	9	168	.12	166	112-194
39	DC1 Stedwick	78	27	15	34	11	143	.43	110	105-161

Urban Open and Nonurban							Total lead			
	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	FN1 SAndrew	100	63	-	-	7	214	.54	159	91-279
2	CO1 Rooney Gulch	100	405	1	1	7	52	.61	39	22-69
3	NY3 Thornell	100	25,416	-	4	10	12	.42	11	9-14
4	MI2 English Rr	98	5,248	-	1	21	4	.60	8	6-10
5	MI? West Br	97	1,378	-	1	25	38	1.40	22	15-31
6	NY3 Thomas Cr	91	13,128	1	11	22	25	1.65	18	10-31
7	MI3 Traver Cr	90	2,303	-	6	0	-	-	-	-
8	MI2 Sheriff Duck	30	557	-	7	17	132	1.09	91	73-311

Mixed							Total lead			
	Site	Land Use 1	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	36	1	68	9	164	.49	147	110-196
2	MD1 Hampden	-	17	40	32	20	227	.82	176	131-232
1	IL1 Mattis N	-	17	3	58	41	554	1.06	180	103-478
4	MI1 Waverly	-	30	11	68	24	311	1.09	75	55-102
5	TN1 SC	-	187	1	43	13	237	.31	227	195-214
6	WI1 Wood Ctr	-	95	12	81	45	582	.94	424	348-517
7	MA1 Rt 9	-	338	7	11	7	419	1.02	167	165-571
8	MA1 Convent	-	100	1	13	7	196	.94	143	80-257
9	MI1 Grand R Ot	-	451	5	38	18	122	.90	91	66-125
10	MI3 Pitt AA-S	-	2001	2	23	6	23	1.63	11	4-28
11	NY2 Cedar	-	76	-	5	28	75	1.25	47	34-69
12	MA1 Anna	-	601	9	12	4	-	-	-	-
13	MI3 Pitt AA-M	-	2871	7	26	5	61	.71	50	27-93
14	MI1 Grace A	-	164	5	28	18	170	1.79	99	65-151
15	MI3 Swift Run	-	1207	2	4	4	-	-	-	-
16	SD1 Meade	-	2030	-	-	24	381	1.13	254	165-390
17	CA1 Knox	-	1542	12	-	22	495	.99	151	259-475
18	FL1 N. Jesuit	-	10	-	13	15	56	1.22	35	33-54
19	FL1 Wilder	-	194	-	97	15	86	.85	55	46-91
20	CO1 North Ave	-	69	9	50	11	158	.32	278	226-343

Commercial							Total lead			
	Site	Land Use % Coml	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	40% Confidence Limits
1	CO1 Villa Italia	100	14	6	91	27	262	1.21	167	172-224
2	MD1 1011 (CBD)	100	27	0	69	61	382	.81	296	254-349
3	NY3 Southgate	100	179	0	21	13	47	.58	42	31-53
4	WI1 Post Office	100	12	2	100	59	191	.93	145	126-173
5	MH1 Pkg Lot	100	1	0	90	13	208	.93	162	171-197
6	TN1 CBD	100	26	5	99	15	158	.52	140	112-175
7	WI1 Rustler	100	12	0	-	44	123	.70	98	83-115
8	RS1 1C Mescall	96	58	-	97	7	-	-	-	-
9	FL1 Marma Fk	91	47	-	45	12	46	1.01	37	31-45
10	WI1 State Fair	74	29	10	37	27	409	.86	310	243-396

Industrial							Total lead			
	Site	Land Use % Ind	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	18	0	69	0	-	-	-	-
2	MI3 Indus Drain	100	63	0	64	13	116	.77	93	65-121
1	KS1 Lenexa	56	72	-	44	6	-	-	-	-
4	MI1 Grace S.	52	15	5	39	13	115	.76	92	66-128

TABLE 6-10. SITE MEAN TOTAL ZINC EMCs (µg/ℓ)

	Residential						Total Zinc			
	Site	Land Use % Res	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Big Dry Cr.	100	37	19	41	15	194	.80	151	110-208
2	CO1 Cherry	100	57	24	38	19	195	.61	155	126-217
3	CO1 116 Claude	100	167	14	24	13	195	.66	158	171-206
4	DC1 Dufief	100	22	-	-	8	156	.26	161	137-179
5	DC1 Lakeridge	100	58	21	31	48	129	.70	106	91-171
6	DC1 Stratton	100	5	-	-	28	84	.42	76	66-88
7	DC1 John M	100	54	15	19	0	-	-	-	-
8	KS1 Overland	100	58	8	38	33	841	.97	596	399-891
9	MA2 Hemlock	100	50	5	16	0	-	-	-	-
10	MD1 Hallion Hill	100	14	10	52	19	1388	2.21	573	117-971
11	MD1 Homeland	100	21	6	29	33	120	.15	113	96-114
12	MD1 Mt Wash	100	17	12	39	29	97	.54	81	67-98
13	MD1 Res Hill	100	10	55	76	11	531	1.20	140	211-542
14	NY1 Carll's C	100	73	11	20	0	-	-	-	-
15	NY1 Unqua	100	-	-	-	0	-	-	-	-
16	NH2 Cranston	100	160	5	22	9	315	.89	117	195-499
17	NH3 L. Foch	100	346	18	39	8	988	1.10	127	180-594
18	TX1 Rollingwood	100	80	1	21	0	-	-	-	-
19	WA1 Surrey	100	91	9	29	118	174	.42	114	107-121
20	WI1 Burbank	100	63	15	50	18	106	1.14	61	42-95
21	WI1 Hastings	100	33	17	51	21	106	1.20	69	49-99
22	IL1 Young Apts	100	9	-	6	12	60	.45	55	44-69
23	TX1 Hart	99	276	0	40	11	-	-	-	-
24	WI1 Lincoln	97	36	18	57	0	-	-	-	-
25	TN1 92	96	89	4	33	11	91	.52	81	61-109
26	DC1 Westleigh	93	41	1	21	14	67	.96	48	38-61
27	KS1 IC - 92nd	92	63	-	17	3	-	-	-	-
28	IL1 John S.	91	39	18	18	1	-	-	-	-
29	SM1 91	91	69	11	11	11	412	.59	754	261-477
30	WA1 Lake Hills	91	102	32	17	126	120	.51	107	99-115
31	IL1 Malfis S.	90	38	22	17	0	-	-	-	-
32	FL1 Charter Hng	85	42	-	16	12	54	1.02	78	35-59
33	DC1 Fairidge	88	19	-	14	44	86	.52	76	67-86
34	DC1 Asbury	86	127	9	22	9	149	.61	295	206-427
35	IL2 Cimb Inlets	85	524	8	12	27	210	.69	189	154-212
36	MA1 Locust	85	154	11	16	6	247	.11	216	184-301
37	NC2 #1023	64	324	6	27	66	178	.81	118	139-160
38	MA1 Jordan	79	110	10	21	9	218	.28	210	177-249
39	DC1 Stedwick	78	27	15	14	45	91	.70	75	64-86

	Urban Open and Nonurban						Total Zinc			
	Site	Land Use % Open	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Seaview	100	613	-	-	17	190	.69	160	125-205
2	CO1 Rooney Gulch	100	4175	0	1	7	115	.56	91	61-136
3	NY3 Thornwood	100	75,415	-	4	9	292	2.39	306	110-720
4	NY2 English Pk	99	5,208	-	1	0	-	-	-	-
5	NY1 Best Br	97	5,158	-	1	0	-	-	-	-
6	NY3 Thomas Cr	51	17,724	1	11	9	1062	3.14	327	121-639
7	MI3 Traver Cr	90	2,707	-	6	2	-	-	-	-
8	MI2 Sheriffs Pool	89	552	-	7	0	-	-	-	-

	Mixed						Total Zinc			
	Site	Land Use %	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	KS1 Noland	-	35	3	68	9	910	2.19	525	242-940
2	MD1 Hampden	-	11	40	72	17	319	.75	112	276-440
3	IL1 Mottis N	-	17	3	96	0	-	-	-	-
4	MI1 Waverly	-	30	11	58	17	121	95	110	92-131
5	TN1 SC	-	197	3	43	13	146	40	134	114-167
6	WI1 Hogo Clr	-	45	17	61	27	475	1.21	305	222-424
7	MA1 R1 9	-	738	1	42	7	244	37	225	166-304
8	MA1 Convent	-	130	1	33	6	207	59	174	135-270
9	MI1 Grand R Hill	-	451	1	38	14	745	71	60	186-[illegible]
10	WI1 Pitl AA-S	-	2901	2	21	4	-	-	-	-
11	NY2 Cedar	-	76	-	5	0	-	-	-	-
12	MA1 Anna	-	601	9	12	5	176	1.50	99	[illegible]
13	MI3 Pitt AA-N	-	2871	7	26	4	-	-	-	-
14	MI1 Grace N	-	154	5	78	9	149	35	140	[illegible]
15	MI3 Swift Run	-	1207	2	4	7	-	-	-	-
16	SD1 Meade	-	2910	-	-	0	-	-	-	-
17	CA1 Knox	-	1542	12	-	21	302	.55	31	[illegible]
19	FL1 N. Jesuit	-	30	-	11	15	94	.68	79	69-101
19	FL1 Wilder	-	194	-	97	15	51	.95	37	36-57
20	CO1 North Ave	-	69	9	50	13	541	.82	471	741-[illegible]

	Commercial						Total Zinc			
	Site	Land Use % Comm	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	CO1 Villa Italia	100	74	0	91	27	120	.82	397	195-333
2	NC1 1911 (C90)	100	21	0	19	60	531	.51	478	428-576
3	NY1 Southgate	100	179	2	21	9	1436	4.56	517	214-1747
4	WI1 Post Office	100	12	0	100	32	145	1.16	44	71-124
5	NH1 Plg Lal	100	1	0	36	31	511	.65	410	361-517
6	TN1 CBD	100	29	0	99	15	115	.41	289	240-349
7	WI1 Rustler	100	12	0	-	19	156	.75	175	96-161
8	KS1 IC Metcalf	96	58	-	97	7	465	.79	168	372-611
9	FL1 Norma Pk	91	47	-	45	12	17	.88	29	19-41
10	WI1 State Fair	74	29	10	77	7	380	.65	234	150-163

	Industrial						Total Zinc			
	Site	Land Use % Ind	Area (A)	Pop. Den (#/A)	% IMP.	No. of OBS	Mean	COV	Median	90% Confidence Limits
1	MA2 Addison	100	10	0	69	8	-	-	-	-
2	MI1 Ladys Drain	100	63	0	64	7	244	.42	225	167-293
3	KS1 Lenexa	56	72	-	44	6	2721	3.79	701	217-2850
4	MI1 Grace S.	52	75	5	39	7	237	.54	196	175-264

* All observations below detection limit.

These tables (one for each pollutant) list each of the appropriate sites in the data base, grouped according to general land use category. Some pertinent site characteristics are identified: drainage area, population density, and the percentage of the total area covered by impervious surfaces. The number of monitored storms at each site is tabulated. Urban runoff quality is summarized by the mean and median EMC for all storms monitored at the site, the storm-to-storm variability of EMC's (defined by the coefficient of variation), and the 90 percent confidence limits for the site median EMC.

Transferability of Data

The urban runoff loading site EMC data were carefully examined in an effort to determine whether specific groupings of results would suggest the presence of consistent patterns of similarities and/or differences that could be used to support estimates of urban runoff characteristics at unmonitored locations and sites.

Variability of EMCs at a Site. Inspection and analysis of the individual site coefficient of variation entries in Tables 6-1 through 6-10 shows that with very few exceptions (usually associated with constituents that were monitored in fewer than 10 storm events) the coefficients of variation fall in the range of 0.5 to 1.0. This applies to all constituents except TSS, for which the range in coefficients of variation is more like 1 to 2.

The frequency of occurrence of any EMC of interest can be estimated readily from the coefficient of variation by using the procedures outlined in Chapter 5. Thus, for TSS, 90 percent of the individual storm events at a given site will have EMCs that do not exceed a value of roughly 3 to 5 times the median EMC value for that site. For the other constituents, 90 percent of the individual storm events at a site will have EMCs less than about 2 to 3 times the median EMC value for that site. More refined estimates and values for other exceedance probabilities can be readily computed using the relationships presented in Chapter 5.

Effect of Geographic Location. Figures 6-4 through 6-13 indicate the range of median EMC's at individual sites, grouped by project. The land use category of the site is indicated by the letter R for residential, M for mixed, and C for commercial/industrial, and the plotting position is the median value as given by the data in Tables 6-1 through 6-10. The ends of the bars for each project are the highest and lowest 90 percent confidence limits for site median EMCs at the project for the constituent in question. Inspection of Figures 6-4 through 6-13 indicates that, for any given constituent, each project can be put into one of three rather general categories: (1) low EMCs and tightly grouped; (2) average characteristics; and (3) wide range and high EMCs. Using the numbers 1, 2, and 3 as shorthand, project categories for each constituent are summarized in Table 6-11. Although no site is category consistent for all constituents, WASHCOG (DC1), Tampa (FL1), Lansing (MI1), and Ann Arbor (MI3) tend to have lower and more tightly grouped EMCs than the others while Kansas City (KS1), Lake Quinsigamond (MA1), and Baltimore (MD1) tend to have a wider range and higher EMCs than the others. Thus we can conclude that some projects represented in the database appear, from the monitoring sites selected, to tend towards somewhat higher or lower EMC median values and ranges than the bulk of the projects. However, there are no distinct geographical patterns revealed.

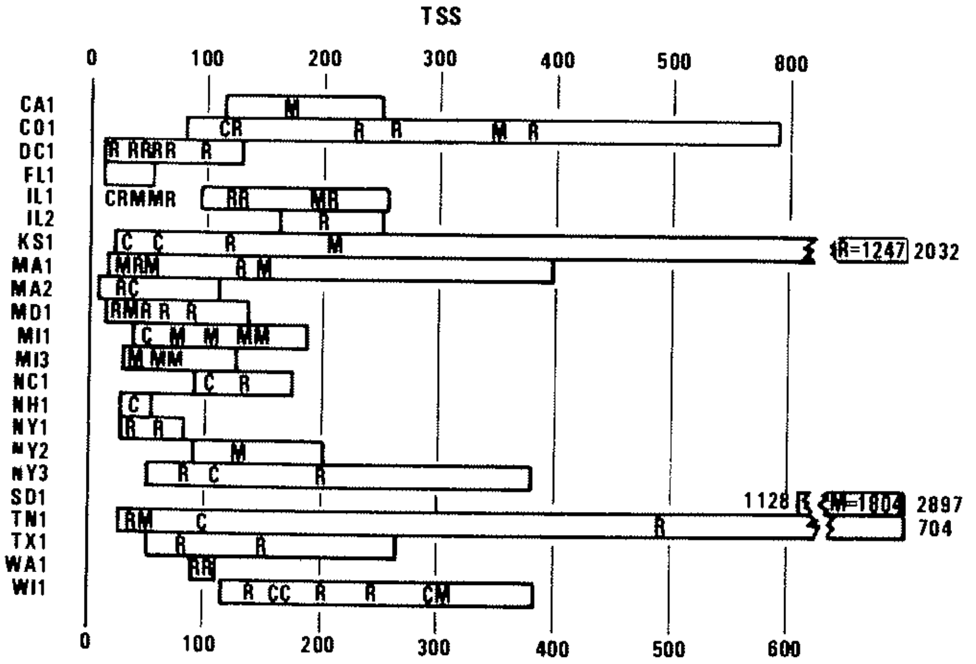

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Figure 6-4. Range of TSS EMC Medians (mg/l) by Project

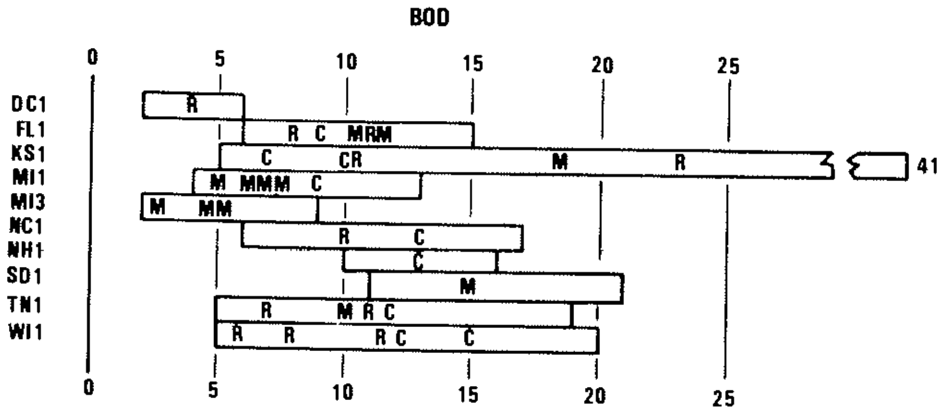


Figure 6-5. Range of BOD EMC Medians (mg/l) by Project

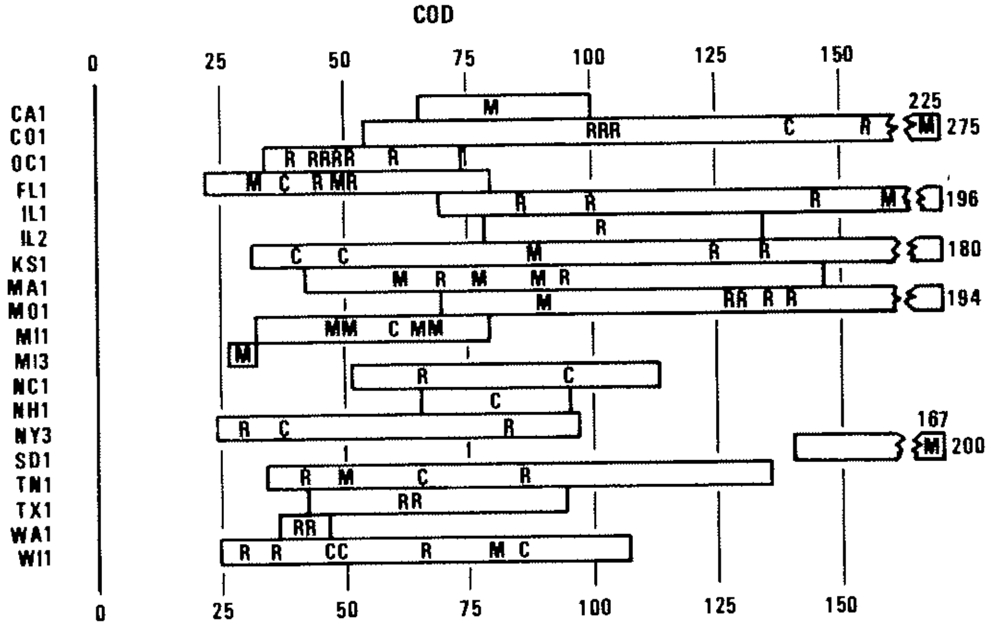


Figure 6-6. Range of COD EMC Medians (mg/l) by Project

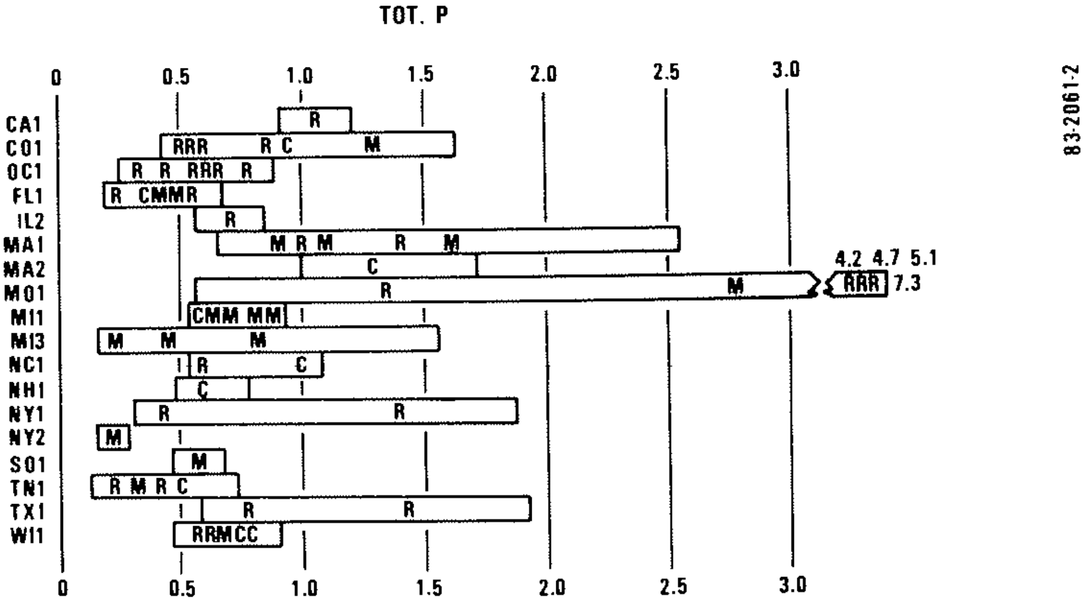


Figure 6-7. Range of Total P EMC Medians (mg/l) by Project

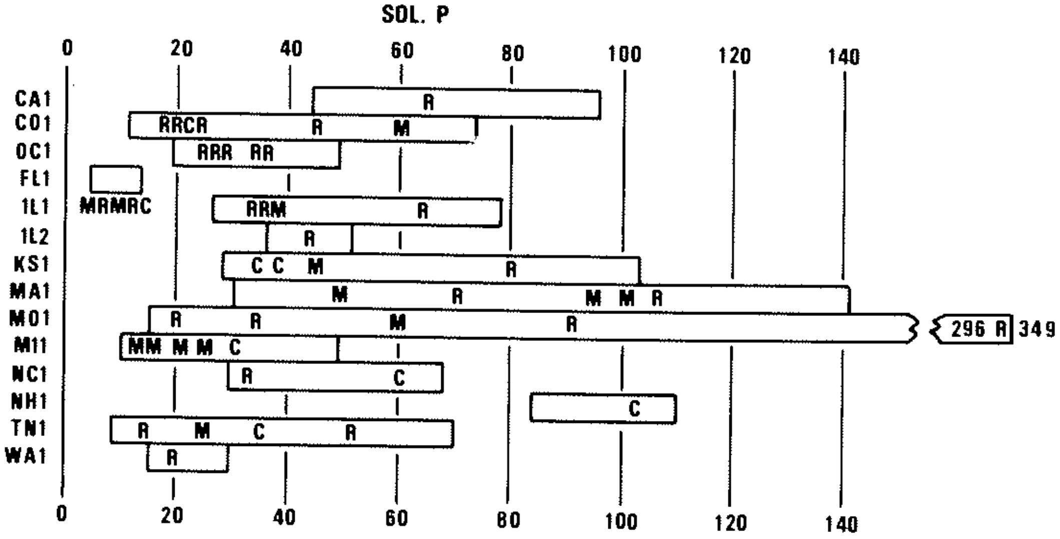


Figure 6-8. Range of Soluble P EMC Medians (mg/l) by Project

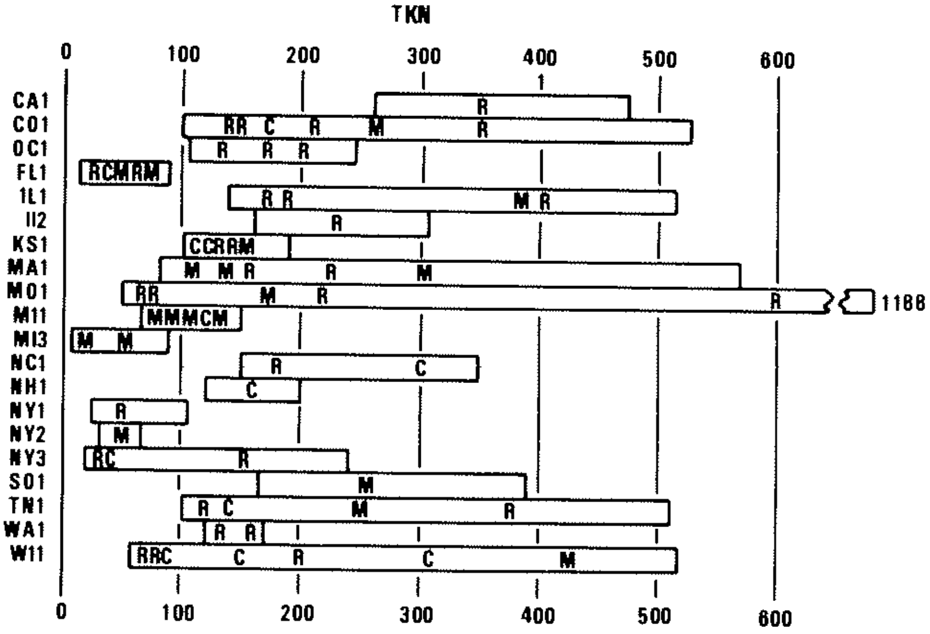


Figure 6-9. Range of TKN EMC Medians (mg/l) by Project

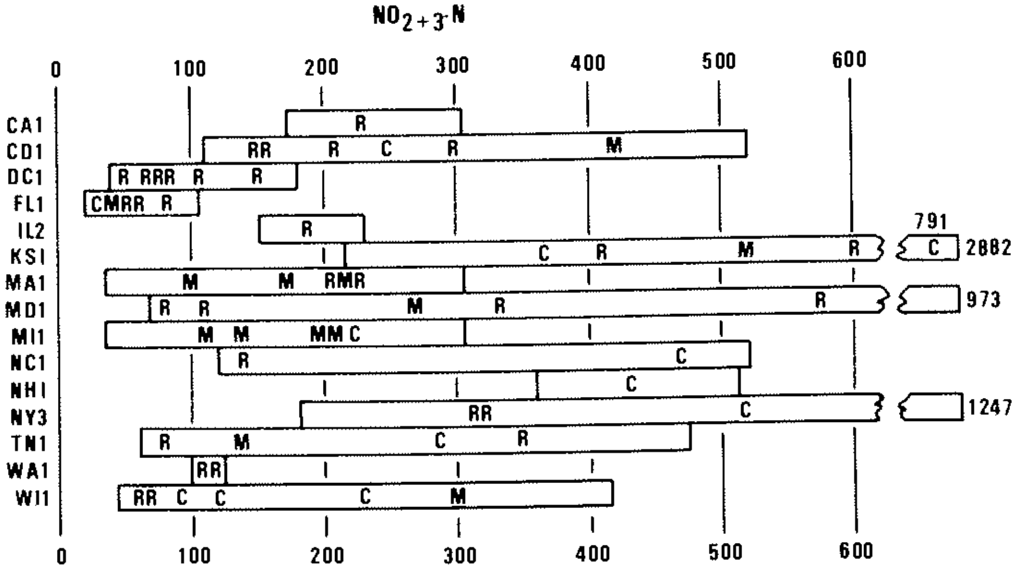


Figure 6-10. Range of NO_{2+3}-N EMC Medians (mg/l) by Project

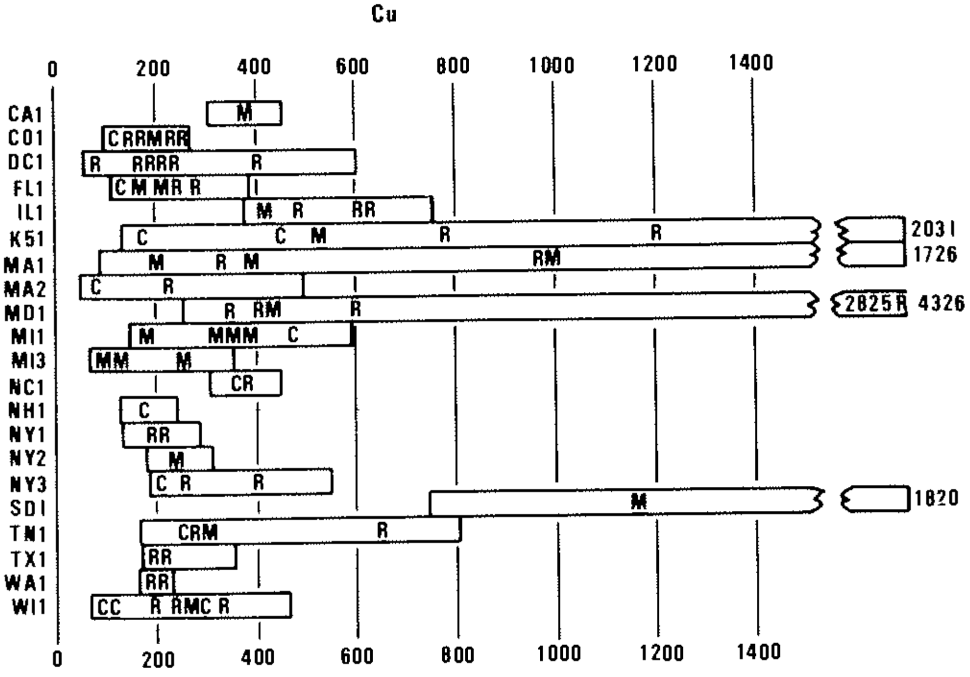


Figure 6-11. Range of Total Cu EMC Medians (µg/l) by Project

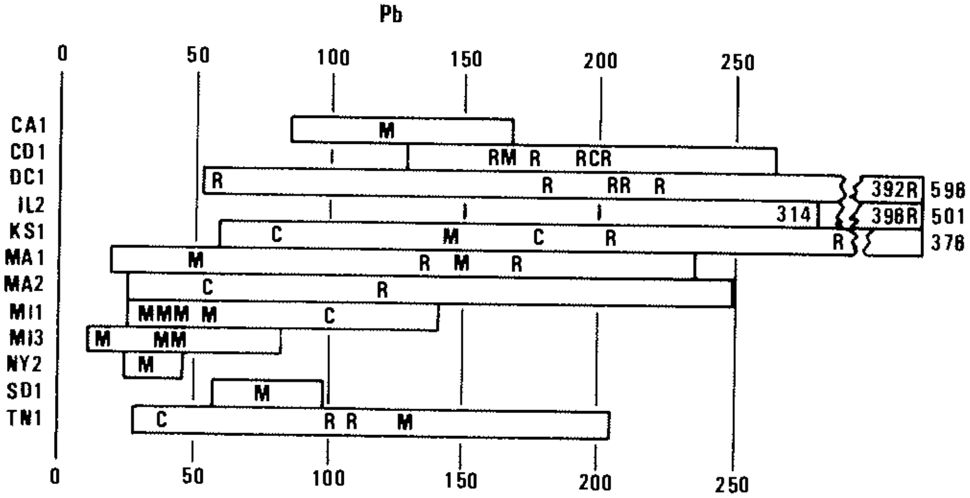


Figure 6-12. Range of Total Pb EMC Medians (μg/l) by Project

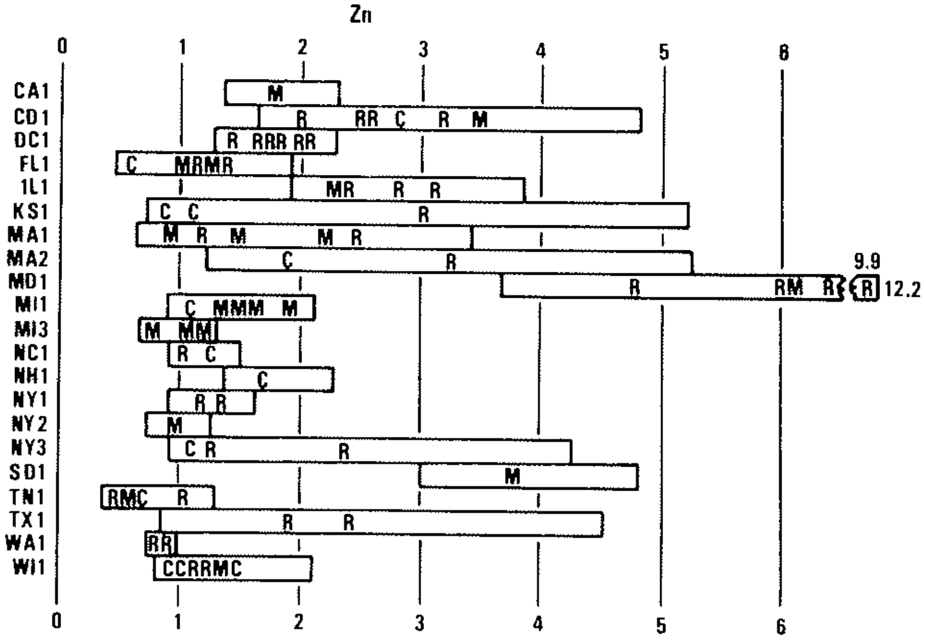


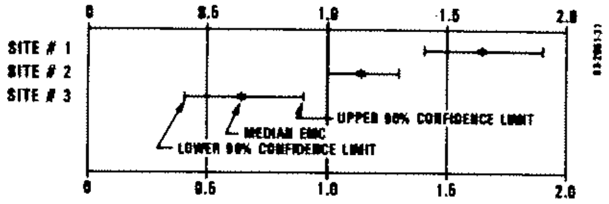
Figure 6-13. Range of Total Zn EMC Medians (μg/l) by Project

TABLE 6-11. PROJECT CATEGORY SUMMARIZED BY CONSTITUENT

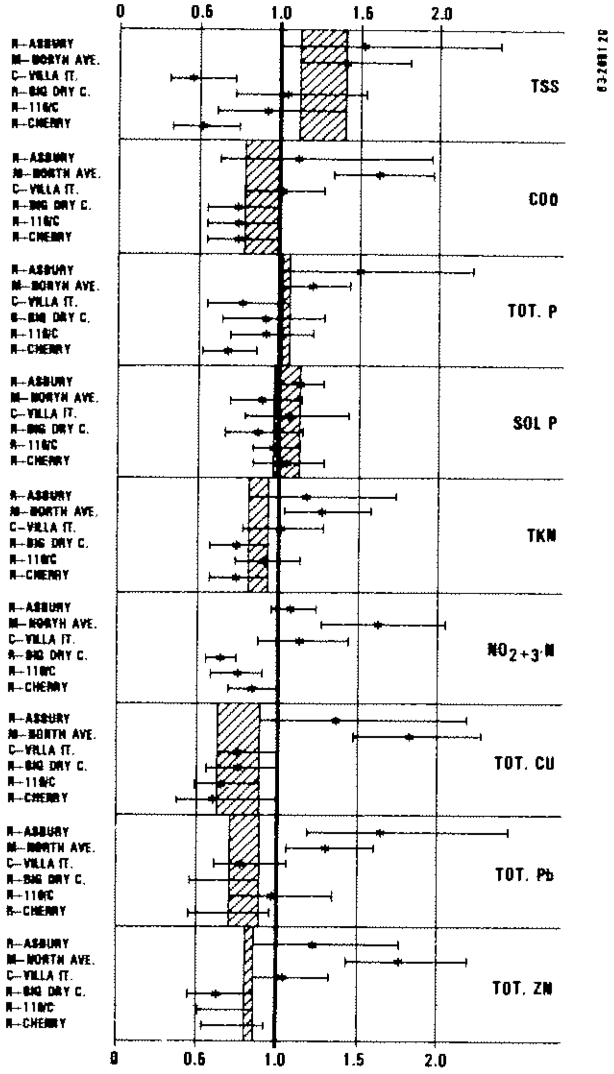
	CO1	DC1	FL1	IL1	KS1	MA1	MD1	MI1	MI3	NY3	TN1	WI1
TSS	3	1	1	2	3	3	1	1	1	2	3	2
BOD	–	–	2	–	3	–	–	2	1	–	2	2
COD	3	1	1	3	3	2	3	1	–	1	2	2
Tot. P.	1	2	1	2	3	3	3	2	1	2	2	2
Sol. P.	2	3	–	–	3	2	–	2	1	–	2	–
TKN	2	1	1	2	2	2	3	1	1	2	1	1
NO_{2+3}-N	2	1	1	–	–	3	3	1	2	–	1	1
Tot. Cu	2	1	1	2	2	3	3	1	–	–	2	–
Tot. b	2	1	1	2	1	2	3	1	–	1	2	2
Tot. Zn	2	1	1	–	3	2	3	2	–	3	2	2

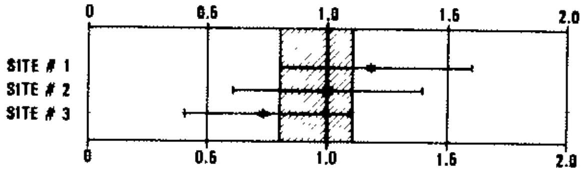
It must also be realized that had any particular project monitored other local sites (or additional sites) its categorization could well change. This can be seen qualitatively by perusing Figures 6-4 through 6-13 and mentally dropping the highest or lowest site from each grouping. Although some locations, such as Tampa, will undoubtably and appropriately be influenced by the relatively low EMCs and tight groupings found there in estimating probable values for other urban sites in the area, there is little to warrant attributing similar characteristics to other locations in the same geographical region. For the other locations it would appear that individual site differences eclipse any possible geographic ones.

Effect of Land Use Category. The data in Tables 6-1 through 6-10 were presented by land use category; residential, mixed, commercial, industrial, and open/non-urban. The question to be addressed here is the extent to which such site categorization can be used to assist in predicting EMC parameters for unmonitored sites. Two approaches were used. In the first, the site data for each project with more than three sites were normalized by dividing the site median and its upper and lower 90 percent confidence limits by the average project median value for the constituent in question. This procedure simply allows all constituents to be viewed on a common scale that is centered at unity. An example of the result is given in Figure 6-14. A legend is provided in Figure 6-14(a) showing the lower 90 percent confidence limit, the upper 90 percent confidence limit, and the location of the point estimate of the median within this confidence interval for a hypothetical constituent. Sites that fall to the right of the unity line have higher EMCs than average for this location, while sites that fall to the left of the unity line have lower EMCs than average. Thus, the interpretation is that for this location, Site #1 is the "dirtiest" (has the highest EMC value), Site #3 is the "cleanest", and Site #2 is in between, being somewhat "dirtier" than average. Since the 90 percent confidence limits for these three sites no not overlap, we know that this difference is statistically significant.



(a) Significantly Different Sites





(b) Sites with No Significant Difference

(c) EMC Data from Denver (CO1)

Figure 6-14. Range of Normalized EMC Medians at Denver (CO1)

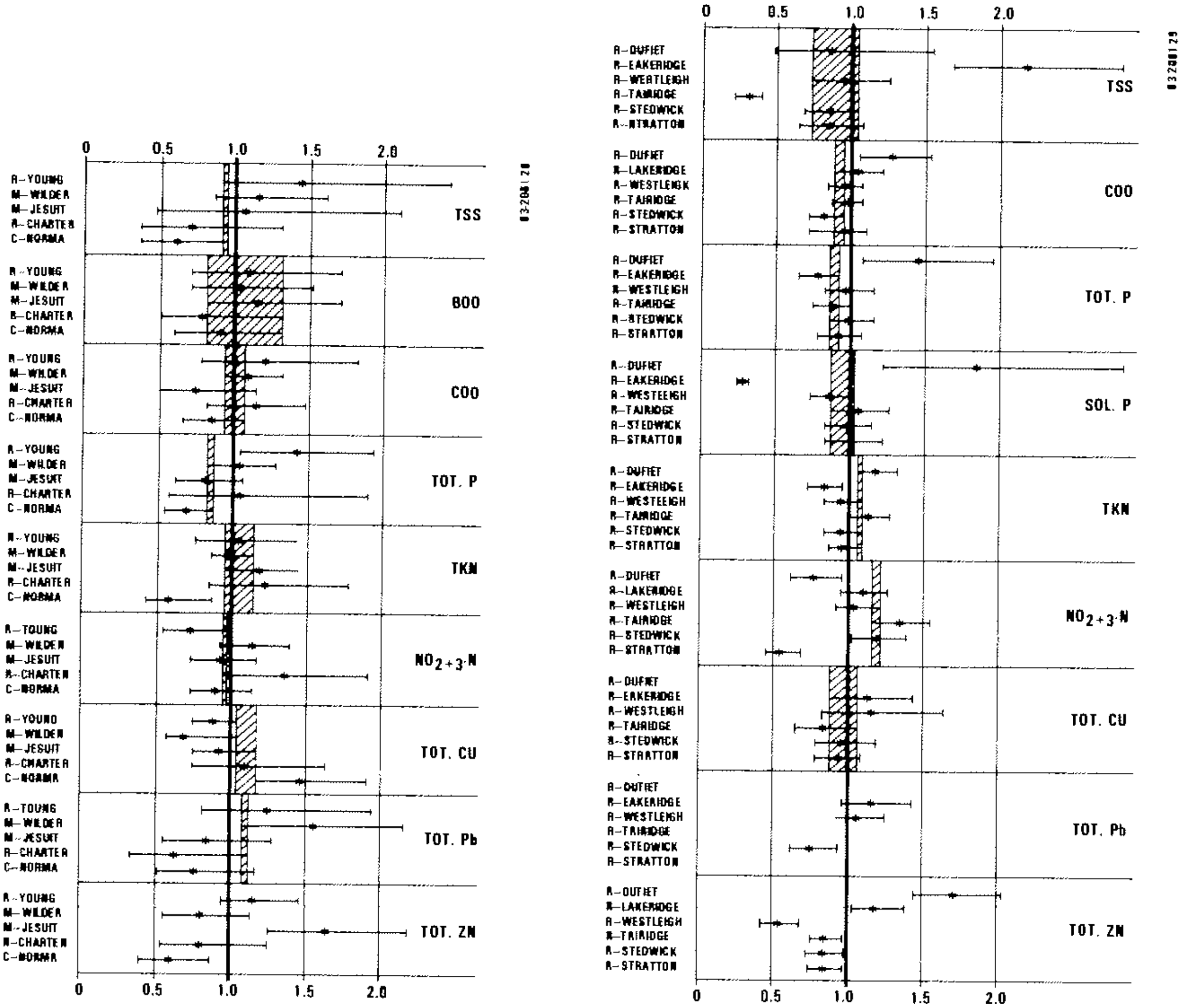
The actual data for the Denver (CO1) project are presented in Figure 6-14(c). With the exception of nitrate + nitrite, there is little to no statistically significant difference among the majority of the sites for each constituent examined. The lack of consistency among the sites over the various constituents is apparent. One can observe that the Cherry site (residential) tends to plot at the lowest position for all constituents, suggesting that it is the "cleanest," the Asbury site (also residential) tends to plot at the highest position, suggesting that it is the "dirtiest." The Big Dry Cottonwood site, which is also residential, tends to fall between these two. Careful examination of other site data does not provide any evidence to explain this difference in response for sites in the same land use category at the same location. Thus, based on the information presented in Figure 6-14(c), one is forced to conclude that land use category does not provide a useful basis for predicting differences in site EMC values, at least for this project.

When the foregoing type of analysis was applied to the other applicable NURP projects, the results were the same. As another example, the range of normalized EMC medians at Tampa (FL1) and WASHCOG (DC1) are shown in Figure 6-15. These are essentially similar to the Denver results just discussed.

The WASHCOG data presented in Figure 6-15(b) suggest that there is little consistent difference among residential land use sites at that project. The data from Champaign/Urbana (IL1) presented in Figure 6-16 suggest just the opposite. As a part of this project's experimental design, two site pairs were selected. The sites of each pair were expected to respond in a similar fashion. That they do and that the responses of the two pairs are different from each other for most constituents is apparent in Figure 6-16. However, there is no consistency in the pair responses. For example, the Mattis pair has significantly higher EMC values for TSS, COD, and Total Pb, while the John Pair is higher in Total P. The residential land use category for these sites provides no explanation of these differences in response.

Based upon the foregoing approach, we can conclude that, while there can be differences in the responses of different sites at a given location, significant differences do not appear to be widespread, and where they occur, the site land use category is virtually useless in trying to understand or predict them.

The second approach to examining the effect of land use category on the EMC parameters of a site makes use of the observation, discussed earlier, that geographic location has no discernible effect on site response. Since site to site variability was shown to be very well represented by the lognormal distribution, analysis procedures similar to those described previously for characterizing an individual site were applied. Table 6-12 lists the median EMCs for all sites within each land use category. The coefficient of variation quantifies the variability of site characteristics within the land use category. To the extent that the sites included in this database provide a "representative" sample of the land use classifications, then the information summarized by Table 6-12 indicates the effect of land use on urban storm runoff pollutant discharges.



(a) Tampa Sites

(b) WASHCOG Sites

Figure 6-15. Range of Normalized EMC Medians at FL1 and DC1

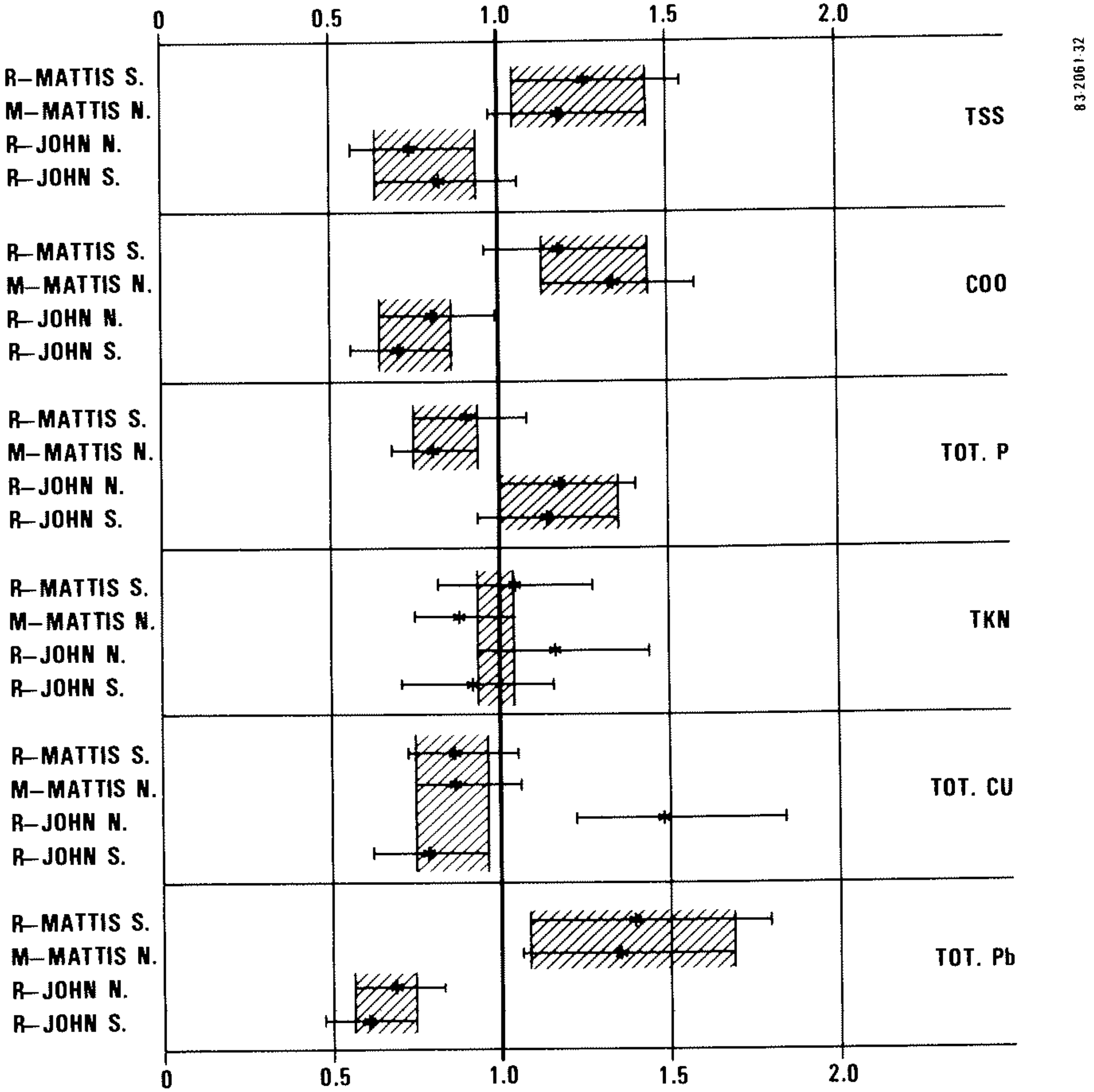


Figure 6-16. Range of Normalized EMC Medians at IL1

TABLE 6-12. MEDIAN EMCs FOR ALL SITES BY LAND USE CATEGORY

Pollutant	▨	Residential		Mixed		Commercial		Open/Nonurban	
		Median	CV	Median	CV	Median	CV	Median	CV
BOD	mg/ℓ	10.0	0.41	7.8	0.52	9.3	0.31	-	-
COD		73	0.55	65	0.58	57	0.39	40	0.78
TSS		101	0.96	67	1.14	69	0.85	70	2.92
Total Lead	µg/ℓ	144	0.75	114	1.35	104	0.68	30	1.52
Total Copper		33	0.99	27	1.32	29	0.81	-	-
Total Zinc		135	0.84	154	0.78	226	1.07	195	0.66
Total Kjeldahl Nitrogen		1900	0.73	1288	0.50	1179	0.43	965	1.00
NO_2 -N + NO_3 -N		736	0.83	558	0.67	572	0.48	543	0.91
Total P		383	0.69	263	0.75	201	0.67	121	1.66
Soluble P		143	0.46	56	0.75	80	0.71	26	2.11

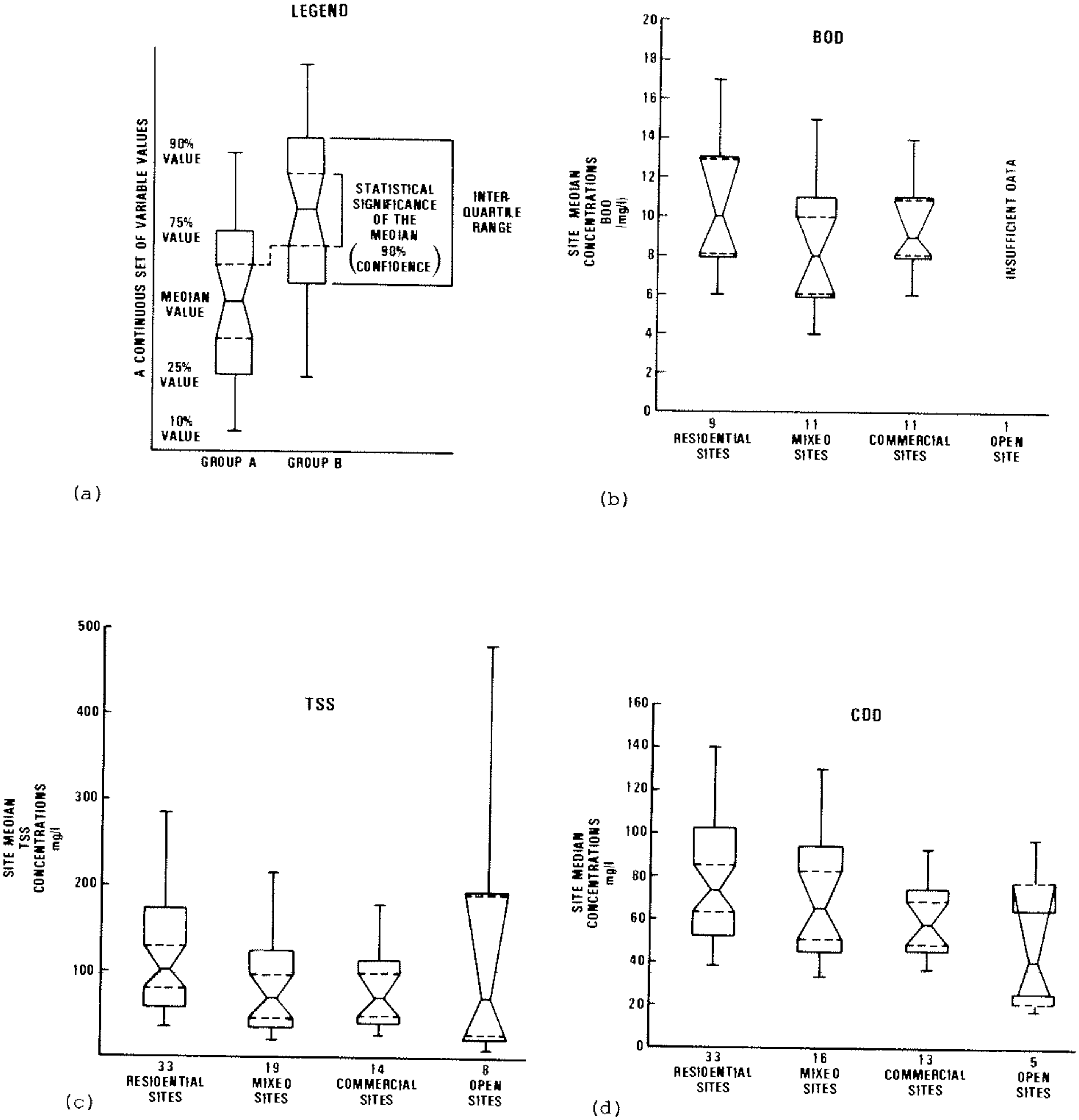
Some caution in the interpretation of the information presented in Table 6-12 is in order since statistical confidence limits are not given. These are indicated in Figure 6-17 (a through k), which illustrates land use differences graphically, with additional statistical detail derived from the basic parameters listed in Table 6-11, to assist in interpretation and comparisons. The box plots which compare characteristics of all sites within a land use category identify the land use, median EMC, its 90 percent confidence limits, and the 10, 25, 75 and 90 percent quantities for the sites. Careful perusal of these box plots leads one to the conclusion that only the open/non-urban land use category appears to be significantly different overall. Responses of the other land use categories are varied and inconsistent among constituents. This may be seen in a somewhat different way by observing the plotting positions of the land use categories presented in Figures 6-4 through 6-13. Here also, there are no consistent tendencies. There are undeniably some trends. For example, in Figure 6-7 commercial sites occupy the lowest plotting position at each project for total phosphorus (MI1 and one WI1 site are exceptions), which certainly suggests that there might be a land use category difference for this constituent.

Review of Figure 6-17(j), however, suggests that while a trend to lower total phosphorus EMC values is apparent as one goes from residential, to mixed, to commercial land uses, the statistical significance may not be great. The actual site median total phosphorus EMC probability density functions for each land use are presented in Figure 6-18. Here it can be seen that although three different pdfs can be drawn for residential, mixed, and commercial land use categories, their degree of overlap is so great that there is little statistical significance to the apparent difference. Since this was the strongest tendency towards land use effect, we must conclude that using this approach there is again no truly discernible and consistent effect of land use on the quality of urban runoff.

The one exception is the open/non-urban category which, as its name suggests, includes atypical sites. The data in Table 6-12 and the box plots of Figure 6-12 suggest that the pdfs for this land use category are quite different from those of the other land use categories, and this is in fact the case. Figure 6-18 shows it dramatically for total phosphorus.

Thus, regardless of the analytical approach taken, we are forced to conclude that, if land use category effects are present, they are eclipsed by the storm to storm variabilities and that, therefore, land use category is of little general use to aid in predicting urban runoff quality at unmonitored sites or in explaining site to site differences where monitoring data exist.

Correlation Between EMCs and Runoff Volume. To examine the possible relationship between the event mean concentration of a particular constituent and the runoff volume, linear correlation coefficients (r) were calculated. The null hypothesis that the two variables are linearly unrelated was tested at both the 90 and 95 percent confidence levels. Since it is possible for correlation to be either positive or negative, the two-tailed test was used. Failure to reject the null hypothesis is interpreted as meaning that linear dependency between the two variables in the population has not been shown.



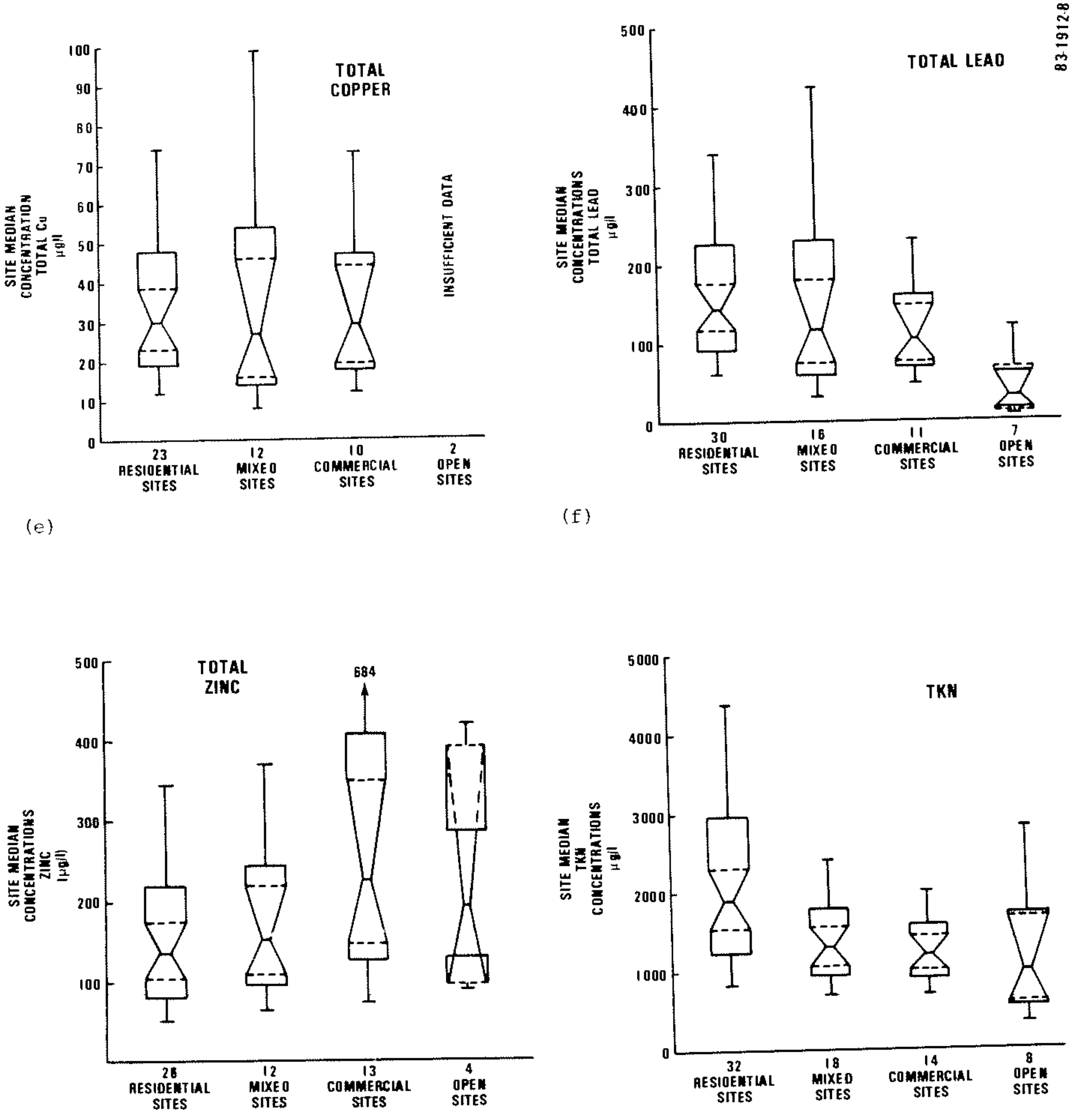
(a)

(b)

(c)

(d)

Figure 6-17. Box Plots of Pollutant EMCs for Different Land Uses



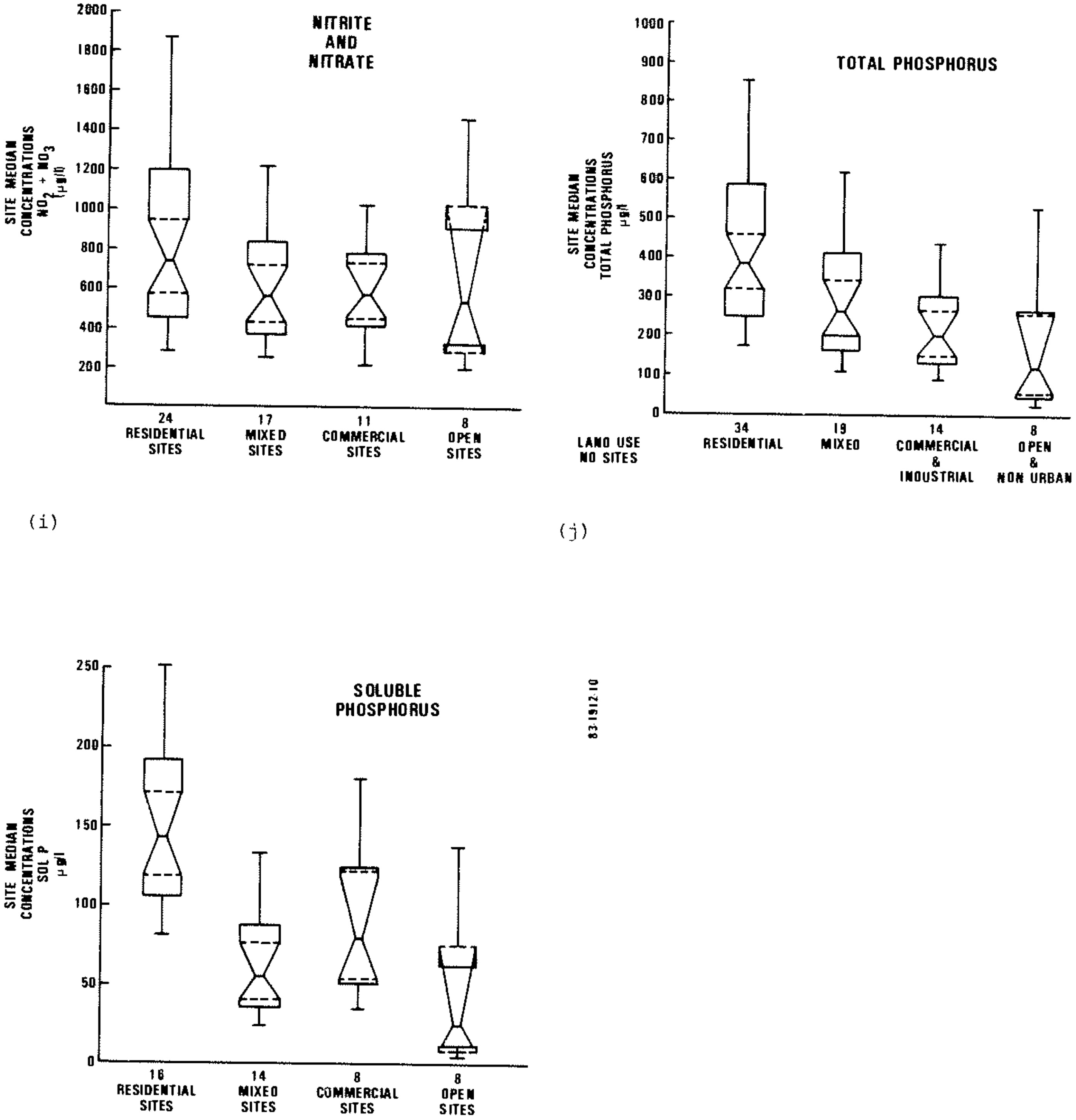
(e)

(f)

(g)

(h)

Figure 6-17. Box Plots of Pollutant EMCs for Different Land Uses (Cont'd)



(i)

(j)

(k)

Figure 6-17. Box Plots of Pollutant EMCs for Different Land Uses (Cont'd)

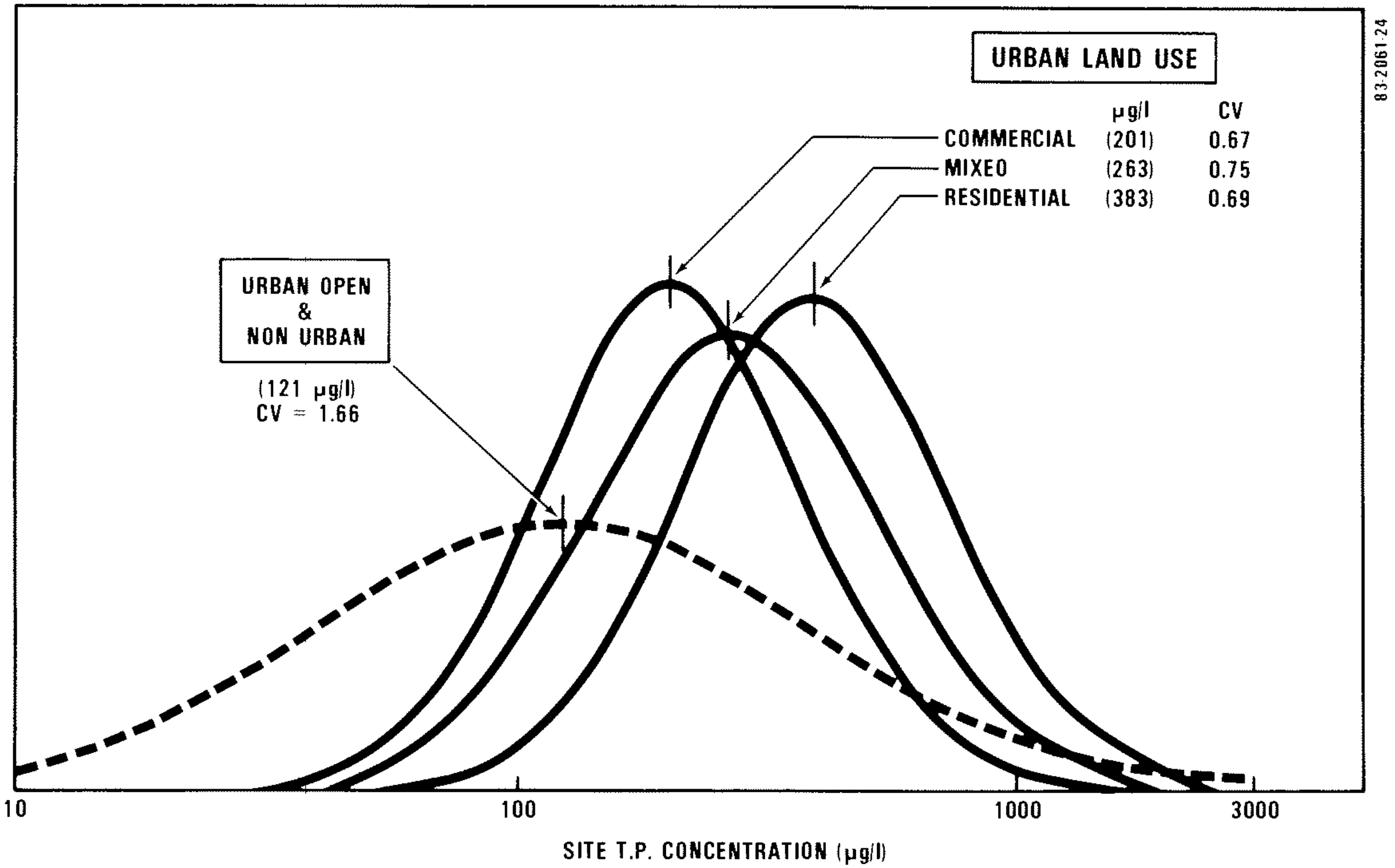


Figure 6-18. Site Median Total P EMC Probability Density Functions for Different Land Uses

The rejection of the null hypothesis means that there is evidence of a linear dependency between the two variables in the population, but it does not mean that a cause-and-effect relationship has been established.

General guidelines for the use of this test suggest that it be used with caution for values of n less than ten due to the high uncertainties associated with estimates of population variance with small samples. Furthermore, when n is 2 a perfect correlation will result but is meaningless. To include as many sites as possible in this examination, all constituents for which n was 5 or greater were included. At the other extreme, when n is very large, say over 100, correlation coefficients are almost always significant but can be so weak that they are meaningless. For n = 100 the critical value of r at the 90 percent confidence level is 0.164, meaning that the correlation explains less than 3 percent of the concentration variability.

A total of 67 sites from 20 of the NURP projects were examined for possible correlation for nine constituents. Of the 517 linear correlation coefficients calculated (not all constituents were measured at all sites), 116 (22 percent) were significant at the 95 percent confidence level and 154 (30 percent) were significant at the 90 percent confidence level. Of the r values that were significant, 83 and 87 percent were negative at the 90 and 95 percent confidence levels respectively. When sites with fewer than 10 events were dropped, the foregoing was essentially unchanged. Greater detail in terms of the number of significant linear correlation by constituent is provided in Table 6-13. There it can be seen that the greatest tendency for positive values of r occurs with TSS, followed by soluble phosphorus. The correlation coefficients for the other 7 constituents all strongly tend to be negative.

When the results are examined by sites, however, a clearer picture emerges. Although it can be correctly argued that unless a correlation coefficient is statistically significant the number is meaningless, it also follows that in such a case they are as likely to be positive as negative. On the other hand, if all the correlation coefficients (whether significant or not) have the same sign, it suggests a tendency for that site. The sign of the correlation coefficient (if greater than 0.1) for each site and constituent examined is given in Table 6-14. Giving appropriate weight to significant r values but considering others as well, some 37 of the sites tend to have negative correlations, 13 tend to be positive, and the remaining 17 tend to be mixed. Perusal of Table 6-14 reveals that this tendency for sites to have either positive or negative correlation coefficients is quite strong, especially for sites with a large number of significant correlations. Sites where erosion, scour, system lag, and such are present could be expected to exhibit a tendency towards positive correlations. Sites lacking such effects could be expected to have negative correlation due to dilution associated with larger runoff events.

The magnitude of the correlation coefficients is indicated in Table 6-15. Two points stand out in particular. First, the r values are not very large, averaging around 0.55. This means that the correlation is only able to explain about 30 percent of the concentration variability. The few high values are always associated with very few observations (n<10) for which the

TABLE 6-13. NUMBER OF SIGNIFICANT LINEAR CORRELATIONS BY CONSTITUENT

(a) ALL SITES							
POLLUTANT	TOTAL # OF SITES	90% SIGNIFICANT CORRELATION			95% SIGNIFICANT CORRELATION		
		TOTAL #	# NEG.	# POS.	TOTAL #	# NEG.	# POS.
TSS	67	13 (19%)	4	9	7 (10%)	3	4
COD	64	24 (38%)	23	1	19 (30%)	19	0
TOT. P	67	20 (30%)	16	4	15 (22%)	12	3
SOL. P	34	10 (29%)	6	4	7 (21%)	4	3
TKN	64	19 (30%)	18	1	14 (22%)	14	0
NO_{2+3}-N	57	17 (30%)	15	2	13 (23%)	11	2
TOT. Cu	49	17 (35%)	15	2	13 (27%)	12	1
TOT. Pb	59	15 (25%)	13	2	12 (20%)	11	1
TOT. Zn	56	19 (34%)	18	1	16 (29%)	15	1
TOTAL	517	154	128	26	116	101	15
PERCENT		30%	83%	17%	22%	87%	13%
(b) SITES WITH $n \geq 10$							
TSS	56	9 (16%)	4	5	7 (12%)	3	4
COD	52	21 (40%)	20	1	16 (31%)	16	0
TOT. P	53	17 (32%)	15	2	12 (23%)	11	1
SOL. P	23	8 (35%)	5	3	6 (26%)	4	2
TKN	50	17 (34%)	16	1	12 (24%)	12	0
NO_{2+3}-N	41	14 (34%)	12	2	12 (29%)	10	2
TOT. Cu	31	13 (42%)	12	1	12 (39%)	11	1
TOT. Pb	45	13 (29%)	12	1	11 (24%)	10	1
TOT. Zn	37	14 (38%)	13	1	11 (30%)	10	1
TOTAL	388	126	109	17	99	87	12
PERCENT		32%	87%	13%	26%	88%	12%

TABLE 6-14. SIGN OF CORRELATION COEFFICIENTS BY SITES

	TSS	COD	TOT. P	SOL. P	TKN	NO_{2+3}·N	TOT. CU	TOT. Pb	TOT. ZN
CA1 KNOX	+	−	+	⊕		⊕	−	−	
S. VIEW.	⊕	+			⊕		+	−	+
CO1 ASBURY	⊕	+	⊕	+	+	−	⊕	+	+
B. DRY C.		−	−	−	⊖	−	−		−
CHERRY			+	⊕		−	+		
N. AVE.		⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖
ROONEY	−	⊖	−	−	−	−	−	−	⊖
VILLA IT.	−	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖
116/C	+	−	⊕			−	+		+
DC1 DUFIEF	−	⊖	+	−	−	−			−
FAIRIDGE		+	+	+	+				+
LAKERIDGE	+		+	⊕		⊖		−	⊖
STEDWICK		−		+		⊖	+	−	⊖
STRATTON	+	−			+		−		−
WESTLEIGH		⊖			−	⊖	⊖	−	⊖
FL1 CHARTER/H	−	⊖	⊖		⊖	−	⊖	⊖	⊖
YOUNG		−	−			−	+		
NORMA P.	+	+				+			−
IL1 JOHN N.	+	⊖	⊖		⊖		−	−	
JOHN S.	+	⊖	⊖		−		−		
MATTIS N.		⊖	⊖		⊖		⊖	⊖	
MATTIS S.	−	⊖	⊖		⊖		⊖	⊖	
KS1 92nd	−	+	−	+	+				

	TSS	COD	TOT P.	SOL P	TKN	NO 2+3·N	TOT. CU	TOT. Pb	TOT. ZN
KS1 LENAXA	+	⊖	⊖	−	−		⊖		
METCALF		−	−	−	−		−		−
NOLAND		⊖	−	⊖			+	−	−
OVERTON	+		+				−	−	⊖
MA1 ANNA	+		+		+	−		−	+
CONVENT	−	+		+	−	−	+		+
JORDAN			+	+	−	⊖	−		⊖
LOCUST	⊕	+	⊕	+	+	⊖	+	⊕	
RT. 9	+			+	−	⊖	+	+	
MA2 ADDISON	⊕		−	−	+	−			
HEMLOCK	⊕		+	⊕	+	−			
MO1 BOLTON	⊕	−	+		−	−	⊖	+	−
HAMPDEN		−	⊖				⊖		−
HOMELAND	+	+	+		−	+	−	+	+
MT. WASH.	⊕	−	−		−	−	+	−	−
RES. HILL	+	⊖			⊖		⊖	−	−
MI1 GRACE S.	+	−	−		−	−	⊖	−	−
GRACE N.	+	−		+					⊖
GRAND		−	−		−		−	−	⊖
IND. DR.	+		+	+		−	−	−	−
WAVERLY		−	−	−	−	−	−		−
NC1 1013		⊖	⊖		⊖	⊖	⊖	⊖	⊖
1023	⊕		+			−	+		
NH1 PKG.	−	⊖	−		⊖	⊖	⊖	⊖	⊖

	TSS	COD	TOT. P	SOL. P	TKN	NO_{2+3}·N	TOT. CU	TOT. Pb	TOT. ZN
NY1 CARLL R.	+					⊖			
NY2 CEDAR				+		⊕		+	
NY3 CRANSTON	+	+	+		−			−	−
E. ROCH.	−	⊖	⊖		⊖			⊖	⊖
SOUTHGATE	+	−	+	−					−
TN1 CBD	⊖	−	⊖	⊖	⊖	−	⊖	⊖	⊖
R1	⊕	+	+	⊖	+	−	⊕	⊕	⊕
R2	+	−	−	−	⊖	−			−
SC	+		−	⊖	−	⊖		+	
TX1 HART	+	⊕			+	+			
R'WOOD.	−	+			⊖				
WA1 LAKE H.	−	⊖	−		⊖		+	⊖	⊖
SURREY D.	−	⊖	⊖		⊖			⊖	⊖
WI1 BURBANK		−	⊕						+
HASTINGS		⊖	−		+	+		⊖	−
LINCOLN		−	−			−		+	
POST D.	⊖	⊖	⊖		⊖	⊖		⊖	−
RUSTLER	⊖	⊖	−		⊖	⊖			−
STATE F.	⊖	⊖	⊖		−	⊖		−	+
WOOD C.					−	−			+

83-2061-33

\+ INDICATES A POSITIVE R VALUE

− INDICATES A NEGATIVE R VALUE

○ INDICATES A SIGNIFICANT R VALUE

BLANK INDICATES EITHER R LESS THAN 0.1 OR NO DATA

TABLE 6-15. CORRELATION COEFFICIENT VALUES BY SITE

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		TSS	COD	TOT. P	SOL. P	TKN	NO_{2+3}-N	TOT. CU	TOT. Pb	TOT. ZN
CA1	KNOX				.43		(.70)			
	S. VIEW.	(.57)				.49				
CO1	ASBURY	.58		(.84)				.58		
	B. DRY C.					-.47				
	CHERRY				(.10)					
	N. AVE.		(-.58)	(-.47)	(-.42)	(-.72)	(-.52)	(-.47)	(-.42)	(-.41)
	ROONEY		(-.78)							(-.75)
	VILLA IT.		(.70)	(-.58)	(-.67)	(-.69)	(-.44)	(-.46)	(-.55)	(-.61)
	116/C			(.85)						
OC1	DUFIEF		(.76)							
	FAIRIDGE									
	LAKERIDGE				(.42)		(-.28)			(-.41)
	STEDWICK						-.28			-.26
	STRATTON				-.2					
	WESTLEIGH		(.32)				-.38	(-.94)		(-.44)
FL1	CHARTER/H		(-.82)	.54	U	(.68)		-.54	(-.67)	-.58
	YOUNG				U					
	NORMA P.				U					
IL1	JOHN N.		-.31	(.39)	U	-.29	U			U
	JOHN S.		.36	(-.42)	U		U			U
	MATTIS N.		(-.84)	(.58)	U	(-.48)	U	(-.40)	(-.46)	U
	MATTIS S.		(-.81)	(-.56)	U	(.53)	U	(.34)	(-.46)	U
KS1	92nd				U		U			

		TSS	COD	TOT P.	SOL P	TKN	NO $_{2+3}$-N	TOT. CU	TOT. Pb	TOT. ZN
KS1	LENAXA		(-.70)	(.51)	U		U	-.80		
	METCALF		.40	-.40	U		U			
	NOLAND		(-.77)		(-.82)	U	U			
	OVERTON					U	U			(-.57)
MA1	ANNA									
	CONVENT									
	JORDAN						(.68)			(.74)
	LOCUST	.80		(.91)			-.82		.78	
	RT. 9						-.87			
MA2	ADDISON	.83	U							
	HEMLOCK	.85	U		(.94)					
MD1	BOLTON	(.50)			U			(-.47)		
	HAMPDEN			.42	U			(-.61)		
	HOMELAND				U					
	MT. WASH.	.42			U					
	RES. HILL		(-.79)		U	(-.58)		(-.55)		
MI1	GRACE S.							.70		
	GRACE N.									(.80)
	GRAND									-.51
	IND. DR.									
	WAVERLY									
NC1	1013		(-.58)	(-.49)	U	(-.57)	(.67)	(-.32)	(.29)	(.64)
	1023	(.32)			U					
NH1	PKG.		(-.58)		U	(.48)	(-.46)	(-.50)	(.41)	(-.58)

		TSS	COD	TOT. P	SOL. P	TKN	NO_{2+3}-N	TOT. CU	TOT. Pb	TOT. ZN
NY1	CARLL R.		U		U		(-.70)	U		
NY2	CEDAR		U				(.42)	U		
NY3	CRANSTON				U		U	U		
	E. ROCH.		(.79)	(-.84)	U	.70	U	U	(-.72)	(-.72)
	SOUTHGATE				U		U	U		
TN1	CBD	.48		(.82)	-.47	(.56)		(.51)	(-.51)	(.85)
	R1	(.82)			(-.62)			(.72)	(.85)	(.82)
	R2					(.81)				
	SC				(-.49)		(.85)			
TX1	HART		.57		U			U		
	R'WOOD.				U	(-.77)		U		
WA1	LAKE H.		(.33)		U	(-.34)			(-.29)	(.37)
	SURREY D.		(-.38)	(-.30)	U	(-.21)		U	(-.18)	(-.23)
WI1	BURBANK			.26	U			U		
	HASTINGS		(.49)		U			U	(-.32)	
	LINCOLN				U	U		U		U
	POST O.	(-.39)	(-.28)	.24	U	(-.48)	(-.53)	U	.23	
	RUSTLER	(-.37)	(.55)		U	.39	.37	U		
	STATE F.	(-.47)	(-.48)	(-.47)	U		(.72)	U		
	WOOD C.				U			U		

◯ INDICATES 95% LEVEL OF SIGNIFICANCE, OTHERS ARE AT THE 90% LEVEL

U INDICATES AN UNMEASURED CONSTITUENT

BLANK INDICATES NO SIGNIFICANT CORRELATION test is suspect since one or two events may dominate the correlation or otherwise cause it to be overstated due to uncertainties in parameter estimation. Second, only 25 percent of the sites account for over two-thirds of the significant correlations. In fact, 33 of the 67 sites had at most one significant correlation, 16 had 2 or 3, and 18 had 4 or more significant r values.

Data for the sites with many significant correlations are presented in Table 6-16. It can be noted that the r values for all constituents are around 0.55. Thus, there is no overall tendency to have strong correlations for some constituents and weak correlations for others. On a site by site basis, the strength of the apparent correlation varies inversely with n as does the significance requirement. Discounting the sites with very low or high values of n, however, the r values for the remainder are again around 0.55, which is the average for all 19 of these sites. Turning to land use, it is significant that half of the sites with many significant correlations have a large commercial/industrial component. Discounting sites with a small number of observations ($n \leq 12$), the sites in Table 6-16 are smaller (average size is 41 acres vs 126 acres for all sites), more impervious (average of 65 percent vs 40 percent for all sites), and have higher runoff coefficients (0.5 vs 0.3 for all sites). Thus, one could conjecture that their responses might tend to be somewhat less random and more ameanable to deterministic analysis (i.e., with conventional modeling approaches). Since they represent only around 25 percent of the total number of sites, however, and the correlations are rather weak, any effect of EMC correlation with runoff volume can be ignored without serious overall error.

This finding of no significant linear correlation between EMCs and runoff volumes is important for several reasons. First, in stormwater monitoring programs there is a natural and appropriate bias that favors emphasizing resource allocation to larger storm events. This was generally the case with the NURP projects as well. However, because of differences in local meteorological conditions, degree of site imperviousness, and other factors, there are appreciable differences in the average sizes of storms monitored by site in the NURP database. Since no significant linear correlation was found, such biases and differences are not expected to influence EMC comparisons to any appreciable extent.

Secondly, the probabilistic methodologies for examining receiving water impacts identified in Chapter 5 assume, as they are now structured, that concentration and runoff volume are independent (i.e., that there is no significant correlation). Although the methods can be modified to account for such correlations if they exist, the finding of no significant correlation indicates that such refinement is not warranted at this time.

Other Factors. We have not exhaustively analyzed all potential effects of other factors that might influence and hence modify our interpretations and conclusions regarding site differences. Factors such as slope, population density, soil type, seasonal bias in monitored events, and precipitation characteristics (average rainfall intensity, peak rainfall intensity, rainfall duration, time since last storm event, etc.) all have a potential

TABLE 6-16. SITES WITH MANY SIGNIFICANT CORRELATIONS

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		TSS	COD	TOT. P	SOL. P	TKN	NO_2+3-N	Cu	Pb	Zn	AVG r^2	AVG r	$\bar{n}$	LAND USE	% IMPERVIOUS	RUNOFF COEFFICIENT
CO1	NORTH AVE.	–	–.58	–.47	–.42	–.72	–.52	–.47	–.42	–.46	.28	52	32	30%C	50%	.239
	VILLA IT.	–	–.70	–.5B	–.67	–.69	–.44	–.46	–.55	–.65	.35	.59	27	100%C	91%	.927
OC1	WESTLEIGH	–	–.32	–	–	–	–.39	–.84	–	–.44	.29	.54	35	93%R	21%	.119
FL1	CHARTER'H	–	–.62	–.54	U	–.68	–	–.54	–.67	–.56	.37	.60	12	89%R	16%	.153
IL1	MATTIS N.	–	–.64	–.59	U	–.48	U	–.40	–.46	U	.27	.52	35	50%C	58%	.639
	MATTIS S.	–	–.61	–.55	U	–.53	U	–.34	–.46	U	.26	.51	33	90%R	37%	.330
KS1	LENAXA	–	–.70	–.51	U	–	U	–.80	–	–	.46	.68	16	50%I	44%	.540
MA																
1	LOCUST	.80	–	.91	–	–	–.82	–	.78	–	.69	.83	6	85%R	16%	.209
MO-																
1	RES. HILL	–	–.79	–	U	–.58	–	–.55	–	–	.42	.65	13	100%R	76%	.4B6
NC1	1013 (CBO)	–	–.58	–.46	U	–.57	–.67	–.32	–.29	–.54	.26	.51	61	100%C	69%	.791
NH1	PKG.	–	–.5B	–	U	–.49	–.46	–.50	–.41	–.58	.26	.51	33	100%C	90%	.658
NY3	E. ROCHESTER	–	–.79	–.84	U	–.70	U	U	–.72	–.72	.57	.76	8	100%R	38%	.195
TN1	CBO	–.48	–	–.62	–.47	–.56	–	–.51	–.51	–.65	.30	.55	15	100%C	99%	.206
	R1	.82	–	–	–.62	–	–	.72	.85	.82	.57	.77	11	91%R	33%	.032
WA-																
1	LAKE H.	–	–.33	–	U	–.34	U	U	–.29	–.37	.11	.33	126	91%R	37%	.199
	SURREY O.	–	–.34	–.30	U	–.21	U	U	–.18	–.23	.07	.26	118	100%R	29%	.177
WI1	P.O.	–.39	–.28	–.24	U	–.46	–.53	U	–.23	–	.14	.37	40	100%C	95%	.899
	RUSTLER	–.37	–.55	–	U	–.39	–.37	U	–	–	.18	.43	20	100%C	95%	.793
	STATE FAIR	–.47	–.48	–.47	U	–	–.72	U	–	–	.30	.55	25	74%C	77%	.622
	AVERAGE r^2	.34	.33	.29	.31	.30	.30	.31	.28	.32						
	AVERAGE r	.58	.58	.53	.55	.55	.55	.56	.53	.57						

influence on the median and variability of pollutant concentrations at a site.

On the basis of limited screening, however, we have concluded that such factors do not appear to have any real consistent significance in explaining observed similarities or differences among individual sites. Therefore, although more detailed and rigorous analysis and evaluation of the NURP database may well provide additional useful insight and understanding of the influence of such other factors, we do not believe that the basic findings and conclusions presented in this report will be significantly altered by the results of such efforts. Furthermore, the value of any such insights as may be developed are likely to have limited influence on general decisions on control of urban runoff. For example, the finding of a strong seasonal effect on EMC values would have little influence on a decision to require detention basins in all newly developing urban areas, nor would it be likely to influence their design.

Urban Runoff Characteristics

Having determined, as discussed in the preceding section, that geographic location, land use category, or other factors appear to be of little utility in explaining overall site-to-site variability or predicting the characteristics of unmonitored sites, the best general characterization of urban runoff can be obtained by pooling the site data for all sites (other than the open/non-urban ones). This approach is appropriate, given the need for a nationwide assessment and the general planning thrust of this report. Recognizing that there tend to be exceptions to any generalization, however realistic and appropriate, in the absence of better information the data given in Table 6-17 are recommended for planning level purposes as the best description of the characteristics of urban runoff.

TABLE 6-17. WATER QUALITY CHARACTERISTICS OF URBAN RUNOFF

Constituent	Event to Event Variability in EMC's (Coef Var)	Site Median EMC	
		For Median Urban Site	For 90th Percentile Urban Site
TSS (mg/l)	1-2	100	300
BOD (mg/l)	0.5-1.0	9	15
COD (mg/l)	0.5-1.0	65	140
Tot. P (mg/l)	0.5-1.0	0.33	0.70
Sol. P (mg/l)	0.5-1.0	0.12	0.21
TKN (mg/l)	0.5-1.0	1.50	3.30
NO_{2+3}-N (mg/l)	0.5-1.0	0.68	1.75
Tot. Cu (μg/l)	0.5-1.0	34	93
Tot. Pb (μg/l)	0.5-1.0	144	350
Tot. Zn (μg/l)	0.5-1.0	160	500

Coliform Bacteria

Coliform bacteria counts in urban runoff were monitored for a significant number of storm events by seven of the NURP projects at 17 different sites. Data were collected at twelve of these sites for more than five and up to 20 storm events. Data on either Fecal Coliform or both Fecal and Total Coliform counts are available for a total of 156 separate storm events. Although the data base for bacteria is thus considerably more restricted than for other pollutants, useful results have been obtained.

Table 6-18 summarizes the results of an analysis of these data. Some variability exists from site to site, and data are too limited to identify any land use distinctions. However, results from the different sites and projects are consistent in showing a very dramatic seasonal effect. Coliform counts in urban runoff during the warmer periods of the year are approximately 20 times greater than those in urban runoff that occurs during colder periods.

The substantial seasonal differences which are observed do not correspond with comparable variations in urban activities. This suggests that seasonal temperature effects and sources of coliform unrelated to those traditionally associated with human health risk may be significant.

In addition to the summarized data presented here, special study reports prepared by the Long Island and Baltimore projects address the issue of animal and other sources of coliform bacteria using information derived from field monitoring and the technical literature. The Baltimore NURP project also conducted small scale site studies which simulated washoff by storms and identified that quite substantial differences in coliform levels can result from the general cleanliness of an area, which they associate with the socio-economic strata of the neighborhood. A special study by the Long Island NURP project examined salmonella counts in urban runoff and in an adjacent shellfish area influenced by urban runoff. The Knoxville, TN project also conducted a special study on Salmonella. These project reports may be obtained through NTIS.

Other issues related to bacteria as a health risk were raised and warrant further investigation. A better understanding is needed of the contribution of domestic animals or such wildlife as may be expected in urban areas to observed coliform levels.

Though high levels of indicator microorganisms were found in urban runoff, the analysis as well as current literature suggests that indicators such as fecal coliform may not be useful in identifying health risks from urban runoff pollutions.

PRIORITY POLLUTANTS

ackground

he NURP priority pollutant monitoring project was conducted to evaluate the resence, concentration, and potential water quality impacts of priority polutants in urban runoff. A total of 121 urban runoff samples were collected

TABLE 6-18. FECAL COLIFORM CONCENTRATIONS IN URBAN RUNOFF

Project and Site		Warm Weather			Cold Weather		
		Site No. Obs	Median EMC (1000/ 100 ml)	C.V.	Site No. Obs	Median EMC (1000/ 100 ml)	C.V.
DC1	Burke	1	4.6	-	1	0.02	-
	Westleigh	1	46	-	2	0.35	-
	Stedwick	2	10	-	1	0.2	-
MD1	Homeland	7	11	1.8	-	-	-
	Mt Wash	1	130	-	1	3.3	-
	Res Hill	1	281	-	1	330	-
NC1	(CBD) 1013	11	15	1.6	8	1.0	0.6
	Res 1023	2	23	-	4	2.6	1.1
NH1	Pkg Lot	20	0.3	0.5	-	-	-
NY1	Carll	12	24	0.9	15	1.4	1.5
	Unqua	7	11	1.6	4	0.9	14
SD1	Meade	9	57	0.7	-	-	-
TN1	CBD	7	54	1.5	7	1.0	1.4
	R1	6	56	2.0	4	1.6	1.9
	R2	6	19	6.2	4	0.5	2.4
	SC	7	12	2.8	4	0.9	1.7
		76 Events			52 Events		
All Sites*		11	21	0.8	9	1	0.7

Notes:

* For general characterization of urban runoff, exclude the following sites:

- NH1 - A small (0.9A) Parking Lot; concentrations low and atypical.

- Four sites with only one observation for season; variability is too high for any confidence in representativeness of a single value.

at 61 sites (two storm events per site) in 20 of the NURP projects that participated in this phase of the program. These sites were predominantly in the residential, mixed, or commercial land use areas as defined earlier. Thus, the results of this effort cannot be attributed to runoff from industrial facilities or complexes. Furthermore, an especially exhaustive quality control component, over and above the standard NURP QA/QC effort, was imposed on the priority pollutant portion of the program, resulting in the rejection of nearly 14 percent of the data. Therefore, there is a high level of confidence in the results of this project.

Since only two samples were collected at each site, no meaningful site statistic could be calculated. Therefore the data were pooled for analysis. In view of the discussion in the preceding section, however, this approach seems to be justified.

A detailed compilation of NURP priority pollutant analytical results including city and site where the sample was collected, date of collection; discrete or composite sample, pH, and pollutant concentration can be found in the final report on the NURP Priority Pollutant Monitoring Program soon to be issued by the Monitoring and Data Support Division of the agency. A summary of the findings taken from the December 5, 1983 draft of that report follows.

Pollutants Not Included in NURP. Asbestos and dioxin were excluded from the NURP program. However, standard laboratory methods will reveal the presence of dioxin at concentrations of 1 to 10 µg/l, and most laboratories did scan their chromatograms for the possible presence of this pollutant. All such scans were negative, and on this basis dioxin is included as "not detected".

Results Not Valid. The NURP results for seven priority pollutants cannot be considered valid. Recent EPA investigation has revealed that standard methods are not appropriate for the measurement of hexachlorocyclopentadiene, dimethyl nitrosamine, diphenyl nitrosamine, benzidine, and 1,2-diphenylhydrazine. Two other pollutants, acrolein and acrylonitrile, must be analyzed within three days of sample collection. Such a time constraint was an impractical one for the NURP program.

Pollutants Detected in Runoff

Seventy-seven priority pollutants were detected in the NURP urban runoff samples. This group includes 14 inorganic and 63 organic pollutants (Table 6-19).

Inorganic Pollutants. As a group, the toxic metals are by far the most prevalent priority pollutant constituents of urban runoff. All 14 inorganics (13 metals, plus cyanides; asbestos excluded) were detected, and all but three at frequencies of detection greater than 10 percent. Most often detected among the metals were copper, lead, and zinc, all of which were found in at least 91 percent of the samples. Their concentrations were also among the highest for any pollutant, and reached a maximum of 100, 460, and 2,400 µg/l, respectively. Other frequently detected inorganics included arsenic, chromium, cadmium, nickel, and cyanide (Table 6-20). Twelve of the thirteen toxic metals (antimony excluded) were also sampled in the special

TABLE 6-19. SUMMARY OF ANALYTICAL CHEMISTRY FINDINGS FROM NURP PRIORITY POLLUTANT SAMPLES[1]

(Includes information received through September 30, 1983)

Pollutant	Cities Where Detected[2]	Frequency of Detection[3]	Range of Detected Concentrations (μg/ℓ)[4]
I. PESTICIDES			
1. Acrolein	Holding times exceeded		
2. Aldrin	4,7,26	6	0.002T-0.1M
3. α-Hexachlorocyclohexane (α-BHC) (Alpha)	7,8,22,26	20	0.002T-0.1M
4. β-Hexachlorocyclohexane (β-BHC) (Beta)	7,8	5	0.018-0.1M
5. γ-Hexachlorocyclohexane (γ-BHC) (Gamma) (Lindane)	7,8,22,26	15	0.007-0.1M
6. δ-Hexachlorocyclohexane (δ-BHC) (Delta)	7,26	6	0.004-0.1M
7. Chlordane	2,8,21,26	17	0.01L-10
8. DDD	Not detected		
9. DDE	26	6	0.007-0.027
10. DDT	7	1	0.1M
11. Dieldrin	26,27	6	0.002-0.1
12. α-Endosulfan (Alpha)	7,26,27	19	0.008-0.2
13. β-Endosulfan (Beta)	Not detected		
14. Endosulfan sulfate	Not detected		
15. Endrin	Not detected		
16. Endrin aldehyde	Not detected		
17. Heptachlor	7,8,27	6	0.01-0.1M
18. Heptachlor epoxide	7,26	2	0.003T-0.1M
19. Isophorone	7	3	10M
20. TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin)	Not included in NURP program		
21. Toxaphene	Not detected		
II. METALS AND INORGANICS			
22. Antimony	7,24,26	13	2.6-23A
23. Arsenic	2,3,7,12,19,20,21,22,26,27	52	1-50.5
24. Asbestos	Not included in NURP program		
25. Beryllium	7,12,20,21	12	1-49
26. Cadmium	1,2,3,7,12,20,21,27	48	0.1M-14
27. Chromium	1,2,7,8,12,17,19,20,21,22,26,27,28	58	1-190
28. Copper	1,2,3,4,7,8,12,17,19,20,21,22,23,26,27,28	91	1L-100
29. Cyanides	4,8,19,22,26,27	23	2-300
30. Lead	1,2,3,4,7,8,12,17,19,20,21,22,26,28	94	6-460
31. Mercury	7,20,28	9	0.6-1.2
32. Nickel	2,3,7,12,20,21,26,27	43	1-182
33. Selenium	7,19,23	11	2-77
34. Silver	3,17,27	7	0.2M-0.8
35. Thallium	7	6	1-14
36. Zinc	1,2,3,7,12,17,19,20,21,22,23,27,28	94	10-2400
III. PCBs AND RELATED COMPOUNDS			
37. PCB-1016 (Aroclor 1016)	Not detected		
38. PCB-1221 (Aroclor 1221)	Not detected		
39. PCB-1232 (Aroclor 1232)	Not detected		
40. PCB-1242 (Aroclor 1242)	Not detected		
41. PCB-1248 (Aroclor 1248)	Not detected		
42. PCB-1254 (Aroclor 1254)	Not detected		
43. PCB-1260 (Aroclor 1260)	2	1	0.03
44. 2-Chloronaphthalene	Not detected		

TABLE 6-19. SUMMARY OF ANALYTICAL CHEMISTRY FINDINGS FROM NURP PRIORITY POLLUTANT SAMPLES[1] (Cont'd)

(Includes information received through September 30, 1983)

Pollutant	Cities Where Detected[2]	Frequency of Detection[3]	Range of Detected Concentrations (µg/l)[4]
IV. HALOGENATED ALIPHATICS			
45. Methane, bromo- (methyl bromide)	Not detected		
46. Methane, chloro- (methyl chloride)	Not detected		
47. Methane, dichloro- (methylene chloride)	4,17,22	11	5-14.5A
48. Methane, chlorodibromo-	28	1	2
49. Methane, dichlorobromo-	28	1	2
50. Methane, tribromo - (bromoform)	28	1	1
51. Methane, trichloro- (chloroform)	4,17,20,22,23,27,28	9	0.27-12
52. Methane, tetrachloro- (carbon tetrachloride)	4,28	3	1-2
53. Methane, trichlorofluoro-[5]	2,4,24,28	5	0.61-27
54. Methane, dichlorodifluoro- (Freon-12)[5]	Not detected		
55. Ethane, chloro-	Not detected		
56. Ethane, 1,1-dichloro-	4,28	3	1.5A-3
57. Ethane, 1,2-dichloro-	28	1	4
58. Ethane, 1,1,1-trichloro-	4,2,7,22,24	6	1.6-30M
59. Ethane, 1,1,2-trichloro-	28	2	2-3
60. Ethane, 1,1,2,2-tetrachloro-	4	2	20-3
61. Ethane, hexachloro-	Not detected		
62. Ethene, chloro- (vinyl chloride)	Not detected		
63. Ethene, 1,1-dichloro-	28	2	1.5-4
64. Ethene, 1,2-trans-dichloro-	20,28	4	1-3
65. Ethene, trichloro-	2,4,8,24,28	6	0.37-12
66. Ethene, tetrachloro-	8,17,22,28	5	19-43
67. Propane, 1,2-dichloro-	28	1	3
68. Propene, 1,3-dichloro-	28	2	1-2
69. Butadiene, hexachloro-	Not detected		
70. Cyclopentadiene, hexachloro-	Standard methods inappropriate		
V. ETHERS			
71. Ether, bis(chloromethyl)[5]	Not detected		
72. Ether, bis(2-chloroethyl)	Not detected		
73. Ether, bis(2-chloroisopropyl)	Not detected		
74. Ether, 2-chloroethyl vinyl	Not detected		
75. Ether, 4-bromophenyl phenyl	Not detected		
76. Ether, 4-chlorophenyl phenyl	Not detected		
77. Bis(2-chloroethoxy) methane	Not detected		
VI. MONOCYCLIC AROMATICS (EXCLUDING PHENOLS, CRESOLS, PHTHALATES)			
78. Benzene	4,17,27	5	1-13
79. Benzene, chloro-	7,20,26,28	5	10-10M
80. Benzene, 1,2-dichloro-	Not detected		
81. Benzene, 1,3-dichloro-	Not detected		
82. Benzene, 1,4-dichloro-	Not detected		
83. Benzene, 1,2,4-trichloro-	Not detected		
84. Benzene, hexachloro-	Not detected		
85. Benzene, ethyl-	4,8,17,20,26,28	6	1-7
86. Benzene, nitro-	Not detected		
87. Toluene	4,17	3	2-9
88. Toluene, 2,4-dinitro-	Not detected		
89. Toluene, 2,6-dinitro	Not detected		

TABLE 6-19. SUMMARY OF ANALYTICAL CHEMISTRY FINDINGS FROM NURP PRIORITY POLLUTANT SAMPLES[1] (Cont'd)

(Includes information received through September 30, 1983)

Pollutant	Cities Where Detected[2]	Frequency of Detection[3]	Range of Detected Concentrations (µg/l)[4]
VII. PHENOLS AND CRESOLS			
90. Phenol	4,7,26	14	1T-15T
91. Phenol, 2-chloro-	28	1	2
92. Phenol, 2,4-dichloro-	Not detected		
93. Phenol, 2,4,6-trichloro-	Not detected		
94. Phenol, pentachloro-	4,8,19,20,26,27,28	19	1T-115
95. Phenol, 2-nitro-	8	1	1M
96. Phenol, 4-nitro-	4,7,8,20,26,28	10	1T-37
97. Phenol, 2,4-dinitro-	Not detected		
98. Phenol, 2,4-dimethyl-	4,7,8,26	8	1T-10M
99. m-Cresol, p-chloro-	4	1	1.5A
100. o-Cresol 4,6-dinitro-	Not detected		
VIII. PHTHALATE ESTERS			
101. Phthalate, dimethyl	8	1	1L
102. Phthalate, diethyl	3,4,17,20,21	6	1-10M
103. Phthalate, di-n-butyl	4,22,24	6	0.5T-11
104. Phthalate, di-n-octyl	8,20,26,27,28	6	0.4T-20
105. Phthalate, bis(2-ethylhexyl)	4,12,14,22,21,26	22	4T-62
106. Phthalate, butyl benzyl	2,8,26	6	1-10M
IX. POLYCYCLIC AROMATIC HYDROCARBONS			
107. Acenaphthene	Not detected		
108. Acenaphthylene	Not detected		
109. Anthracene	2,17,20,21,26,28	7	1-10M
110. Benzo (a) anthracene	2,21,27	4	1-10M
111. Benzo (b) fluoranthene	26,27	5	1-5
112. Benzo (k) fluoranthene	2,21,27	3	4-14
113. Benzo (g,h,i) perylene	21	1	5
114. Benzo (a) pyrene	2,21,26,27	6	1-10M
115. Chrysene	2,7,17,21,26,27	10	0.6T-10M
116. Dibenzo (a,h) anthracene	21	1	1T
117. Fluoranthene	2,8,12,17,21,26,27,28	16	0.3T-21
118. Fluorene	20	1	1
119. Indeno (1,2,3-c,d) pyrene	21	1	4
120. Naphthalene	4,24,26,28	9	0.8T-2.3
121. Phenanthrene	2,8,17,20,21,26,27,28	12	0.3T-10M
122. Pyrene	2,3,8,12,17,21,26,27,28	15	0.3T-16

TABLE 6-19. SUMMARY OF ANALYTICAL CHEMISTRY FINDINGS FROM NURP PRIORITY POLLUTANT SAMPLES[1] (Cont'd)

(Includes information received through September 30, 1983)

Pollutant	Cities Where Detected[2]	Frequency of Detection[3]	Range of Detected Concentrations (µg/ℓ)[4]
X. NITROSAMINES AND OTHER NITROGEN-CONTAINING COMPOUNDS			
123. Nitrosamine, dimethyl (DMN)	Standard methods inappropriate		
124. Nitrosamine, diphenyl	Standard methods inappropriate		
125. Nitrosamine, di-n-propyl	Not detected		
126. Benzidine	Standard methods inappropriate		
127. Benzidine, 3,3'-dichloro-	Not detected		
128. Hydrazine, 1,2-diphenyl-	Standard methods inappropriate		
129. Acrylonitrile	Holding times exceeded		

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[1] Based on 121 sample results received as of 9/30/83, adjusted for quality control review.

[2] Cities from which data are available:

1. Durham, NH
2. Lake Quinsigamond, MA
3. Mystic River, MA
4. Long Island, NY
7. Washington, DC
8. Baltimore, MD
12. Knoxville, TN
17. Glen Ellyn, IL
19. Austin, TX
20. Little Rock, AR
21. Kansas City, KS
22. Denver, CO
23. Salt Lake City, UT
24. Rapid City, SD
26. Fresno, CA
27. Bellevue, WA
28. Eugene, OR

Numbering of cities conforms to NURP convention.

[3] Percentages rounded to nearest whole number.

[4] Some reported concentrations are qualified by STORET quality control remark codes, to wit: A = Value reported is the mean of two or more determinations; G = Value reported is the maximum of two or more determinations; L = Actual value is known to be greater than value given; M = Presence of material verified but not quantified; T = Value reported is less than criteria of detection. One value in this column indicates one positive observation or that all observations were equal.

[5] No longer included as a priority pollutant.

TABLE 6-20. MOST FREQUENTLY DETECTED PRIORITY POLLUTANTS IN NURP URBAN RUNOFF SAMPLES[1]

Priority Pollutants Detected in 75 Percent or More of the NURP Samples

	Inorganics		Organics
30.	Lead (94%)		None
36.	Zinc (94%)		
28.	Copper (91%)		

Priority Pollutants Detected in 50 percent to 74 percent of the NURP Samples

	Inorganics		Organics
27.	Chrominum (58%)		None
23.	Arsenic (52%)		

Priority Pollutants Detected in 20 percent to 49 percent of the NURP Samples

	Inorganics		Organics
26.	Cadmium (48%)	105.	Bis(2-ethylhexyl) phthalate (22%)
32.	Nickel (43%)	3.	α-Hexachlorocyclohexane (20%)
29.	Cyanides (23%)		

Priority Pollutants Detected in 10 percent to 19 percent of the NURP Samples

	Inorganics		Organics
22.	Antimony (13%)	12.	α-Endosulfan (19%)
25.	Beryllium (12%)	94.	Pentachlorophenol (19%)
33.	Selenium (11%)	7.	Chlordane (17%)
		5.	γ-Hexachlorocyclohexane (Lindane) (15%)
		122.	Pyrene (15%)
		90.	Phenol (14%)
		121.	Phenanthrene (12%)
		47.	Dichloromethane (methylene chloride) (11%)
		96.	4-Nitrophenol (10%)
		115.	Chrysene (10%)
		117.	Fluoranthene (16%)

[1] Based on 121 sample results received as of September 30, 1983, adjusted for quality control review. Does not include special metals samples.

metals project in order to determine the relationships among dissolved, total, and total recoverable concentrations. The discussion and result of this separate effort are in a subsequent section of this chapter.

A comparison of individual urban runoff sample concentrations undiluted by stream flow (i.e., end of pipe concentrations) with EPA water quality criteria and drinking water standards reveals numerous exceedances of these levels, as shown in Table 6-21. Freshwater acute criteria were exceeded by copper concentrations in 47 percent of the samples and by lead in 23 percent. Freshwater chronic exceedances were common for lead (94 percent), copper (82 percent), zinc (77 percent), and cadmium (48 percent). One organ oleptic (taste and odor) criteria exceedance was observed. Regarding human toxicity, the most significant pollutant was lead. Lead concentrations violated drinking water criteria in 73 percent of the observations.

Whenever an exceedance is noted above, it does not necessarily imply that an actual violation of criteria did or will take place in receiving waters. Rather, the enumeration of exceedances is used as a screening procedure to make a preliminary identification of those pollutants for which their presence in urban runoff requires highest priority for further evaluation. Exceedances of freshwater chronic criteria levels may not persist for a full 24-hour period, for example. However, many small urban streams probably carry only slightly diluted runoff following storms, and acute criteria or other exceedances may in fact be real in such circumstances.

Among the inorganics, the most frequently detected pollutants are also those which are found at the highest concentrations, which most frequently exceed water quality criteria and which are the most geographically well-distributed. One additional observation can be made concerning the samples from Washington, D.C. These samples accounted for a preponderance of the detections of many of the less frequently detected inorganics, including antimony, beryllium, mercury, nickel, selenium, and thallium. No sampling or analytical irregularities have been identified which explain this result.

Organic Pollutants. In general, the organic pollutants were detected less frequently and at lower concentrations than the inorganic pollutants. Sixty-three of a possible 106 organics were detected. The most commonly found organic was the plasticizer bis (2-ethylhexyl) phthalate (22 percent) followed by the pesticide α-hexachlorocyclohexane (α-BHC) (20 percent). An additional 11 organic pollutants were reported with detection frequencies between 10 and 20 percent; 3 pesticides, 3 phenols, 4 polycyclic aromatics, and a single haloginated aliphatic (Table 6-20).

Criteria exceedances were less frequently observed among the organics than the inorganics. One unusually high pentachlorophenol concentration of 115 µg/l resulted in the only exceedance of the organoleptic criteria (Table 6-21). This observation and one for the chlordane exceeded the freshwater acute criteria. Freshwater chronic criteria exceedances were observed for pentochlorophenol, bis (2-ethylhexyl) phthalate, γ-hexachlorocyclohexane (Lindane), α-endosulfan, and chlordane. All other organic exceedances were in the human carcinogen category and were most serious for α-hexachlorocyclohexane (α-BHC), γ-hexachlorocyclohexane (γ-BHC or Lindane), chlordane, phenanthrene, pyrene, and chrysene.

TABLE 6-21. SUMMARY OF WATER QUALITY CRITERIA EXCEEDANCES FOR POLLUTANTS DETECTED IN AT LEAST 10 PERCENT OF NURP SAMPLES: PERCENTAGE OF SAMPLES IN WHICH POLLUTANT CONCENTRATIONS EXCEED CRITERIA[1]

Pollutant	Frequency of Detection (%)	Detections/ Samples[2]	Criteria Exceedances (%)[3]						
			None	FA	FC	TO	HH	HC[4]	DW
I. PESTICIDES									
3. α-Hexachlorocyclohexane	20	21/106						8,18,20	
5. γ-Hexachlorocyclohexane (Lindane)	15	15/100			8			0,10,15	
7. Chlordane	17	7/42		2	17			17,17,17	
12. α-Endosulfan	19	9/49			19				
II. METALS AND INORGANICS									
22. Antimony	13	14/106	X						
23. Arsenic	52	45/87						52,52,52	1
25. Beryllium	12	11/94			6*			12,12,12	
26. Cadmium[5]	48	44/91		8	48		1		1
27. Chromium[5,6]	58	47/81			1*				1
28. Copper[5]	91	79/87		47	82				
29. Cyanides	23	16/71		3	22		4		
30. Lead[5]	94	75/80		23	94		73		73
32. Nickel[5]	43	39/91			5		21		
33. Selenium	11	10/88			5		10		10
36. Zinc[5]	94	88/94		14	77				
IV. HALOGENATED ALIPHATICS									
47. Methane, dichloro-	11	3/28						0,0,11	
VII. PHENOLS AND CRESOLS									
90. Phenol	14	13/91	X						
94. Phenol, pentachloro-	19	21/111		1*	11*	1			
96. Phenol, 4-nitro-	10	11/107	X						
VIII. PHTHALATE ESTERS									
105. Phthalate, bis(2-ethylhexyl)	22	15/69			22*				
IX. POLYCYCLIC AROMATIC HYDROCARBONS									
115. Chrysene	10	11/109						10,10,10	
117. Fluoranthene	16	17/109	X						
121. Phenanthrene	12	13/110						12,12,12	
122. Pyrene	15	16/110						15,15,15	

* Indicates FTA or FTC value substituted where FA or FC criterion not available (see below).

[1] Based on 121 sample results received as of September 30, 1983, adjusted for quality control review.

[2] Number of times detected/number of acceptable samples.

[3] FA = Freshwater ambient 24-hour instantaneous maximum criterion ("acute" criterion).
FC = Freshwater ambient 24-hour average criterion ("chronic" criterion).
FTA = Lowest reported freshwater acute toxic concentration. (Used only when FA is not available.)
FTC = Lowest reported freshwater chronic toxic concentration. (Used only when FC is not available.)
TO = Taste and odor (organoleptic) criterion.
HH = Non-Carcinogenic human health criterion for ingestion of contaminated water and organisms.
HC = Protection of human health from carcinogenic effects for ingestion of contaminated water and organisms.
DW = Primary drinking water criterion.

[4] Entries in this column indicate exceedances of the human carcinogen value at the 10^{-5}, 10^{-6}, and 10^{-7} risk level, respectively. The numbers are cumulative, i.e., all 10^{-5} exceedances are included in 10^{-6} exceedances, and all 10^{-6} exceedances are included in 10^{-7} exceedances.

[5] Where hardness dependent, hardness of 100 mg/l $CaCO_3$ equivalent assumed.

[6] Different criteria are written for the trivalent and hexavalent forms of chromium. For purposes of this analysis, all chromium is assumed to be in the less toxic trivalent form.

An additional 50 organic pollutants were found in one to nine percent of the samples. These frequencies of detection are low, and the pollutant is noted in Table 6-22.

Among the PCB group, there was only a single detection of one PCB type among all the samples. Approximately two-thirds of the halogenated aliphatic compounds were detected. Among those cities reporting these compounds, the city of Eugene, Oregon, figured prominently. For example, eight pollutants from this group were found in Eugene only. None of the pollutants in the ethers group were detected.

Monocyclic aromatics were rarely detected in the samples. However, many reported detections of benzene and toluene, two commonly reported pollutants, had to be withdrawn due to contamination problems.

Of the 11 phenolics, four have not been reported in urban runoff, while three have been observed only once. The remaining four have been found fairly frequently but at low concentrations. Exceedances of criteria were noted only for pentachlorophenol.

All the phthalate esters were detected at least once in the NURP program, with bis (2-ethylhexyl) found most frequently. Several times the reported concentration exceeded the lowest observed freshwater acute toxic concentration for this pollutant. Given the significant blank contamination problems with the phthalates, however, these findings must be interpreted with caution.

Only two of the polycyclic aromatic hydrocarbons were not detected in at least one sample. Crysene, phenanthrene, pyrene, and fluoranthene were each found at least 10 percent of the time. All the observed concentrations for the first three of these pollutants exceeded the criteria for the protection of human health from carcinogenic effects (there are no such criteria for fluoranthene). Results for the polycyclic aromatics were generally free from quality control problems.

There were no detections of nitrosamines or other nitrogen-containing compounds. Due to methodological and holding time problems, however, results for only two compounds can be used. Moreover, for one of these compounds, 3,3-dichlorobenzidine, performance evaluation results were unacceptable in several cases.

Pollutants Not Detected In Urban Runoff

Some 43 priority pollutants were not detected in any acceptable runoff samples (Table 6-22). All of these pollutants are organics. This group of substances should be considered to pose a minimal threat to the quality of surface waters from runoff contamination.

While the priority pollutants which were not detected are of less immediate concern than those pollutants found often, they cannot safely be eliminated from all future consideration. Many of these pollutants have associated water quality criteria which are below the limits of detection of routine

TABLE 6-22. INFREQUENTLY DETECTED ORGANIC PRIORITY POLLUTANTS IN NURP URBAN RUNOFF SAMPLES[1]

Priority Pollutants Detected in 1 percent to 9 percent of the NURP Samples

51. Trichloromethane (9%)
120. Naphthalene (9%)
98. 2,4-Dimethyl phenol (8%)
109. Anthracene (7%)
2. Aldrin (6%)
6. δ-Hexachlorocyclohexane (6%)
9. DDE (6%)
11. Dieldrin (6%)
17. Heptachlor (6%)
58. 1,1,1-Trichloroethane (6%)
65. Trichloroethene (6%)
85. Ethylbenzene (6%)
102. Diethyl phthalate (6%)
103. Di-n-butyl phthalate (6%)
104. Di-n-octyl phthalate (6%)
106. Butyl benzyl phthalate (6%)*
114. Benzo(a)pyrene (6%)
4. β-Hexachlorocyclohexane (5%)
53. Trichlorofluoromethane (5%)[2]
66. Tetrachloroethene (5%)
78. Benzene (5%)
79. Chlorobenzene (5%)
111. Benzo(b)fluoranthene (5%)*
64. 1,2-*trans*-dichloroethene (4%)
110. Benzo(a)anthracene (4%)
19. Isophorone (3%)
52. Tetrachloromethane (carbon tetrachloride) (3%)
56. 1,1-Dichloroethane (3%)
87. Toluene (3%)
112. Benzo(k)fluoranthene (3%)
18. Heptachlor epoxide (2%)*
59. 1,1,2-Trichloroethane (2%)*
60. 1,1,2,2-Tetrachloroethane (2%)*
63. 1,1-Dichloroethene (2%)
68. 1,3-Dichloropropene (2%)*
113. Benzo(g,h,i)perylene (2%)
10. DDT (1%)*
43. PCB-1260 (1%)*
48. Chlorodibromomethane (1%)*
49. Dichlorobromomethane (1%)*
50. Tribromomethane (bromoform) (1%)*
57. 1,2-Dichloroethane (1%)*
67. 1,2-Dichloropropane (1%)*
91. 2-Chlorophenol (1%)*
95. 2-Nitrophenol (1%)*
99. p-Chloro-m-creosol (1%)*
101. Dimethyl phthalate (1%)*
116. Dibenzo(a,h)anthracene (1%)*
118. Fluorene (1%)*
119. Indeno(1,2,3-cd)pyrene (1%)*

TABLE 6-22. INFREQUENTLY DETECTED ORGANIC PRIORITY POLLUTANTS IN NURP URBAN RUNOFF SAMPLES[1] (Cont'd)

Priority Pollutants Not Detected in NURP Samples

8. DDD
13. β-Endosulfan
14. Endosulfan sulfate
15. Endrin
16. Endrin aldehyde
21. Toxaphene
37. PCB-1016
38. PCB-1221
39. PCP-1232
40. PCB-1242
41. PCB-1248
42. PCB-1254
44. 2-Chloronaphthalene
45. Bromomethane (methyl bromide)
46. Chloromethane (methyl chloride)
54. Dichlorodifluoromethane (Freon-12)[2]
55. Chloroethane
61. Hexachloroethane
62. Chloroethene (vinyl chloride)
69. Hexachlorobutadiene
71. Bis(chloromethyl) ether[2]
72. Bis(chloroethyl) ether
73. Bis(chloroisopropyl) ether
74. 2-Chloroethyl vinyl ether
75. 4-Bromophenyl phenyl ether
76. 4-Chlorophenyl phenyl ether
77. Bis(2-chloroethoxy) methane
80. 1,2-Dichlorobenzene
81. 1,3-Dichlorobenzene
82. 1,4-Dichlorobenzene
83. 1,2,4-Trichlorobenzene
84. Hexachlorobenzene
86. Nitrobenzene
88. 2,4-Dinitrotoluene
89. 2,6-Dinitrotoluene
92. 2,4-Dichlorophenol
93. 2,4,6-Trichlorophenol
97. 2,4-Dinitrophenol
100. 4,6-Dinitro-o-cresol
107. Acenaphthene
108. Acenaphthylene
125. Di-n-propyl nitrosamine
127. 3,3'-Dichlorobenzidine

TABLE 6-22. INFREQUENTLY DETECTED ORGANIC PRIORITY POLLUTANTS IN NURP URBAN RUNOFF SAMPLES[1] (Cont'd)

Priority Pollutants Not Analyzed for or Withdrawn for Methodological Reasons or Holding Time Violations

1. Acrolein
20. TCDD (Dioxin)
24. Asbestos
70. Hexachlorocyclopentadiene
123. Dimethyl nitrosamine (DMN)
124. Diphenyl nitrosamine
126. Benzidine
128. 1,2-Diphenyl hydrazine
129. Acrylonitrile

* Detected in only one or two samples.

[1] Based on 121 sample results received as of September 30, 1983, adjusted for quality control review.

[2] No longer on the priority pollutant list.

analytical methods. Some of these substances may in fact have been present in the NURP samples. Four priority pollutants not detected in runoff were found in street dust sweepings from Bellevue, Washington, suggesting that further urban runoff samplings can be expected to detect more priority pollutants. More sensitive analytical methodologies must be used and dilution effects considered before it can be said with assurance that these pollutants are not found in urban stormwater runoff at levels which, without dilution, pose a threat to human health or aquatic life.

DDD, chloromethane, 1,2-dichlorobenzene, and 2,4-dichlorophenol were detected in runoff samples at least once, but these observations had to be withdrawn for quality control reasons. Therefore, among the not detected pollutants, these four can be considered to have a slightly elevated possibility of actually being present in the runoff samples.

RUNOFF-RAINFALL RELATIONSHIPS

A runoff coefficient (Rv), defined as the ratio of runoff volume to rainfall volume, has been determined for each of the monitored storm events. As with the EMCs, the runoff coefficient values at a particular site are, with relatively few exceptions, well characterized by a lognormal distribution. Table 6-23 summarizes the statistical properties of Rv's at the loading sites in the data base.

Figure 6-19 illustrates the relationship between percent impervious area and the median runoff coefficient for the site. Sites which monitored fewer than 5 storms are excluded. The upper plot (a) groups the results from 16 of the

TABLE 6-23. RUNOFF COEFFICIENTS FOR LAND USE SITES

Residential

	Site	Land Use Res	No. of Events	Drainage Area (Ac)	Population Density (Pers/Acre)	Imperv.	Runoff Coef (Rv) Median	Coef Var
1	CO1 [illegible]	100	26	33	19	[illegible]	[illegible]	.27
2	CO1 [illegible]	100	25	[illegible]	24	36	[illegible]	.35
3	[illegible]	100	24	167	14	[illegible]	[illegible]	4
4	CC1 Gullet	100	67	17	2	19	.06	[illegible]
5	DC1 Coleridge	100	48	68	1	[illegible]	.18	[illegible]
6	DC1 Stratton	100	31	2	[illegible]	[illegible]	[illegible]	.97
7	KL1 [illegible]	100	17	5	-	-	.05	.64
8	[illegible] N	100	27	63	15	19	.13	[illegible]
9	LS1 Overlap	100	11	58	9	18	.09	.11
10	MA2 Seldon	100	6	50	5	16	.15	.16
11	MD1 [illegible] Hill	100	15	14	30	11	.44	[illegible]
12	MD1 Homeland	100	25	29	9	29	[illegible]	.28
13	MD1 Mt Wash	100	20	17	12	29	.14	1.25
14	MD1 Pea Hill	100	11	10	55	26	.41	.54
15	[illegible] Carll's W.	100	29	73	13	20	.21	.51
16	NI2 [illegible]	100	11	166	5	27	.18	.35
17	NI2 [illegible]	100	9	146	1M	35	.20	.42
18	[illegible] Rollingwood	100	9	60	3	[illegible]	.02	.29
19	WA1 Surrey	100	134	95	9	29	14	56
20	WI1 Burbank	100	44	13	15	50	.17	.47
21	WI1 Hastings	100	33	33	17	51	.27	.37
22	[illegible]	95	34	175	N	40	.09	.95
23	WI1 Lincoln	97	19	30	10	57	.21	.55
24	TN1 17	96	21	89	4	13	.01	.67
25	DC1 [illegible]	93	14	41	3	21	.12	1.15
26	KS1 [illegible]	92	14	61	-	[illegible]	.05	1.09
27	[illegible] John S.	91	20	39	12	12	.17	.54
28	TN1 R1	91	9	99	13	32	.01	98
29	WA1 Lake Hills	91	[illegible]	102	12	37	.20	.51
30	[illegible] Mathis	90	20	28	22	[illegible]	.13	.16
31	FL1 Charter M.	89	11	42	-	36	[illegible]	4.65
32	OL1 [illegible]	3M	44	19	-	34	.15	1.27
33	CO1 Asbury	86	16	127	9	[illegible]	.19	.97
34	[illegible]	86	29	574	8	[illegible]	.17	.48
35	MA1 Locust	85	6	154	11	15	.21	.33
36	NC1 [illegible]	84	63	374	1	[illegible]	[illegible]	[illegible]
37	MA1 Jordan	79	9	1111	10	21	[illegible]	.15
38	DC1 [illegible]	[illegible]	45	[illegible]	15	14	.20	1.07

Mixed

	Site	Land Use	No. of Events	Drainage Area (Acs)	Population Density (Pers/Acre)	Imperv	Runoff Coef (Rv) Median	Coef Var
1	[illegible]	-	25	28	3	66	.09	1.04
2	[illegible]	-	22	[illegible]	40	72	.29	.51
3	[illegible]	-	[illegible]	17	[illegible]	56	.64	.57
4	[illegible] Waverly	-	35	32	11	68	.06	.25
5	TN1 [illegible]	-	12	157	3	43	.14	.46
6	WI1 [illegible]	-	44	45	14	51	.26	.42
7	MA1 [illegible]	-	[illegible]	332	-	33	.20	.99
8	MA1 [illegible]	-	6	109	1	77	.50	.36
9	MI1 Grand & Ot	-	23	453	5	36	.31	.50
10	[illegible]	-	15	194	-	-	.91	1.12
11	MI1 [illegible] AA-S	-	6	2001	-	21	.29	.41
12	[illegible] Cedar	-	12	76	-	9	.08	1.05
13	[illegible]	-	15	30	-	12	.32	1.03
14	MA1 [illegible]	-	6	603	9	12	.17	1.64
15	MI1 [illegible] AA-N	-	6	2671	7	26	.10	.43
16	MI1 [illegible]	-	23	164	5	26	.11	.41
17	[illegible] Swift Run	-	5	1107	1	4	21	.18
18	SD1 Meade	-	12	2030	-	-	10	.57
19	[illegible]	-	42	1690	12	-	.26	.71
20	CO1 North Ave	-	33	19	1	50	.24	.59

Commercial

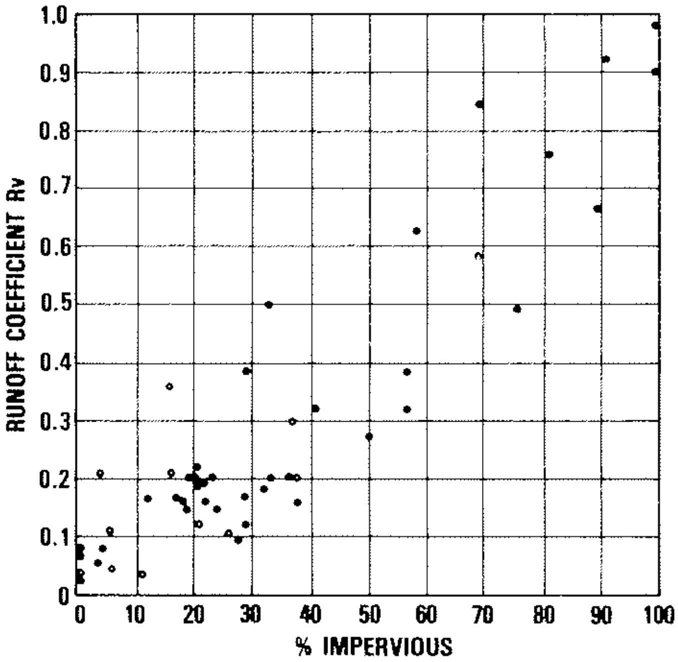
	Site	Land Use % Com	No. of Events	Drainage Area (Acs)	Population Density (Pers/Acre)	Imperv	Runoff Coef (Rv) Median	Coef Var
1	[illegible] Villa Italia	100	23	14	0	91	.93	.45
2	NC1 1912 [illegible]	100	112	21	0	69	.79	.49
3	NI3 Southgate	100	13	179	2	21	.20	.28
4	WI1 Post Office	100	54	12	0	100	.90	.19
5	WI1 Rustler	100	39	12	0	100	.79	.19
6	[illegible]	100	14	1	1	90	.86	.50
7	TN1 CBD	100	14	[illegible]	0	99	[illegible]	.41
8	LS1 [illegible]	[illegible]	21	68	-	97	.46	.55
9	[illegible] Normal Park	[illegible]	12	47	-	85	.48	.86
10	WI1 State Fair	[illegible]	21	29	10	77	.62	.24

Industrial

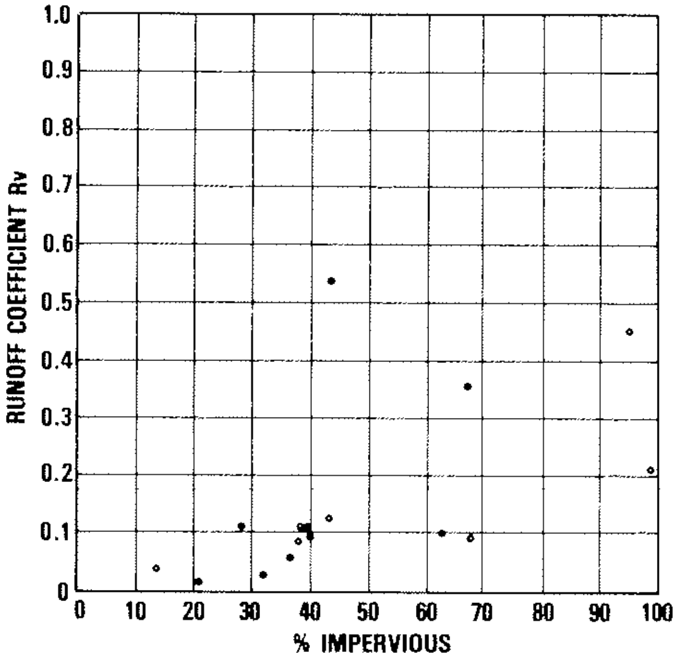
	Site	Land Use % Ind	No. of Events	Drainage Area (Acs)	Population Density (Pers/Acre)	Imperv	Runoff Coef (Rv) Median	Coef Var
1	[illegible] Addison	100	6	38	0	69	.50	.53
2	NI1 [illegible]	100	18	61	0	64	.16	.71
3	[illegible]	59	15	72	-	44	.54	.37
4	MI1 [illegible]	[illegible]	20	5	5	39	.13	.41

Urban Open and Nonurban

	Site	Land Use % Open	No. of Events	Drainage Area (Acs)	Population Density (Pers/Acre)	Imperv	Runoff Coef (Rv) Median	Coef Var
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		105	-	1	.14	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]



(a) 16 Projects



(b) 4 Projects (KS1, MI1, TN1, TX1)

83-1912

Figure 6-19. Relationship Between Percent Impervious Area and Median Runoff Coefficient

20 projects investigated. The lower plot (b) groups results from the remaining four projects (KS1, MI1, TN1, TX1). The reason for the difference is unexplained. However, the separate grouping is based on the fact that the relationship for these sites is internally consistent and significantly different than the bulk of the project results.

Figure 6-20 illustrates the same impervious area/runoff coefficient relationship, but shows the 90 percent confidence limits for median Rv's.

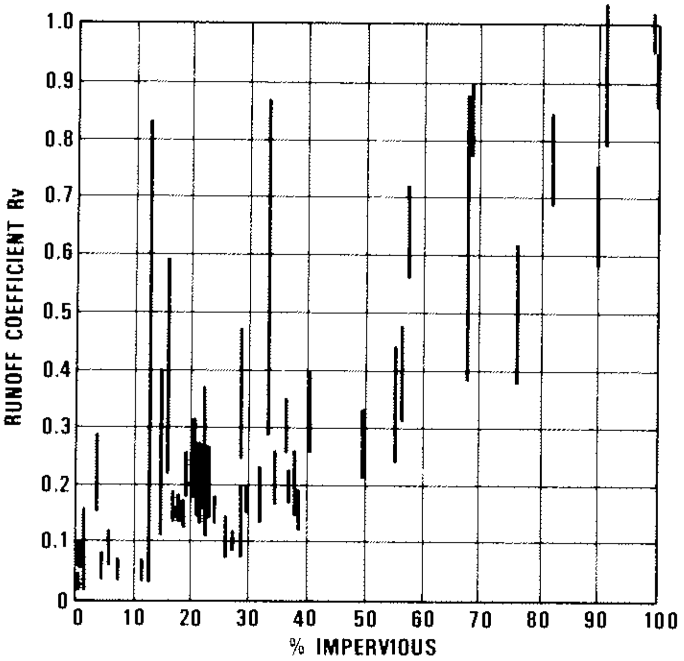
POLLUTANT LOADS

Although the EMC median concentration values are appropriate for many applications (e.g., assessing water quality impacts in rivers and streams), when cumulative effects such as water quality impacts in lakes and comparisons with other sources on a long-term basis (e.g., annual or seasonal loads) are to be examined, the EMC mean concentration values should be used. Taking the EMC median and coefficient of variation values given in Table 6-17, we have converted them into mean values using the relationship given in Chapter 5. These EMC mean concentrations and the values used in the load comparison to follow are listed in Table 6-24.

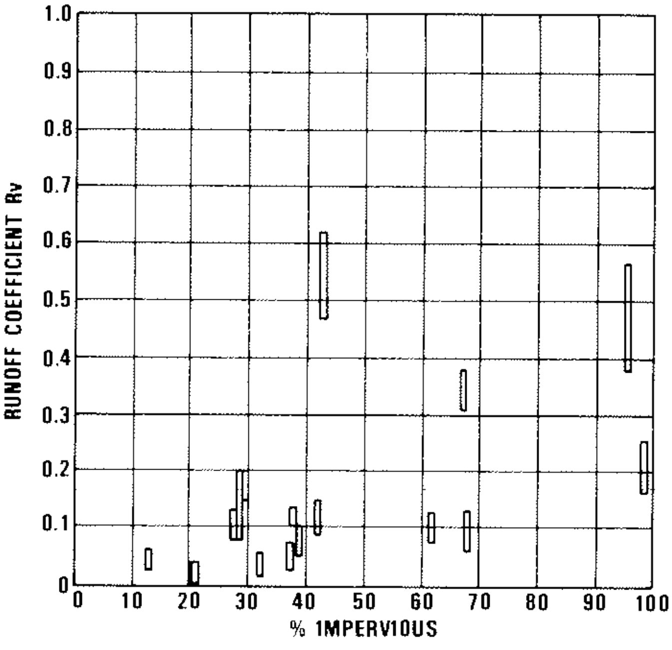
The range shown for site mean concentrations for both the median and 90th percentile urban sites reflects the difference in means depending on whether the higher or lower value of coefficient of variation listed in Table 6-17 is used to describe event-to-event variability of EMC's at urban sites. The range in values shown for use in the load comparisons below reflects the median and 90th percentile site mean concentrations, using the average of the range caused by coefficient of variation effects.

TABLE 6-24. EMC MEAN VALUES USED IN LOAD COMPARISON

Constituent	Site Mean EMC		
	Median Urban Site	90th Percentile Urban Site	Values Used in Load Comparison
TSS (mg/l)	141 - 224	424 - 671	180 - 548
BOD (mg/l)	10 - 13	17 - 21	12 - 19
COD (mg/l)	73 - 92	157 - 198	82 - 178
Tot. P (mg/l)	0.37 - 0.47	0.78 - 0.99	0.42 - 0.88
Sol. P (mg/l)	0.13 - 0.17	0.23 - 0.30	0.15 - 0.28
TKN (mg/l)	1.68 - 2.12	3.69 - 4.67	1.90 - 4.18
NO_{2+3}-N (mg/l)	0.76 - 0.96	1.96 - 2.47	0.86 - 2.21
Tot. Cu (ug/l)	38 - 48	104 - 132	43 - 118
Tot. Pb (ug/l)	161 - 204	391 - 495	182 - 443
Tot. Zn (ug/l)	179 - 226	559 - 707	202 - 633



(a) 16 Projects



(b) 4 Projects (KS1, MI1, TN1, TK1)

Figure 6-20. 90 Percent Confidence Limits for Median Runoff Coefficients

It is a straightforward procedure to calculate mean annual load estimates for urban runoff constituents on a Kg/Ha basis by assigning appropriate rainfall and runoff coefficient values and selecting EMC mean concentration values from Table 6-24. In and of themselves, however, such estimates seem to be of little utility. Therefore, it was decided to do a comparison of the mean annual loads from urban runoff with those of a "well run" secondary treatment plant. We chose to use TSS = 25 mg/l, BOD = 15 mg/l, and Tot. P = 8 mg/l for the effluents from such plants for the purposes of this order of magnitude comparison. For a meaningful comparison for a specific situation, locally appropriate values should be used. Based upon Table 6-24, the corresponding urban runoff mean concentrations used were TSS = 180 mg/l, BOD = 12 mg/l, and Total P = 0.4 mg/l as typical and TSS = 548 ug/l, BOD = 19 mg/l, and Tot. P = 0.88 mg/l as a "worst case" for comparison purposes.

The value of 0.35 was selected as a typical mean runoff coefficient. It is the median of the NURP mean runoff coefficient database for the twenty projects discussed earlier; their average is 0.42, but we believe that this number is overly weighted by the disproportionate number of highly impervious sites in the database. Assuming an average population density of 10 persons per acre (the average of the NURP sites) and a mean annual rainfall of 40 inches per year, urban runoff averages 104 gallons per day per capita. This is also a reasonable estimate of sewage generation in an urban area. Therefore, as a first cut, the ratio of mean pollutant concentrations of urban runoff and POTW effluents will also be the ratio of their annual loads. Thus, we have;

$$\text{TSS} = \frac{180}{25} \approx 7 \;;\; \text{BOD} = \frac{12}{15} \approx 0.8 \;;\; \text{Tot. P} = \frac{0.4}{8} \approx 0.05$$

using typical urban runoff values, and;

$$\text{TSS} = \frac{548}{25} \approx 22 \;;\; \text{BOD} = \frac{19}{15} \approx 1.3 \;;\; \text{Tot. P} = \frac{0.88}{8} \approx 0.1$$

using the "worst case" values. These numbers suggest that annual loads from urban runoff are approximately one order of magnitude higher than those from a well run secondary treatment plant for TSS, the same order of magnitude for BOD, and an order of magnitude less for Tot. P.

If the hypothetical urban area just described were to go to advanced waste treatment and achieve an effluent quality of TSS = 10 mg/l, BOD = 5 mg/l, and Total P = 1 mg/l and no urban runoff controls were instituted, the mean annual load reductions to the receiving water would be:

$$\text{TSS} = \frac{25 - 10}{180 + 25} \approx 7\% \;;\; \text{BOD} = \frac{15 - 5}{12 + 15} \approx 37\% \;;\; \text{Tot. P} = \frac{8 - 1}{0.4 + 8} \approx 83\%$$

for our typical case, and;

$$\text{TSS} = \frac{25 - 10}{548 + 25} \approx 3\% \;;\; \text{BOD} = \frac{15 - 5}{19 + 15} \approx 29\% \;;\; \text{Tot. P} = \frac{8 - 1}{0.88 + 8} \approx 79\%$$

for our "worst case." On the other hand, if urban runoff controls that reduced TSS by 90 percent, BOD by 60 percent, and Total P by 50 percent were instituted, (typical results from a well-designed detention basin), the mean annual load reductions to the receiving water would be:

$$\text{TSS} = \frac{180 - 18}{180 + 25} \approx 79\% \ ; \ \text{BOD} = \frac{12 - 7}{12 + 15} \approx 19\% \ ; \ \text{Total P} = \frac{0.4 - 0.2}{0.4 + 8} \approx 2\%$$

for our typical case, and;

$$\text{TSS} = \frac{548 - 55}{548 + 25} \approx 86\% \ ; \ \text{BOD} = \frac{19 - 8}{19 + 15} \approx 32\% \ ; \ \text{Total P} = \frac{0.88 - 0.44}{0.58 + 8} \approx 5\%$$

Thus, if these pollutants are causing receiving water quality problems, consideration of urban runoff control appears warranted for TSS, both urban runoff control and AWT might be considered for BOD, and only AWT would be effective for Total P.

The foregoing should be viewed as illustrative of a preliminary screening for trade-off studies that can be performed using appropriate values for a specific urban area, rather than as description of any particular real-world case. They are, however, believed useful in providing order of magnitude comparisons. Local values for annual rainfall, runoff coefficient, or point source characteristics that are different than those used in the illustration will of course change the results shown; although in most cases the changes would not be expected to cause a significant change in the general relationship.

As a final perspective on urban runoff loads, Table 6-25 presents an estimate of annual urban runoff loads, expressed as Kg/Ha/year, for comparison with other data summaries of nonpoint source loads which state results in this manner. Load computations are based on site mean pollutant concentrations for the median urban site and on the specified values for annual rainfall and runoff coefficient. Typical values for mean runoff coefficient (based on NURP data) have been assigned for residential land use ($Rv = 0.3$), commercial land use ($Rv = 0.8$), and for an aggregate urban area which is assumed to have representative fractions of the total area in residential, commercial, and open uses ($Rv = 0.35$).

Several useful observations can be made. The annual load estimates which results are comparable to values and ranges reported in the literature. Although the findings presented earlier in this chapter indicated that the land use category does not have a significant influence on site concentrations of pollutants, on a unit area basis total pollutant loads are significantly higher for commercial areas because of the higher degree of imperviousness typical of such areas. For broad urban areas, however, the relatively small fraction of land with this use considerably mitigates such an effect.

Finally, the annual loads shown by Table 6-25 have been computed on the basis of a 40 inch annual rainfall volume. For urban areas in regions with higher

TABLE 6-25. ANNUAL URBAN RUNOFF LOADS KG/HA/YEAR

Constituent	Site Mean Con.mg/l	Residential	Commercial	All Urban
Assumed Rv		0.3	0.8	0.35
TSS	180	550	1460	640
BOD	12	36	98	43
COD	82	250	666	292
Total P	0.42	1.3	3.4	1.5
Sol. P	0.15	0.5	1.2	0.5
TKN	1.90	5.8	15.4	6.6
NO_{2+3}-N	0.86	2.6	7.0	3.6
Tot. Cu	0.043	0.13	0.35	0.15
Tot. Pb	0.182	0.55	1.48	0.65
Tot. Zn	0.202	0.62	1.64	0.72

NOTE. Assumes 40 inches/year rainfall as a long-term average.

or lower rainfall, these load estimates must be adjusted. The results presented earlier suggest that pollutant concentrations are not sensitive to runoff volume; however, total loads (the product of concentration and volume) are strongly influenced by the volume of runoff. For estimates using equivalent site conditions (Rv), loads for areas with other rainfall amounts are obtained by factoring by the ratio of local rainfall volume to the 40 inch volume used for the table. Planners who believe that the average annual runoff coefficients in their local areas are substantially different from those used in the table can make similar adjustments.

CHAPTER 7
RECEIVING WATER QUALITY EFFECTS OF URBAN RUNOFF

INTRODUCTION

The effects of urban runoff on receiving water quality are very site specific. They depend on the type, size, and hydrology of the water body, the designated beneficial use and the pollutants which affect that use, the urban runoff (URO) quality characteristics, and the amounts of URO dictated by local rainfall patterns and land use.

A number of the NURP projects examined receiving water impacts in some detail, others less rigorously. Because of the uniqueness of URO water quality impacts, individual project results are considered best used for confirmation and support, rather than as a basis for broad generalizations.

Accordingly, this chapter is structured to address each of the principal categories of receiving water bodies separately; streams and rivers, lakes, estuaries and embayments, and groundwater aquifers. Some can be addressed more thoroughly than others at this time. The approach taken to develop a general, national scale screening assessment of the significance of URO pollutant discharges is to compute anticipated effects using analysis methodologies identified in Chapter 5, where these are appropriate and to compare anticipated effects indicated by such generalizations to specific experiences and conclusions drawn by relevant individual NURP projects.

As with any generalization, there will be exceptions. Specific local situations can be expected which are either more or less favorable than the general case. The results presented herein should therefore be interpreted as representative estimates of a substantial percentage of urban runoff sites, but not all of them.

Receiving waters have distinctive general characteristics which depend on the water body type (e.g., stream, lake, estuary) and relatively unique individual characteristics which depend on geometry and hydrology. Given a minimum acceptable amount of data on water bodies and their setting, it appears possible to make useful generalizations regarding the quantitative effects of urban runoff on concentrations of various pollutants in the receiving waters and to draw inferences concerning the influence urban runoff may have on the beneficial uses of the water bodies. However extending the results of such an analysis to an assessment of the prevalence of urban runoff induced "problems" on a national scale cannot be accomplished in a way would provide an acceptable level of confidence in any conclusions drawn therefrom. In addition to the importance of local hydrology, meteorology, and urban characteristics, the emphasis placed on each of the three elements that influence problem definition;

(1) Denial or serious impairment of beneficial use;

(2) Violation of ambient water quality standards; and

(3) Local perception;

will result in a high degree of site-specificity to the determination of the existence of a problem.

RIVERS AND STREAMS

General

Flowing streams carry pollutant discharges downstream with the stream flow. For intermittent stormwater discharges, a specific stream location and the biota associated with it are exposed to a sequence of discrete pulses contaminated by the pollutants which enter with urban runoff. Because of the inherent variability of urban runoff (URO), the average concentrations in such pulses vary, as do their duration and the interval between successive pulses. Table 7-1 summarizes average values for storm duration and intervals between storm events for selected locations in the U.S., based on analysis of long term rainfall records using a methodology (SYNOP) presented in an earlier NURP document (the NURP Data Management Procedures Manual). The information presented provides a sense of the temporal aspects of such intermittent pulses and, by inference, the intermittent exposure patterns to which stream biota are subjected. For many locations, storm pulses are produced for about six hours every three days or more, on average.

A probabalistic methodology has been used to examine the concentration characteristics of the storm pulses produced in streams, given the variability of the relevant processes which are directly involved. Stream flow rates, runoff flow rates, and concentrations vary and result in variable stream concentrations. For streams, it is not the runoff volume per se that is important. The combination of stream and runoff flow rates (together with runoff concentration) determine the pollutant concentration in the stream pulse. The duration of the runoff event and the stream velocity dictate the spatial extent of the storm pulse in the stream. The analysis presented in this section addresses the frequency and magnitude of pollutant concentrations in the instream storm pulses which are produced.

Runoff and Stream Flow Rates

The local combination of stream and runoff flow rates for an urban location are, as indicated, important determinants of the stream concentrations which will result. For long-range projections, the most appropriate data sources for characterizing these parameters are long-term stream flow gauging records (USGS) and long-term rainfall records (USWS).

Figure 7-1(a) illustrates the regional variation of average daily stream flows expressed as cfs/sq mile of drainage area, based on long-term (50 years or more) gauging records at over 1000 stations. Figure 7-1(b) presents a somewhat simplified regional pattern for average rainfall intensity. The data base for this plot is considerably smaller, consisting of rainfall records (usually 10 to 30 years of record) for approximately 40 cities. Localized peturbations exist, but are smoothed out by contours presented.

TABLE 7-1. AVERAGE STORM AND TIME BETWEEN STORMS FOR SELECTED LOCATIONS IN THE UNITED STATES

Location	Average Annual Values in Hours	
	Storm Duration	Time Between Storm Midpoints
Atlanta, GA	8.0	94
Birmingham, AL	7.2	85
Boston, MA	6.1	68
Caribou, ME	5.8	55
Champaign-Urbana, IL	6.1	80
Chicago, IL	5.7	72
Columbia, SC	4.5	68
Davenport, IA	6.6	98
Detroit, MI	4.4	57
Gainesville, FL	7.6	106
Greensboro, SC	5.0	70
Kingston, NY	7.0	80
Louisville, KY	6.7	76
Memphis, TN	6.9	89
Mineola, NY	5.8	89
Minneapolis, MN	6.0	87
New Orleans, LA	6.9	89
New York City, NY	6.7	77
Steubenville, OH	7.0	79
Tampa, FL	3.6	93
Toledo, OH	5.0	62
Washington, DC	5.9	80
Zanesville, OH	6.1	77
Mean	6.1	81
Denver, CO	9.1	144
Oakland, CA	4.3	320
Phoenix, AZ	3.2	286
Rapid City, SD	8.0	127
Salt Lake City, UT	7.8	133
Mean	6.5	202
Portland, OR	15.5	83
Seattle, WA	21.5	101
Mean	18.5	92

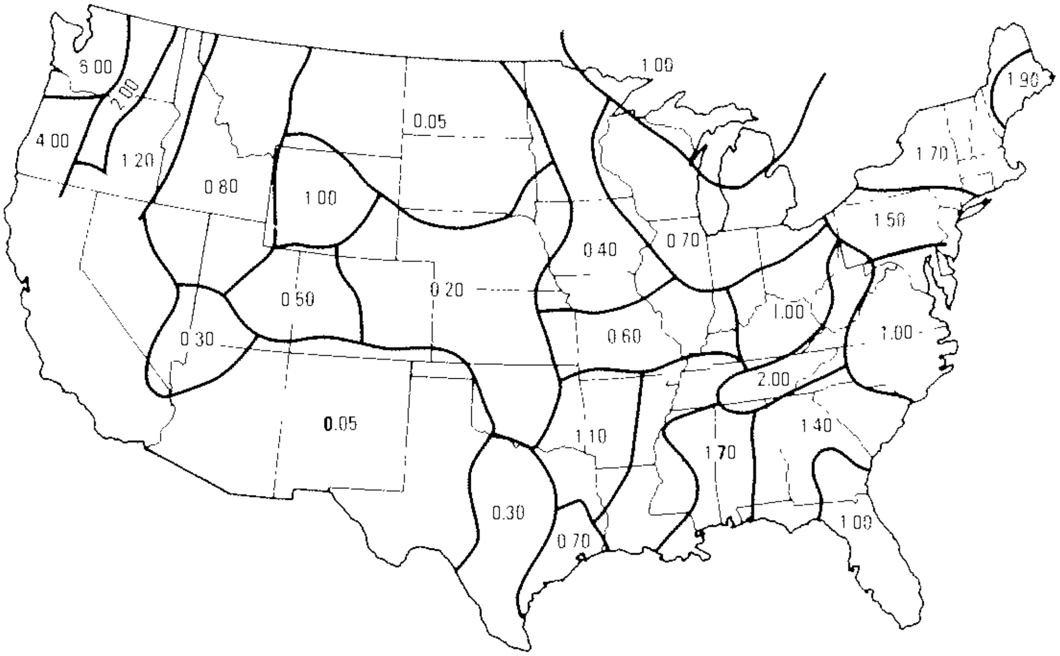


Figure 7-1(a). Regional Value of Average Annual Streamflow (cfs/sq mi)

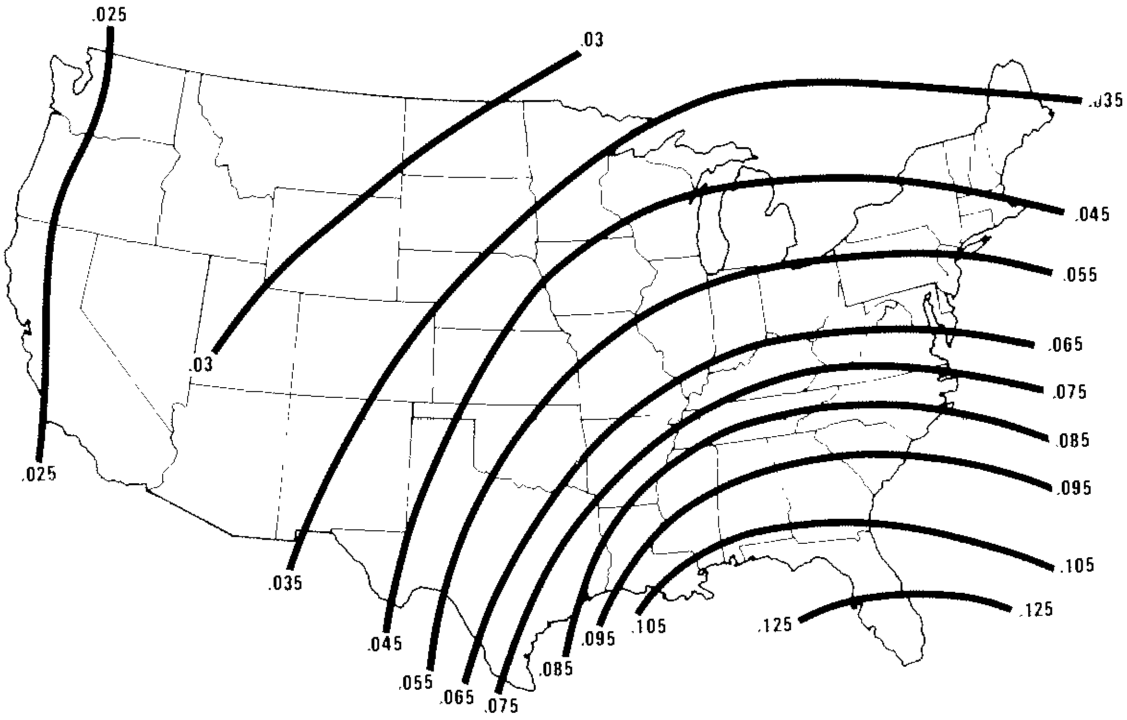


Figure 7-1(b). Regional Value of Average Storm Event Intensity (inch/hr)

Variability of daily stream flows was determined for a smaller sample (about 150 sites) of the stream sites. Variability of storm event average intensities was determined for all of the rain gauge locations in the current data base. These results are summarized in Table 7-2.

Total Hardness of Receiving Streams

Where the beneficial use of principal concern is the protection of aquatic life, the URO pollutants of major concern appear to be heavy metals, particularly copper, lead and zinc. The potential toxicity of these pollutants are strongly influenced by total hardness, as indicated by Table 5-1 in Chapter 5. Other beneficial uses deal with pollutants and effects that are not influenced by total hardness or (as with drinking water supplies) do not modify the assigned significance of heavy metal concentrations on the basis of total hardness.

As with stream flow and precipitation, distinct regional patterns also exist for receiving water total hardness concentrations. Figure 7-2 delineates the national pattern of regional differences. These patterns impose an additional regional influence on the potential of urban runoff to create problem conditions in streams and rivers.

Technical Approach To Screening Analysis

The magnitude and frequency of occurrence of intermittent stream concentrations of pollutants of interest, that result from urban runoff, has been computed using the probabilistic methodology discussed in Chapter 5.

The input data required for application of the methodology includes representative values for the mean and variability of stream flow, runoff flow, and runoff pollutant concentrations. The material presented earlier in this chapter provides the basis for assigning values for the flows; the results summarized in Chapter 6 provide the basis for specifying pollutant concentration inputs. In order to translate the probability distribution of stream concentrations (which is the basic output of the analysis methodology) to an average recurrence interval, which is considered to provide a more understandable basis for comparisons, the average number of storms per year is also required. This is estimated directly from the average interval between storm midpoints generated by the statistical analysis of hourly rainfall records.

For a general screening on a national scale, an estimate of typical values for a selected geographic location must be made. This has been done, and the set of input values considered to be typical of geographical location are described and summarized below. The values used should be considered reasonably representative of the majority of sites in the area, but it should be recognized that not all potential sites will have conditions either as favorable or unfavorable as those listed.

We have worked with a limited sample in assigning typical values. A greater data base on rainfall and stream flow would permit greater spatial definition

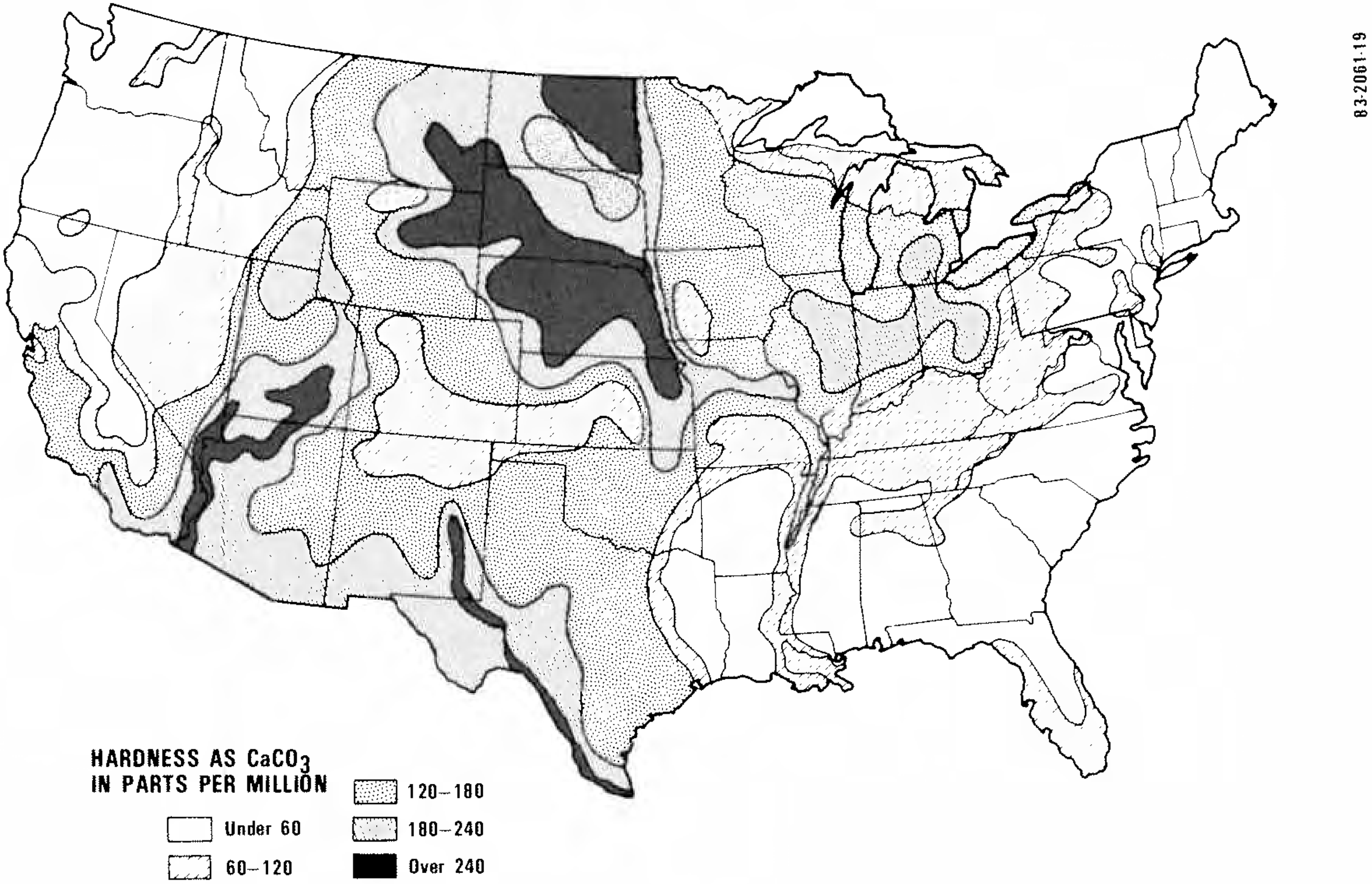


Figure 7-2. Regional Values for Surface Water Hardness

than shown in the results. Specific regions or states could, with development of a more detailed spatial definition of stream flows and rainfall, extend the analysis presented to provide a considerably more comprehensive assessment of problem potential for local areas. This would involve the development of input parameters (rainfall and streamflow) readily derived from available long term USGS stream flow records and USWS rainfall records and their use in the methodology with quality parameters based either on the NURP analysis presented in Chapter 6, or on local monitoring activities.

The analysis methodology presently available permits computation of the probability distribution of instream concentrations, incorporating the effect of upstream (background) concentrations of the pollutant of interest. The results presented here assume upstream concentrations of zero, principally because of our inability at present to make reliable estimates of typical values for the magnitude and variability for pollutants of interest, especially on the broad national scale being examined. As a result, the summaries will show the effects of urban runoff contributions only. In cases where the background is small relative to the URO contribution, the summaries will represent actual conditions quite closely. However, where background is high and has appreciable variability, the implications of the URO contribution will be overstated, particularly the inferred improvement which could result from control of URO.

In order to perform a national screening of regional influences on urban runoff impacts, eight geographical regions illustrated by Figure 7-3 have been delineated. Using the information summarized by Figures 7-1 and 7-2, typical values for the pertinent rainfall/runoff and stream parameters have been assigned for each of the regions. Table 7-2 summarizes the values for these parameters which are used in the screening analysis.

TABLE 7-2. TYPICAL REGIONAL VALUES

Area	Event Average Rainfall Intensity		Average Number of Events/year	Average Runoff Flow Rate		Stream Flow Rate (Daily Avg Flows)		Stream Total Hardness (mg/l)
	Mean (in/hr)	c.v.		Mean Event (cfs/sq mi)	c.v.	Mean (cfs/sq mi)	c.v.	
1	0.04	1.00	110	5	0.85	1.75	1.25	50
2	0.10	1.35	100	12	1.15	1.25	1.25	50
3	0.08	1.35	90	10	1.15	1.00	1.25	50
4	0.055	1.25	110	7	1.05	0.75	1.25	200
5	0.04	1.10	63	5	0.95	0.35	1.25	200
6	0.03	1.10	70	4	0.95	0.05	1.25	300
7	0.045	1.20	30	5	1.00	0.05	1.25	200
8	0.025	0.85	80	3	0.75	4.50	1.25	50

Average stream flow and rainfall intensity were taken from the plots, which are based on sources previously described. The estimate for variability of daily stream flows (coefficient of variation) is based on computed values for a sample of about 150 perennial streams. Results for a number of regional

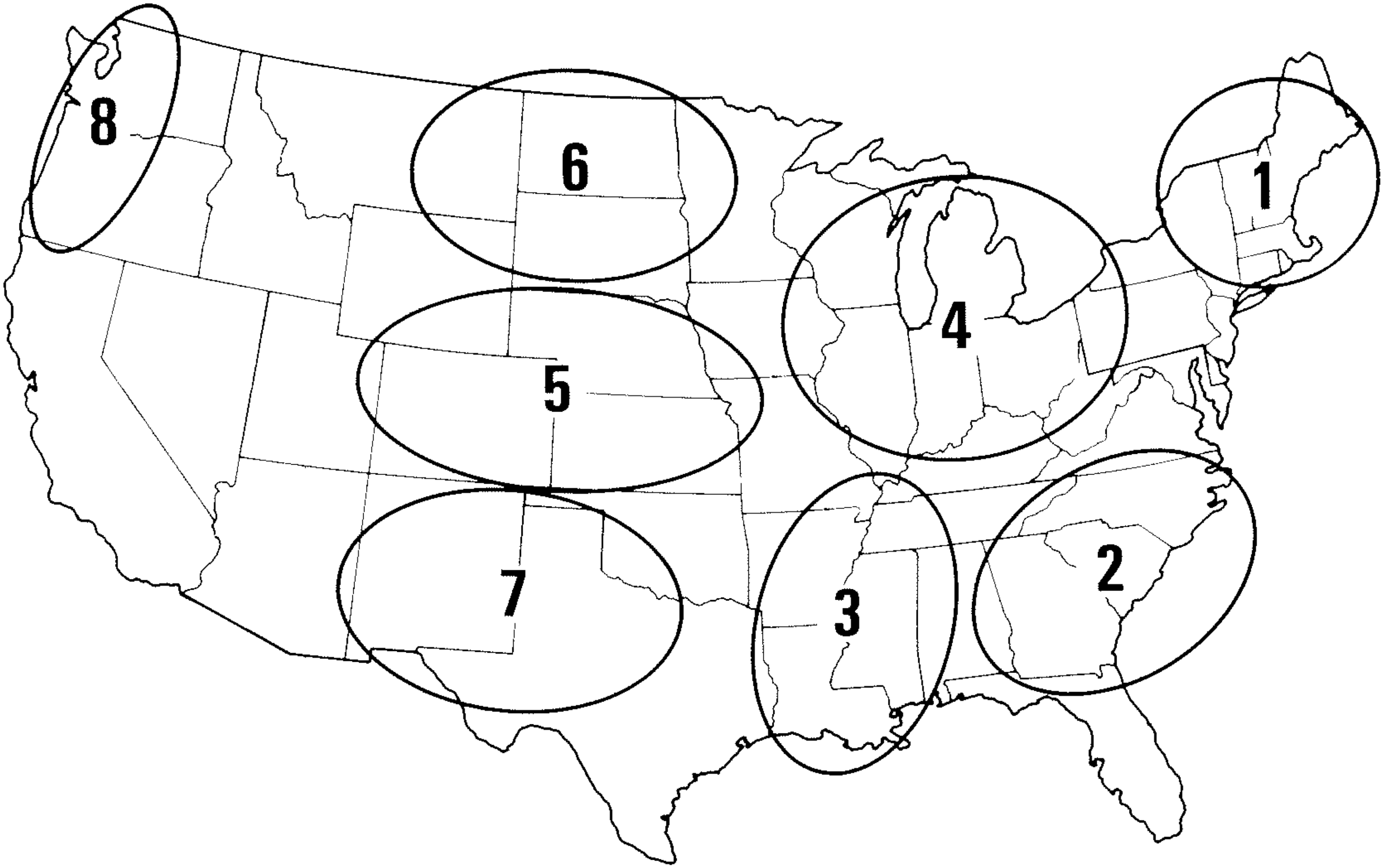


Figure 7-3. Geographic Regions Selected for Screening Analysis

groupings indicated median values for coefficient of variation to fall between approximately 1 and 1.5. Since there were no clear regional patterns apparent, a uniform value for coefficient of variation of stream flows of 1.25 was assigned.

The coefficient of variation of rainfall intensities was taken directly from the statistical analysis of the rainfall records examined. This was reduced by 15 percent to provide estimates of the coefficient of variation of runoff flow rates, based on a recent published report, "Comparison of Basin Performance Modeling Techniques", Goforth, Heaney and Huber, ASCE JEED, November 1983, using the SWMM model on a long-term rainfall record.

The quality characteristics of urban runoff used in the screening analysis are listed in Table 7-3, and are based on the results summarized in Chapter 6. The analysis results have been rounded in the selection of representative site median EMCs and are interpreted as being representative of an array of urban sites discharging into the receiving stream being analyzed.

Average site conditions are based on the 50th percentile of all urban sites. Since the data analysis indicated that sites at some locations tend to cluster at either the higher or lower ends of the range for all sites, high range and low range site conditions were also selected for use in the screening analysis. High range site conditions are nominally based on the 90th percentile of all site median concentrations; the low range on the 10th percentile site. The variability of EMCs from storm to storm at any site is based on the median of the coefficients of variation of EMCs at sites monitored by NURP. This value was used for the low range and average site condition and was increased nominally for the high range site condition.

TABLE 7-3. URBAN RUNOFF QUALITY CHARACTERISTICS
USED IN STREAM IMPACT ANALYSIS
(Concentrations in μg/l)

	COPPER		LEAD		ZINC	
	Site Median EMC	Coef Var	Site Median EMC	Coef Var	Site Median EMC	Coef Var
Low Range of Site Conditions	15	0.6	50	0.75	75	0.7
Average Site Conditions	35	0.6	135	0.75	165	0.7
High Range of Site Conditions	90	0.7	350	0.85	450	0.8

An illustrative example of a site-specific application of the probabilistic analysis methodology employed is presented in order to:

1. Illustrate the nature of the computational results produced;

2. Assist in the interpretation of the tabulations presented later which summarize results of the national scale screening analysis;

3. Indicate how magnitude/frequency of instream concentrations may be interpreted for inferences concerning the absence or presence of a "problem" and where a problem is concluded to exist, its degree of severity; and

4. Demonstrate how alternative URO control options may be evaluated in terms of their expected impact on water quality and potential effect on problem severity.

From selected representative values for mean and variability of stream and runoff conditions, the probability distribution of resulting instream concentrations during storm events can be computed. Figure 7-4 illustrates a plot of such an output. Uncertainty in estimates for specific inputs can be accommodated by sensitivity analyses which incorporate upper and lower bounds for specific parameter values. Results are then presented as a band rather than a specific projection. The probabilities which are the basic output of the analysis may be converted to average recurrence intervals to provide what is believed to be a more understandable basis for interpreting and evaluating results.

Figure 7-5 presents results converted to the average recurrence interval at which specific stream concentrations will be produced during storm runoff periods.

The significance of a particular magnitude/frequency pattern of stream concentrations caused by urban runoff can be evaluated by comparing them with concentrations which are significant for the beneficial use of the water body. In the example presented, we have excluded comparisons with drinking water criteria on the basis that urban streams are not generally used as domestic water sources, and in any event, the criteria relate to finished water, and surface water supplies almost invariably receive treatment.

Protection of aquatic life is selected for the screening analysis of the impact of urban runoff because it is believed to be the predominant potential beneficial use for urban streams on a national scale. The concentrations which result from urban runoff are compared with stream target concentrations associated with different degrees of adverse impact, as discussed and tabulated in Chapter 5.

In the site specific situation illustrated, the stream concentrations of copper caused by untreated urban runoff discharges exceed the "EPA Maximum" criterion more than ten times per year on average. The concentration level suggested by the NURP analysis to be the Threshold level of adverse biological impacts is exceeded an average of five times per year (recurrence interval 0.2 year), and significant mortality of more sensitive biological species occurs about once every three years on average. Although this stress level may not be great enough to result in a total denial of the use, there are many who would argue that it represents an unacceptably severe degree of impairment of this beneficial use.

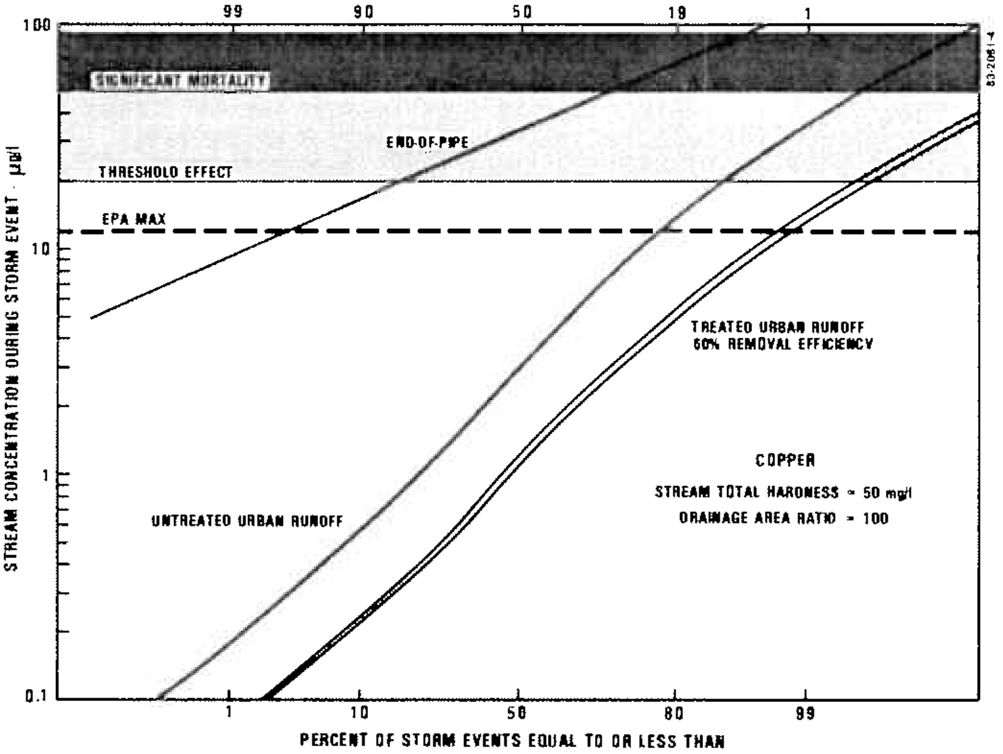


Figure 7-4. Probability Distributions of Pollutant Concentrations During Storm Runoff Periods

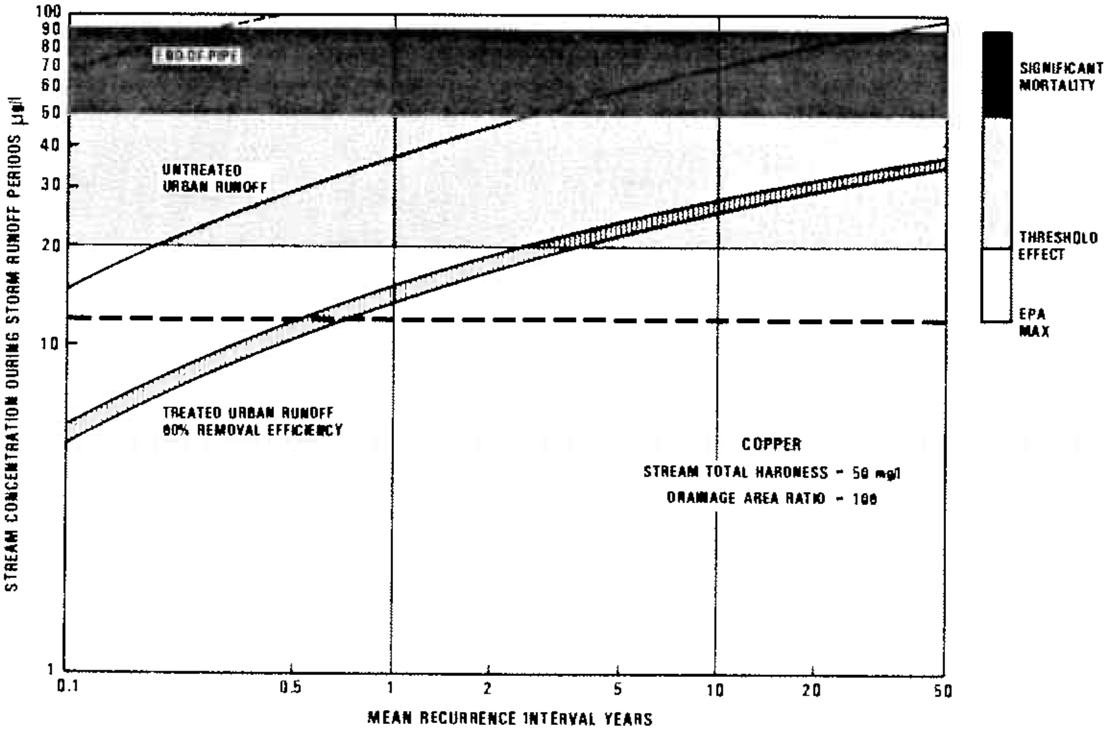


Figure 7-5. Recurrence Intervals for Pollutant Concentrations

The projection labeled "treated urban runoff" may be taken to represent the in-stream result for either the originally considered discharge following the application of controls which effect a 60 percent reduction, or of an uncontrolled urban runoff site with lower levels of copper in the runoff. In this case, threshold levels are reached only once every 3 or 4 years on average, and significant mortality levels are virtually never reached. Even though the ambient "EPA MAX" criterion is exceeded once or twice a year on average, one might conclude that the implied degree of stress is tolerable and is not interpreted to represent a significant degree of impairment of the use.

The Threshold and Significant Mortality levels are estimates, which have been explained earlier. In addition, the "acceptable" frequency at which specific adverse effects can be tolerated is subjective at this time, since there are no formal guidelines. However, an approach of this nature must be taken in any evaluation of the significance of urban runoff and the importance of applying control measures. There are two reasons why this is necessary. First, because of the stochastic nature of the system we are dealing with, virtually any target concentration we elect to specify will be exceeded at some frequency, however rare. Secondly, from a practical point of view, there are limits to the capabilities of controls, however rigorously applied. In the illustration presented, the untreated urban runoff site assigned urban runoff copper concentrations equivalent to the average urban site. Since NURP analysis data indicate that the copper in urban runoff has a soluble fraction of about 40 percent, the level of removal used in the example reflects a control efficiency approaching the practical limit. Receiving water impacts are significantly reduced, but not totally eliminated.

Results of Screening Analysis

A projection of stream water quality responses has been made for each of the eight geographical areas shown by Figure 7-3. The rainfall, runoff, and stream flow estimates used in the computations are those summarized in Table 7-2. The urban runoff quality characteristics used are those presented in Table 7-3.

To consolidate screening analysis results for easier comparison, results are not presented as continuous concentration/frequency curves as used in the illustrative example presented above. Instead, the comparison plots which follow show only the recurrence interval at which specified biological effects levels are exceeded. The concentrations which correspond with these effects are strongly influenced by stream total hardness, and hence vary regionally. Table 7-4, based on information presented in Chapter 5, summarizes the stream target concentrations used in the screening analysis summary.

Analysis results are presented for Copper (Figure 7-6), Lead (Figure 7-7) and Zinc (Figure 7-8). Each individual bar represents a different geographical region, and the analysis is performed for two drainage area ratios. Since regional stream flow differences are based on unit flows (cfs/sq mile of drainage area), actual flow in a receiving stream at a particular location is

TABLE 7-4. REGIONAL DIFFERENCES IN TOXIC CONCENTRATION LEVELS
(Concentrations in µg/l)

Pollutant	Stream Total Hardness µg/l	Geo-graphic Regions	EPA MAX	Suggested Values For		
				Threshold Effects[1]	Significant (a)	Mortality[2] (b)
Copper	50	1,2,3,8	12	20	50	90
	200	4,5,7	42	80	180	350
	300	6	62	115	265	500
Lead	50	1,2,3,8	74	150	350	3200
	200	4,5,7	400	850	1950	17,850
	300	6	660	1400	3100	29,000
Zinc	50	1,2,3,8	180	380	870	3200
	200	4,5,7	570	1200	2750	8000
	300	6	800	1700	3850	11,000

[1] Threshold Effects - mortality of the most sensitive individual of the most sensitive species.

[2] Significant Mortality

Level (a) - mortality of 50 percent of the most sensitive species.

Level (b) - mortality of the most sensitive individual of 25th percentile sensitive species.

a function of both the unit flow rate and the size of the contributing drainage area. The "drainage area ratio" (DAR) used in the analysis is

$$\text{DAR} = \frac{\text{Urban Area Contributing Runoff}}{\text{Stream Drainage Area Upstream of Urban Input}}$$

It is a measure of the location of the urban area relative to the headwaters of the receiving stream.

The shading scheme used on the bars duplicates that used earlier in the illustrative example (Figure 7-5), and identifies the recurrence interval for each of the target concentrations. For example, instream copper concentrations during storm runoff periods in geographic region 1, with average site conditions for copper concentrations in urban runoff, and a DAR = 10, are projected to be as follows (middle plot, Figure 7-6).

- EPA MAX - ambient criterion is exceeded at a frequency of 0.02 year (= 50 times/year) or about every other storm event on average.

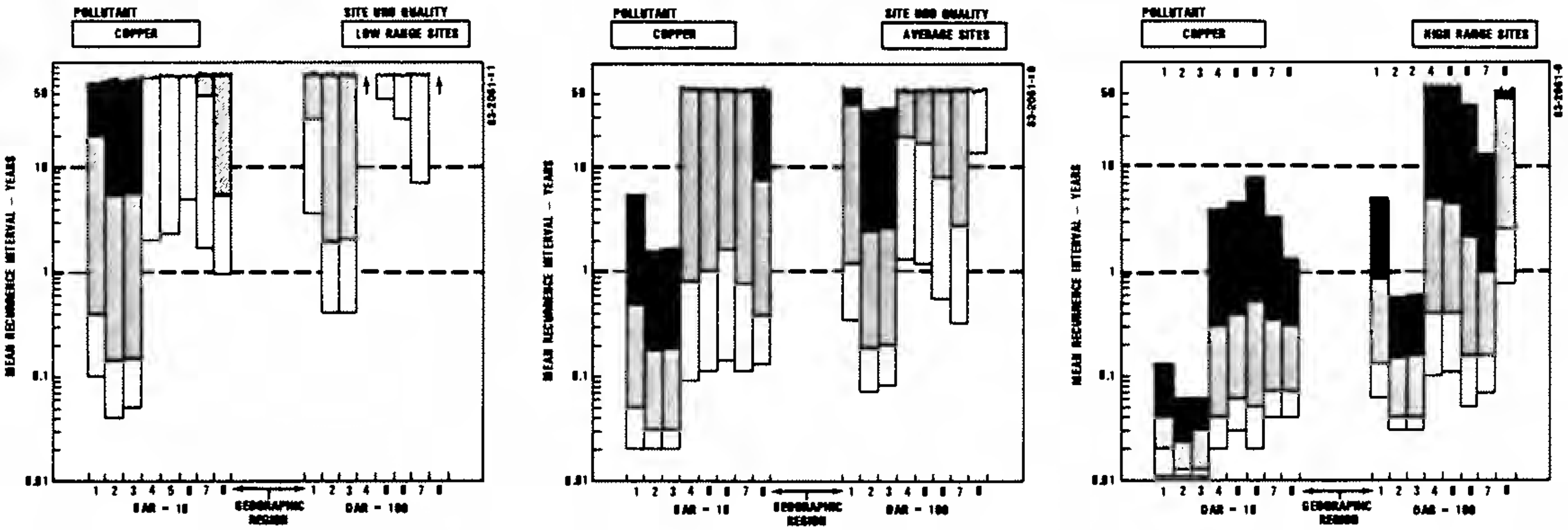


Figure 7-6. Exceedance Frequency for Stream Target Concentration
COPPER

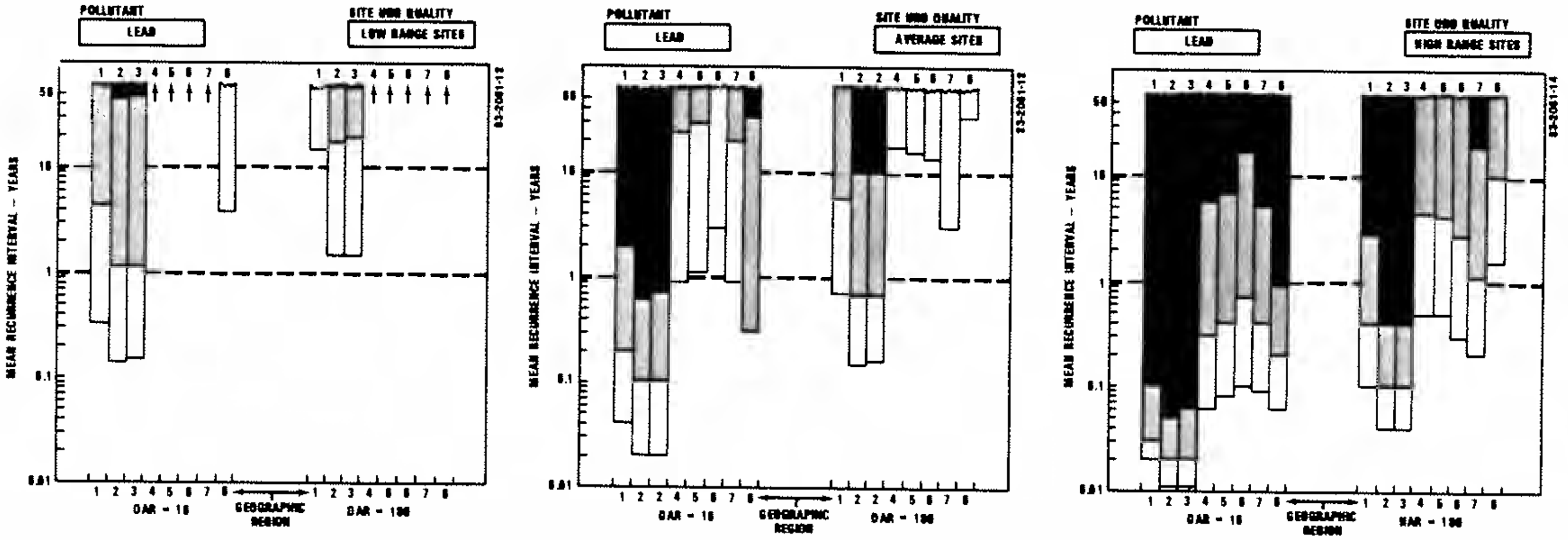


Figure 7-7. Exceedance Frequency for Stream Target Concentration
LEAD

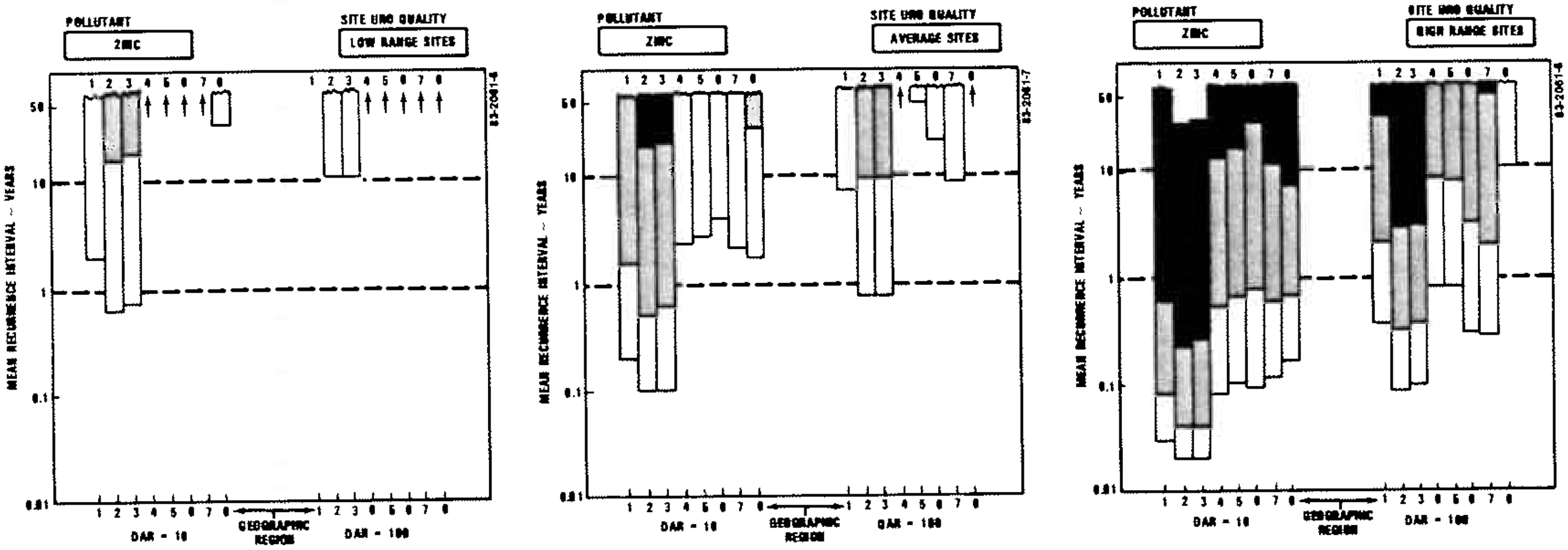


Figure 7-8. Exceedance Frequency for Stream Target Concentration ZINC

- Threshold concentration levels at which adverse biological stress for short duration exposures is projected to occur have a recurrence interval of about 0.05 years (20 times/year).

- Significant mortality levels are exceeded at intervals of about 0.5 year (twice/year) for the less severe effect, to about once in 5.5 year for the more severe impact specified.

The plot is terminated at an upper level for recurrence interval of 50 years. Although the analysis procedure computes specific recurrence intervals in excess of this value, a realistic interpretation suggests that such conditions are for practical purposes quite unlikely to ever be reached or exceeded. At computed recurrence intervals of about 10 years or more estimates are not considered to be reliable and are very probably conservative. Therefore, indicated mean recurrence intervals in excess of 10 years probably (and 50 years certainly) should be interpreted as "unlikely" or "highly unlikely".

Discussion

An inspection of the screening analysis results (Figures 7-6 through 7-8) indicates the reason why it is unrealistic to attempt a broad generalization on whether urban runoff is, or is not a "problem" in rivers and streams. Water quality impacts can vary widely, depending on regional rainfall and stream hydrology, urban site quality characteristics, drainage area ratio (reflecting the size of the receiving stream relative to the urban area), and the total hardness of the receiving stream. While the screening analysis results provide an informative and useful perspective on the issue, it should be recognized that any specific site may differ considerably from the typical conditions used to characterize rainfall and stream flow for the area, and further, that local variations in runoff quality characteristics within the range defined by the NURP data can also have significant influence. The dominant indication of the analysis is that the problem potential for urban runoff is highly site-specific. Nevertheless some useful generalizations can be made.

Perhaps the major factor which dictates whether urban runoff discharges of copper, lead, or zinc will adversely impact aquatic life is the natural hardness of the receiving streams. As a result, the southeast and gulf coast areas are consistently indicated to be more sensitive than other areas of the country. Of the remaining soft water areas, the northeast is somewhat less sensitive; the Pacific northwest markedly less. This is attributed to significantly lower storm intensities in these areas, coupled in the northwest with appreciably higher stream flows.

Drainage area ratios have an important effect, reflecting as they do the magnitude of stream flow at the urban location. The effect is much greater for geographical regions with high unit flow (cfs/sq mile) than for lower stream flow regions.

Finally, the quality characteristics of the urban sites have a significant influence. Stream concentrations differ markedly depending on whether the local urban sites tend to cluster toward the lower or higher end of the range of site median concentrations indicated by the NURP data base.

A comparison of the relative position of the bars on Figures 7-6, 7-7 and 7-8, is sufficient to indicate the comparative sensitivity to urban runoff pollutant discharges. However, it is also desirable to decide whether a given stream effect constitutes a serious degree of impairment of an aquatic life beneficial use. There are no formal guidelines, and interpretations that are either more liberal or more restrictive than those suggested below may be preferred by others dealing with specific stream segments. For the interpretation of the national scale screening analysis, the following decision basis has been used to identify the situations in which urban runoff is likely to result in a water use "problem", (i.e., cause an unacceptable degree of use impairment):

- Threshold effects - (mortality of the most sensitive individual of the most sensitive species) occur more often than about once a year on average.

- Significant mortality - using the lower of the two levels (i.e., 50 percent mortality of the most sensitive species), occurs more often than about once every 10 years on average.

Using these guidelines for assessing the occurrence of problem situations, copper is shown to be the most significant of the three heavy metals consistently found in urban runoff at elevated concentration levels. Where site concentrations are at the high range of observed urban site conditions, problems are expected in all geographic regions at a DAR = 10, and in all geographic regions except region 8 at DARs as high as 100. When site concentrations are in the average range of observed conditions, problem situations are restricted to geographic regions 2 and 3 (plus region 1 at DAR = 10). When site copper concentrations are in the lower range of observed site conditions, problem situations are restricted to geographic regions 2 and 3 at low DARs. They are marginal (significant mortality once every 5 years) but remain a problem according to the definition adopted. The "marginal" attribution is used here, because the more severe degree of significant mortality (most sensitive individual of 25th percentile sensitive species) is indicated by the analysis virtually never to occur.

Thus, copper discharges in urban runoff are indicated to represent a significant threat to aquatic life use in regions 2 and 3 (southeast and Gulf Coast) under almost all possibilities for urban site runoff quality. In region 1 (northeast), problems would be expected at all but the lower range of site concentrations. In the hard water areas (regions 4, 5, 6, 7) problems are expected only where site runoff quality is in the high end of the range of observed site median concentrations.

It should be noted that the analysis has been based on total copper concentrations in urban runoff. Toxic effects are usually considered to be exerted by the soluble form of the metal, and EPA defines an "active" fraction based on a mild digestion which converts some of the inactive particulates to soluble forms, to account for transformations which may occur in the natural water systems. Copper in urban runoff has a typical soluble fraction of about 50 percent, and the active fraction would therefore fall somewhere between 50 and 100 percent of the total concentration used in the analysis. The analysis has been performed using the total fraction, since adequate information is not available at present to reliably adjust these values. However, although the problem assessment presented above may be somewhat conservative, further refinement along these lines would not change the inferences drawn from the screening analysis results.

Zinc, like copper, has an indicated soluble fraction in the order of 50 percent, and the screening analysis indications will also be unaffected by this consideration. It is indicated to be unlikely to pose a significant threat to aquatic life in most urban runoff situations. Exceptions are restricted to soft water areas in the east and south, lower DARs, and sites with high zinc concentrations in urban runoff.

Lead results must be viewed with greater caution, because soluble fractions in urban runoff are indicated to be quite low (less than 10 percent). Problem indications are therefore likely to be reasonably conservative, i.e., overstate the problem potential. Problem situations may be expected to be restricted to soft water areas in the east and Gulf areas when urban sites have average site concentrations and DARs are low, and even at high DARs when site concentrations are in the high range. Lead is not indicated to be a threat to aquatic life in the hard water areas of the country or in the Pacific northwest, except for the combination of low DAR and high site concentration.

In performing the screening analysis, upstream concentrations were assumed to be zero; that is, the receiving stream had only a diluting effect on the urban runoff pollution. In actual cases background concentrations will be greater than zero, and in some instances upstream contributions (e.g., agricultural runoff, another city) could be significant and result in more severe conditions than those identified in the screening analysis.

On the basis of the foregoing, it appears appropriate to identify copper as the key toxic pollutant in urban runoff, for the following reasons:

- Problem situations anticipated for lead and zinc do not occur under any conditions for which copper does not show up as a problem as well - and with more severe impacts. On the other hand, copper is indicated to be a problem in situations where lead or zinc are not.

- Based on the ratios between concentrations producing increasingly severe effects, copper is suggested to be a more generic toxicant. It has an effect on a broad range of species. This is in contrast to lead and zinc for which a substantially greater degree of species selectivity is indicated. Some species are sensitive, others relatively insensitive to lead and zinc.

- From the NURP data, locations which tend to have site median concentrations in the low, average, or high end of the range have generally consistent patterns for each of the three heavy metals.

- Control measures which produce reductions in copper discharges to receiving waters could be expected to result in equivalent reductions in zinc, and greater reductions in lead, by virtue of its significantly greater particulate fraction.

Copper is accordingly suggested to be an effective indicator for all heavy metals in urban runoff relative to aquatic life. It might be used as the focus for control evaluations, site specific bioassays, monitoring activities, and the like.

It should be noted that while immediate water column impacts of lead are not as significant as those for copper, the high particulate fraction of lead would tend to result in greater accumulations in the stream bed. This aspect has not been addressed by the NURP program in sufficient detail to warrant any comment on its potential significance.

The results of the screening analysis summarized by Figures 7-6 through 7-8 are approximate, because they are influenced by the suitability of the typical values for stream and runoff flows which were assigned. This however can be refined by the use of appropriate values which can be developed from readily available data bases, and thus adjusted for local variations which are to be expected. A second issue relative to the reliability of the projections is the validity of the computations, given that the input parameters are representative. This has been confirmed by a number of validation tests, discussed in the NURP supporting document referenced earlier, which addresses the stream analysis methodology.

The remaining issue for evaluating the reliability of the indications of problem potential produced by the screening analysis is the reasonableness of the intermittent exposure concentration levels, which have been associated with various biological effects levels, and the guidelines adopted for this discussion, which determine whether or not a problem is expected. While rather tenuous at this time, the information available does provide support.

Two of the NURP projects examined aquatic life effects in streams receiving runoff from monitored sites.

- Bellevue, WA concluded that whatever adverse effects were observed were attributable to habitat impacts (stream bed scour and deposition) as opposed to chemical toxicity. For this project, heavy metal concentrations in the monitored urban runoff sites were typical of the average for all urban sites. The screening analysis results under these conditions do not indicate the expectation of a problem.

- Tampa, FL conducted extensive bioassay tests but failed to show any adverse effect of water column concentrations of pollutants in urban runoff. The screening analysis results presented in Figure 7-6 indicate marginal problem conditions at low DAR for this geographic region. At this project however, all monitored sites show heavy metal concentrations significantly lower than the low range conditions used in the screening analysis. When the screening analysis is repeated using site concentrations representative of Tampa monitoring results, a problem situation is not predicted, even at DARs lower than is probably the case for this location.

LAKES

Because lakes provide extended residence times for pollutants, the significant time scale for evaluating urban runoff impacts is at least seasonal, and usually annual or longer, rather than the storm event scale used for streams. The screening methodology identified in Chapter 5, uses annual nutrient loads to assess the tendency for development of undesirable eutrophication effects.

Figure 7-9 illustrates the effect of urban runoff on average lake phosphorus concentration. The very significant influence of area ratio is evident. The larger the urban area which drains into a lake of a given size, the greater the annual loading, and the higher will be the lake phosphorus concentration and the eutrophication effects produced.

The phosphorus concentrations characteristic of the urban sites surrounding a particular lake are also seen to be significant. The three bands shown reflect the range of possibilities, based on the NURP data. The same basis is used to estimate the phosphorus loads from average urban sites and those at the higher and lower ends of site conditions, as was described for heavy metals in the previous section. In this case, because it is annual mass loads which are of interest, site median concentrations have been converted to site mean values for use in the computations.

Lake phosphorus concentrations are also influenced by the annual runoff volume (annual precipitation and runoff coefficient). The results illustrated are based on an annual rainfall of 30 inches and an overall average runoff coefficient of 0.2. Plotted results may be scaled up or down in proportion to the ratio between local values for these parameters and those used in the illustration.

Finally, the lake morphology and hydrology influence the outcome; specifically depth (H) and residence time (τ). This is reflected by the width of each of the bands, which are based on a range of values for H/τ (1 to 10) estimated to be fairly typical for lakes in urban settings.

If an average lake phosphorus concentration of 20 µg/l is used as a reference concentration to assess the tendency for producing undesirable levels of biostimulation, it is apparent that only lakes with rather small area ratios are likely to be unaffected by urban runoff nutrient discharges. Since the three bands represent different concentration levels of phosphorus in urban runoff, qualitative inferences may be drawn concerning the beneficial use impacts of control activities. More detailed estimates may of course be made by use of the methodology with site specific parameters.

The salient feature of the situation, as generalized by the analysis summarized by Figure 7-9, is that the problem potential of urban runoff for lakes is quite site specific. The illustration considers only urban runoff loads; in an actual situation, all nutrient sources (point and nonpoint)

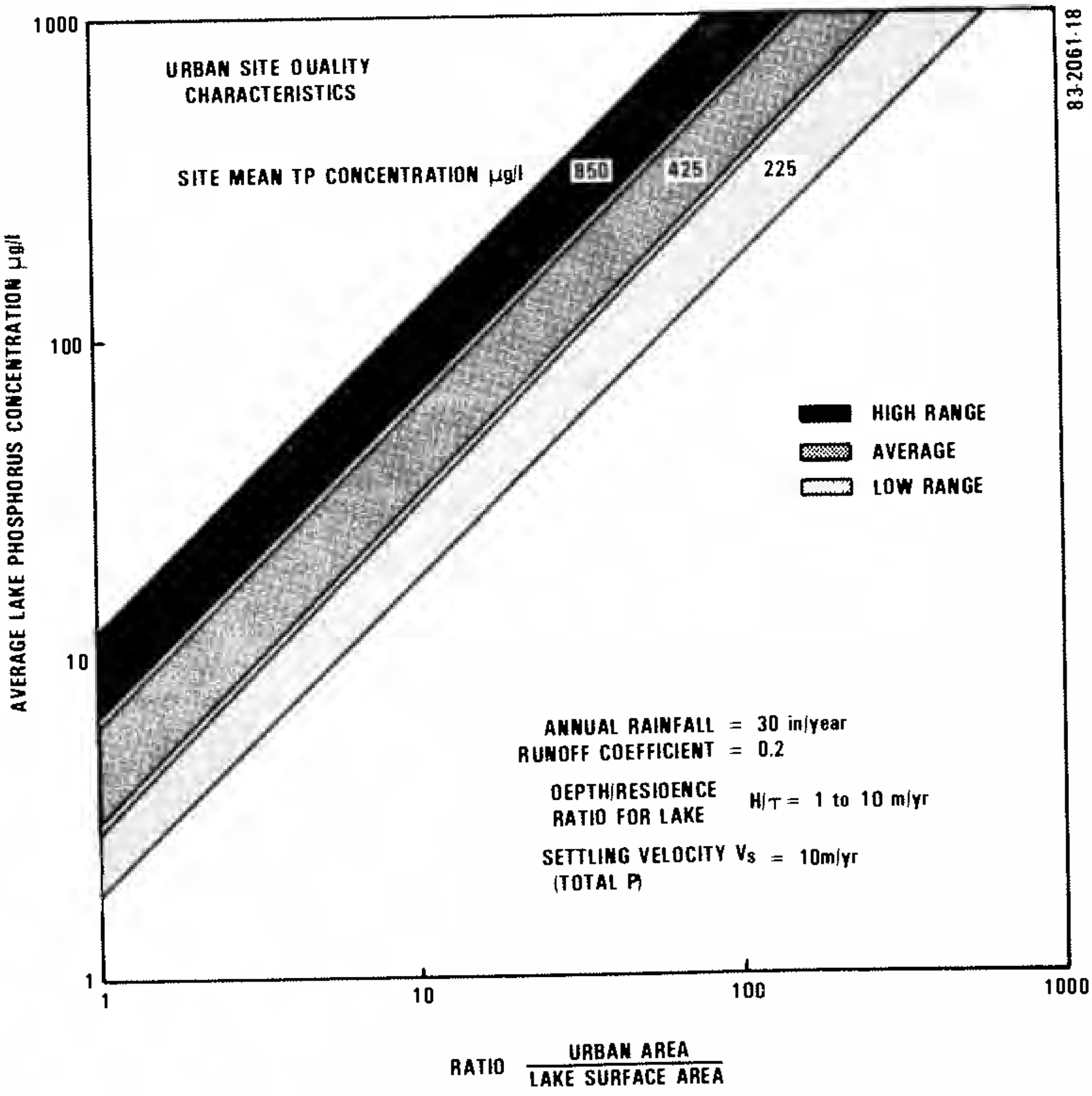


Figure 7-9. Effect of Urban Runoff on Lake Phosphorus Concentrations

would be considered, and this would tend to modify the relative significance of urban runoff on lake conditions.

Several of the NURP projects addressed impacts on lake quality in some depth. These projects include the following:

- Irondequoit Bay, NY - Lake has been highly eutrophic, due to point and nonpoint discharges. Sewage treatment plant and combined sewer overflow discharges have been removed, so that residual sources are recycle from lake sediments and nonpoint sources, including urban runoff, from the contributing drainage area. Further reductions are considered necessary to meet targets. (Area ratio is high at this location.)

- Lake George, NY - Lake is oligotrophic; the study addressed the concern that urban runoff from present and potential future development would unacceptably accelerate degradation of existing water quality. (Area ratio is low at this location.)

- Lake Quinsigamond, MA - Urban runoff was determined to be one of a number of sources preventing water quality objectives from being met. Some control of urban runoff phosphorus loads was recommended as one of the elements of an overall management plan.

Each of the above situations is sufficiently unique, and the mix of urban runoff and other load sources is sufficiently different to suggest that it is inappropriate to attempt a broad generalization. The interested reader may refer to the individual project documents which are available through NTIS for more information.

ESTUARIES AND EMBAYMENTS

These water bodies are normally of sufficient size and complexity that simple screening analyses have not been considered to be sufficiently useful or effective to justify their use.

The Long Island, NY NURP project examined and confirmed that urban runoff sources of coliform bacteria are the principal contributors to the water column concentrations that result in closure of shellfish beds in a number of embayments (principally the Great South Bay). Estimates of control activities that would allow the opening of presently closed areas were also made. The reader is referred to the project documents for further information.

The significance of urban runoff and other nonpoint source loads on eutrophic levels in the Potomac estuary is being investigated under a study which is not associated with the NURP program. However, among other objectives of the WASHCOG NURP project, estimates of urban nonpoint source loads have been developed to support this study.

Although specific situations where urban runoff is significant have been identified, no general assessment for water bodies of this type can be made at this time.

GROUNDWATER AQUIFERS

Much of the precipitation which falls on an area either percolates directly into the ground, or does so after relatively short overland flow distances. This condition is essentially uncontrollable and distinctly different from the case where urban runoff from impervious areas is deliberately collected and routed to a recharge device which causes it to percolate to groundwaters.

This type of control approach is a practical and effective technique for reducing pollutant loads which would otherwise reach surface waters as discussed in Chapter 8. The concern addressed here is with the extent to which groundwater aquifers may be contaminated by this practice.

The Long Island, NY and Fresno, CA NURP projects examined this issue through extensive tests utilizing recharge basins ranging from recent installations to others which have been in service in excess of 20 years. A somewhat simplified consolidation of the salient findings of these two projects is presented below. The interested reader is referred to the individual project report documents, available through NTIS, for the important details and qualifications.

- Most pollutants of importance in urban runoff are intercepted during the process of infiltration and quite effectively prevented from reaching the groundwater aquifers underlying recharge basins. The pollutants tested and found to behave in this manner include the heavy metals, an appreciable number of the organic priority pollutants and pesticides, and coliform bacteria.

- Chlorides, which are sometimes present in urban runoff at elevated concentrations due to road deicing practices, are not attenuated during recharge.

- Pollutants accumulate in the upper soil layers. The concentrations found are a function of the length of time a basin has been in service. Effective retention of pollutants takes place with all soil types tested, ranging from clays to sands. The depth of pollutant penetration is affected by soil type; however in no case did contaminant enrichment of soil exceed several meters depth, and highest concentrations were found near the surface.

- The limit of the ability of the soil to retain the pollutants of interest is unknown. Additional study of this aspect is appropriate. However given the long service periods of a number of the recharge basins studied, this does not appear to represent an imminent concern.

- At both of these NURP locations, groundwater surfaces were at least 20 feet, and often appreciably more, below the base of the recharge device. The indicated findings may not be applicable at locations with shallow depths to groundwater.

- No significant differences in interception/retention of pollutants is apparent for basins with bare versus vegetated recharge surfaces. However vegetation does apparently help to maintain infiltration rates normal for the soil type.

- Surface soil accumulations of priority pollutants in dual purpose installations used for both recharge and recreational use warrants further investigation to determine whether such practice creates unacceptable health risks or requires appropriately designed and conducted maintenance procedures.

CHAPTER 8
URBAN RUNOFF CONTROLS

INTRODUCTION

This chapter summarizes the information developed by the individual NURP project studies relating to performance characteristics of selected techniques for the control of urban runoff quality. The number of control practices addressed here is considerably smaller than the array of best management practices suggested in prior studies and publications. This is not intended to exclude consideration of other approaches. However, the techniques discussed in this chapter may be taken as an expression of controls considered by the agencies involved to be potentially attractive and practicable at localized planning levels. They represent the practices for which performance data were obtained under the NURP program and which can be analyzed and evaluated in this report.

Most of the NURP projects provide in their project reports a detailed analysis and evaluation of the controls that were studied. These reports are available through NTIS. In addition to this information source, an analysis was performed by EPAs NURP headquarters team, using results available from all project studies. The objective was to provide an overview and a generic description of performance characteristics in a format considered to be useful for planning activities. Thus, in addition to providing a consolidated summary of project results, this chapter presents a summary of the results of applying analysis methodologies developed under the NURP program. Further detail on the former can be obtained by reference to relevant project report documents; a more comprehensive development of the latter is provided in separate NURP documents ("Detention and Recharge Basins for Control of Urban Runoff Quality", and "Street Sweeping for Control or Urban Runoff Quality").

The types of control techniques which received attention (to a greater or lesser degree) in the NURP program can be grouped into four general categories.

- Detention Devices - These include normally dry detention basins typically designed for runoff quantity control, normally wet detention basins, dual purpose basins, over-sized drain pipes, and catchbasins.

- Recharge Devices - These include infiltration pits, trenches, and ponds; open-bottom galleries and catchbasins; and porous pavements.

- Housekeeping Practices - These are principally street sweeping, but also include sidewalk cleaning, litter containers, catchbasin cleaning, etc.

- Other - These include the so-called "living filter" approaches, grassed swales, wetlands, etc.

DETENTION DEVICES

General

Detention basins proved to be one of the most popular approaches to urban runoff quality control selected at the local level, based on the number of individual projects which elected to study them and the number of detention devices tested in the study. It is perhaps instructive to note that nearly all the detention facilities studied were either already in place, or required only modifications of outlet structures before initiation of the NURP-supported studies. In general, detention devices proved to provide a highly effective approach to control of urban runoff quality, although the design concept has a significant bearing on performance characteristics.

Table 8-1 lists the NURP projects that included detention devices as elements of their study program. Both the number of devices, and the number of storms analyzed vary considerably, as indicated in Table 8-1, depending on project priorities and other relevant activities. As a result, not all of the sites are incorporated in the summary presented below. The Washington Area Council of Governments (WASHCOG) conducted a particularly thorough and comprehensive investigation of control techniques, particularly detention basins. They have prepared several useful and informative analyses of performance results on these devices.

Dry Basins

This is a type of detention basin which is currently in fairly extensive service in various parts of the country. The performance objective of such basins is commonly called "peak shaving", that is, to limit the maximum rate of runoff to some preselected magnitude, usually a maximum pre-development rate. The purpose is to control flooding and erosion potential in areas downstream of new development. Such basins employ a bottom outlet having a hydraulic capacity restricted to the maximum allowable flow. Runoff from smaller storms flows along the bottom of the basin and is discharged without restriction. Flows in excess of design are backed up in the basin temporarily and ponding occurs only during larger storms and for relatively short periods of time. This class of retention basin is thus normally dry.

Performance of such basins, from a pollutant removal aspect, range from insignificant to quite poor. Accordingly, the limited data available are not discussed in this chapter.

Wet Basins

This designation covers detention basins which maintain a permanent pool of water. They may vary considerably in appearance, ranging from natural ponds or small lakes dedicated urban runoff control to enlarged sections in

TABLE 8-1. DETENTION BASINS MONITORED BY NURP STUDIES

Project	Site	Design Type	No. Events in/out
CO1 Denver	North Ave	Dry Basin	39/21
DC1 Washington, D.C.	Burke	Wet Basin	60/35
	Lakeridge	Dry Basin	49/41
	Stedwick	Dual-Purpose	48/34
	Westleigh	Wet Basin	41/45
IL2 N. Illinois	Lake Ellyn	Wet Basin	29/23
MI1 Lansing	Dryer Farms	Dry Basin	2/8
	Grace St. N*	Wet Basin	23/21
	Grace St. S*	Wet Basin	20/22
	Waverly Hills	Wet Basin	35/30
MI3 Ann Arbor	Pitt-AA	Wet Basin	6/6
	Traver	Wet Basin	5/5
	Swift Run	Wet Basin	5/5
NY1 Long Island	Unqua Pond	Wet Basin	8/8

* These are oversized storm drains installed below street level. Inverts of control sections are below the general grade line, so a permanent pool is maintained.

constructed drainage systems. Runoff from an individual storm displaces all or part of the prior volume, and the residual is retained until the next storm event. This pattern may or may not be modified by natural base inflows during dry weather depending on the local situation.

Detention basins utilizing this design concept have been shown by the NURP studies to be capable of highly effective performance in urban runoff applications, as summarized below. Although performance characteristics of individual basins ranged from poor to excellent, analysis shows these differences to be attributable to the size of the basin relative to the connected urban area and local storm characteristics. Performance data also indicate that in addition to removal of particulate forms or pollutants by sedimentation, some basins exhibit substantial reductions in soluble nutrients (soluble phosphorus, nitrate + nitrite nitrogen). This is attributed to biological processes which are permitted to proceed in the permanent water pool.

There are a number of ways to characterize detention basin performance. The primary basis selected by NURP for doing so is to define performance efficiency on the basis of the total pollutant mass removed over all storms. This provides a meaningful general measure for comparison, is relevant for water quality effects associated with extended time scales (e.g., nutrient load impacts on lakes), and conforms with the capabilities of the NURP analysis methodology developed to provide a planning-level basis for estimating cost/benefit differences in size or application density of this type control.

Table 8-2 tabulates performance in terms of reduction in pollutant mass loads over all monitored storm events. The analysis methodology developed under the NURP program activities suggests that performance should be expected to improve as the overflow rate (QR/A = mean runoff rate ÷ basin surface area) decreases and as the volume ratio (VB/VR = basin volume ÷ mean runoff volume) increases. The NURP basins used in the analysis are listed in increasing order of expected performance capabilities.

The wide range of relative basin sizes provided by this data base is apparent, and performance is seen to generally correspond with expectations. The poorest performance occurs in a basin with an average overflow rate during the mean storm of about six times the median settling velocity (1.5 ft/hr) of particles in urban runoff. In addition, less than 5 percent of the mean storm runoff volume remains in this basin following the event, to be susceptible to additional removal by quiescent settling during the interval between storms. The basins which exhibit high removal efficiencies, at the other end of the scale, have size relationships which result in the mean storm displacing only about 10 percent of the available volume, and producing overflow rates which are only a small fraction of the median particle settling velocity.

This rationale is described more completely in the supporting NURP document on detention basins identified earlier. The testing of the methodology against the NURP monitoring data is presented, and the basis for the performance projections illustrated below is documented.

Figure 8-1 presents a projection of removal efficiency of urban runoff detention devices as a function of basin size relative to the contributing catchment area and regional differences in typical rainfall patterns. The removal rates apply for TSS, which are all settleable, and must be factored by the particulate/soluble fraction of other pollutants which have significant soluble fractions in urban runoff. It applies for the specific basin average depth and area runoff coefficient indicated (which are fairly typical based on NURP data). However performance relationships could be different than indicated based on relevant local values for the controlling parameters.

An alternate approach for characterizing performance of detention basins concentrates on the variable characteristics of individual storm events and how these are modified by the detention device. A comparison of the mean and coefficient of variation of basin inflow and discharge concentrations provides another measure of performance of an urban runoff detention device.

TABLE 8-2. OBSERVED PERFORMANCE OF WET DETENTION BASINS
REDUCTION IN PERCENT OVERALL MASS LOAD

Project and Site	No. of Storms	Size Ratios		Average Mass Removals - All Monitored Storms (Percent)									
		QR/A	VB/VR	TSS	BOD	COD	TP	Sol.P	TKN	NO_{2+3}	T.Cu	T.Pb	T.Zn
Lansing Grace St. N.	18	8.75	0.05	(-)	14	(-)	(-)	(-)	(-)	(-)	(-)	9	(-)
Lansing Grace St. S.	18	2.37	0.17	32	3	(-)	12	23	7	1	(-)	26	(-)
Ann Arbor Pitt-AA	6	1.86	0.52	32	21	23	18	(-)	14	7	•	62	13
Ann Arbor Traver	5	0.30	1.16	5	(-)	15	34	56	20	27	•	•	5
Ann Arbor Swift Run	5	0.20	1.02	85	4	2	3	29	19	80	•	82	(-)
Long Island Unqua	8	0.08	3.07	60	(TOC=7)		45	•	(-)	(-)	•	80	•
Washington, D.C. Westleigh	32	0.05	5.31	81	•	35	54	71	27	•	•	•	26
Lansing Waverly Hills	29	0.04	7.57	91	69	69	79	70	60	66	57	95	71
NIPC Lake Ellyn	23	0.10	10.70	84	•	•	34	•	•	•	71	78	71

Notes: (-) Indicates apparent negative removals.

• Indicates pollutant was not monitored.

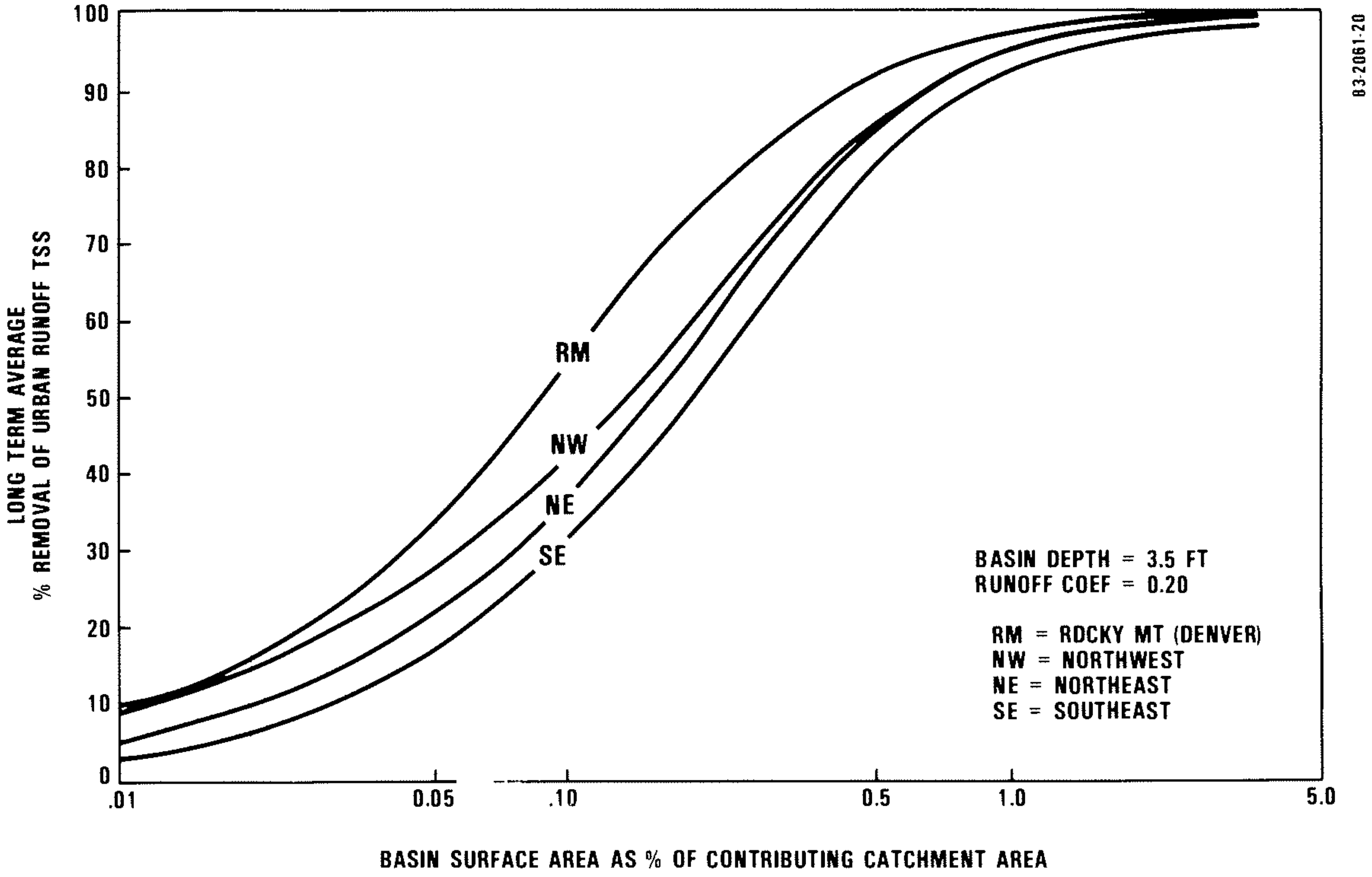


Figure 8-1. Regional Differences in Detention Basin Performance

This approach provides more useful information for subsequently evaluating the effect of controls on water quality impacts on rivers and streams. As evident from the discussion in Chapter 6, reductions in the mean and variability of runoff concentrations (and the inferred reduction in mean and variability of runoff rates) will have a significant beneficial effect on the severity of impacts on flowing streams.

Table 8-3 summarizes detention basin performance when assessed in this manner. It should be noted that in most cases more inlet storm events were monitored than discharge events, and that some inlet events do not have a matching discharge event and vice-versa. Further, for the larger basins where storm inflow displaces only a fraction of the basin volume, it is unlikely that influent and effluent for a specific event represent the same volume of water. The tacit assumption in this analysis is that the inflow events which were monitored provide a representative sample of the total population of all influent event mean concentrations (EMCs). Similarly, the monitored effluent events are assumed to be a representative sample of all basin discharge EMCs. The appropriateness of this assumption is obviously more uncertain where the number of individual storm events monitored is small.

For each basin influent and effluent, the arithmetic mean and variance were computed based on the relationships for lognormal distributions. The percent reduction in the mean concentration and the coefficient of variation are tabulated (Table 8-3). Note that where the number of monitored events shown in this table differ from those listed in Table 8-2, it is because the mass removal computations were restricted to synoptic storms (i.e., matching influent and effluent results were available for an event).

Performance characteristics are generally consistent using either approach, even though each displays a different type of information. Performance improves with detention basin size relative to catchment size and hence the magnitude of the runoff processed. Giving greater weight to the sites monitoring large numbers of storms, indications are that for most pollutants wet ponds also generally result in a considerable reduction in the variability of pollutant concentrations.

A significant exception to this tendency to reduce variability is shown for the soluble nitrogen forms (NO_2 + NO_3). The positive removal efficiency indicated by reduction of mean concentrations must be attributed to biological processes rather than sedimentation. A substantial increase in variability is consistently indicated by the data. Among the heavy metals, lead which is nearly all in particulate form shows significant reductions in variability. Copper and zinc which have high (40 to 60 percent) soluble fractions show an ambiguous pattern with regard to changes in variability.

In a few of the cases where atypical results are indicated, unique local conditions suggest plausible explanations. For example, at the Ann Arbor (Traver) site, erosion from an unstabilized bank at the outlet of this newly constructed basin is attributed to the poor suspended solids removal observed. The poor removal characteristics at the Unqua site for TKN and nitrate may be associated with the significant wildfowl population at this site.

TABLE 8-3. OBSERVED PERFORMANCE OF WET DETENTION BASINS (PERCENT REDUCTION IN POLLUTANT CONCENTRATIONS)

(a) Mean EMC

Project and Site	No. of Storms (1)	Percent Reduction in Mean EMC									
		TSS	BOD	COD	TP	Sol.P	TKN	NO_{2+3}	T.Cu	T.Pb	T.Zn
Lansing Grace St. N.	23/20	(6)	(26)	15	(10)	(26)	11	(1)	(9)	39	(9)
Lansing Grace St. S.	18/17	22	4	(3)	6	0	(5)	(20)	25	14	7
Ann Arbor Pitt-AA	6/6	38	17	23	28	(2)	11	8	·	59	22
Ann Arbor Traver	5/5	0	(66)	12	37	63	19	28	·	·	19
Ann Arbor Swift Run	5/5	83	11	(3)	(38)	21	25	77	·	86	·
Long Island Unqua	8/8	34	(TOC=26)		38	·	(31)	(10)	·	78	·
Washington, D.C. Westleigh	40/40	83	·	33	59	70	19	28	10	·	10
Lansing Waverly Hills	35/30	87	52	52	69	56	30	54	53	93	58
NIPC Lake Ellyn	25/20	92	·	64	61	62	·	82	88	91	87

(b) Coefficient of Variation of EMCs

Project and Site	No. of Storms (1)	Percent Reduction in Coef of Variation of EMCs									
		TSS	BOD	COD	TP	Sol.P	TKN	NO_{2+3}	T.Cu	T.Pb	T.Zn
Lansing Grace St. N.	23/20	14	49	35	(7)	(13)	30	0	0	45	(31)
Lansing Grace St. S.	18/17	(7)	(59)	39	13	0	20	21	17	18	15
Ann Arbor Pitt-AA	6/6	17	(6)	10	28	(84)	37	0	·	53	(5)
Ann Arbor Traver	5/5	14	(109)	58	(3)	42	(150)	(82)	·	·	0
Ann Arbor Swift Run	5/5	(5)	39	50	(150)	0	20	(150)	·	26	·
Long Island Unqua	8/8	(87)	(TOC=66)		47	·	19	(66)	·	65	·
Washington, D.C. Westleigh	40/40	46	·	(26)	15	20	41	(280)	0	·	(14)
Lansing Waverly Hills	35/30	38	5	69	34	26	(8)	(198)	(22)	34	(36)
NIPC Lake Ellyn	25/20	44	·	41	71	48	·	(115)	60	19	41

Notes: (1) In/Out; numbers are approximate, and vary with pollutant. Removals in parentheses indicate negative removal.

Dot (·) indicates pollutant either not monitored or number of observations is too small for reliable estimate of percent reduction.

The ability of detention basins to reduce coliform bacteria concentrations is also of considerable interest because of the significant impact these urban runoff contaminants exert on recreational or shellfish harvesting beneficial uses. Other than at the Unqua site of the Long Island NURP project, the number of observations made for indicator bacteria were too few to support a reliable assessment of the ability of detention basins to effect quality improvements. However, extensive data of this nature were secured on detention basin influent and effluent during all monitored storms at the Unqua site.

Since coliform bacteria have a high rate of die-off in natural waters, performance characteristics based on total mass reductions are not particularly meaningful. The Unqua site data were analyzed to evaluate performance in terms of reductions in concentration levels. Over eight monitored storms at this site, covering a wide range in storm size, the mean EMC (MPN/100 ml) was reduced by 94 percent for total coliform, 91 percent for fecal coliform, and 95 percent for fecal streptococcus bacteria. Variability of bacteria concentrations in the pond outlet increased, with effluent coefficients of variation ranging from about 10 to 100 percent greater than influents. Accordingly, detention basins employing permanent pools (wet ponds) are indicated to be capable of substantial reductions in indicator bacteria.

Dual Purpose Basins

In the absence of a well defined terminology, we have adopted this designation to define basins that are normally dry, and hence retain their full potential for flood control, but which have outlet designs that result in a slow release rate for detained storm flows. Detention time is extended considerably compared with that provided by dry basins employing conventional outlet designs.

One of the detention basins examined by the WASHCOG NURP project, was of this type. This project designates such designs as "Extended Detention Dry Ponds." The pond was converted from a conventional dry pond by replacing the outlet pipe with a perforated riser enclosed in a gravel jacket. The modification was designed to detain stormwater runoff for up to 24 hours, instead of the 1 to 2 hours typically observed in conventional dry ponds.

For undetermined reasons, average detention periods during the study were in the order of 4 to 8 hours, and hence considerably shorter than the design objective. Nevertheless, based on monitoring of more than 30 storm events, the removal of particulate forms of urban pollutants was typically high and comparable to the performance efficiency of wet ponds.

Observed removals for this site (Stedwick) are summarized by Table 8-4, showing percent reductions in both mass and concentration distributions. The principal differences in performance of dual purpose basins compared with wet basins are suggested by the available data to consist of the following:

- Soluble pollutants (e.g., soluble P and Nitrate/Nitrite) are not effectively reduced because of the absence of a permanent pool within which biological reactions have an opportunity to occur in addition to sedimentation.

- The variability of pollutant EMC's does not appear to be modified to the extent that this occurs in wet ponds.

TABLE 8-4. PERFORMANCE CHARACTERISTICS OF A DUAL-PURPOSE DETENTION DEVICE

(Stedwick Site - Washington Area NURP Project)

Pollutant	Percent Reduction In		
	Pollutant Mass Load Over All Monitored Storms	Pollutant EMC's	
		Mean	Coef Var
TSS	64	63	(31)
COD	30	41	17
Total P	< 15	11	0
Sol P	1	(4)	(13)
TKN	•	8	(11)
Organic N	30	•	•
NO_{2+3}	10	13	6
T. Cu	•	•	•
T. Pb	84	•	•
T. Zn	57	43	33

Although the performance characteristics of basins of this type are indicated to be somewhat inferior to the potential offered by wet ponds, there are a number of considerations which make dual purpose basins highly attractive candidates for quality control of urban runoff. These include the fact that flood control requirements are likely to be more economically obtained than with wet basins and that many existing stormwater management basins may be readily modified to significantly enhance their capability for improving the quality of urban runoff. In areas where ordinances requiring conventional stormwater management ponds are already in existence, the only changes required would be an alternate specification of the outlet design.

Costs

The information presented here is intended to provide an order of magnitude estimate of the cost of providing different levels of control of urban runoff pollutant discharges, when wet detention devices are used as the best management practice (BMP). The summary is based on the size versus performance relationship presented earlier in Figure 8-1 and on the size versus cost relationships presented below.

The analysis is based on cost information developed by the WASHCOG NURP project and discussed in detail in one of their project reports produced for the NURP effort. Construction cost estimates as a function of basin volume are shown by Figure 8-2, adopted from this source. This estimate compares quite favorably with a similar cost/size relationship developed previously by the Soil Conservation Service (SCS).

The cost relationship shown by this figure applies to "dry pond" designs and relates only to expected cost of construction activities. For specific cost estimates, the results derived from Figure 8-2 should be modified as appropriate, in accordance with the following:

- The highly variable capital cost of land acquisition is not included in the construction costs.

- Outlet modifications to provide a dual purpose basin design will increase construction costs by about 10 to 12 percent.

- Pond designs which meet the peak shaving requirements of conventional (dry) pond designs, but also provide a permanent pool of water may have costs up to 40 percent greater than indicated by the cost relationship shown by Figure 8-2.

- An additional allowance equal to 25 percent of construction costs is suggested to allow for planning, design, administration, and construction related contingencies.

- Operation and maintenance costs are estimated to involve an annual expenditure of approximately 3 to 5 percent of base construction cost, that is, before application of the 25 percent factor for design, planning, and administration. The total is composed of two elements: 2 to 3 percent of construction cost estimates the annual cost of routine maintenance and upkeep; an additional 1 to 2 percent of construction cost estimates the annualized cost of sediment removal operations for a 10 year clean-out cycle.

Planning agencies often distinquish between "on-site" controls, which are applied to relatively small urban catchments, often installed by the developer of an urban property, and "off-site" controls, which involve larger basins and serve substantially larger urban drainage areas. Because of the appreciable economy of scale inherent in the cost relationship defined by Figure 8-2, this factor must be taken into account in developing cost/performance summaries for urban runoff quality control using detention basins. Accordingly, the control costs presented below for wet basin designs indicate the differences based on the size of the urban catchment the basin is designed to serve.

Figure 8-3 presents a planning level approximation of both present value and annual cost of wet detention basins. Amoritization of costs is based on a 20 year basin life and an interest rate of 10 percent.

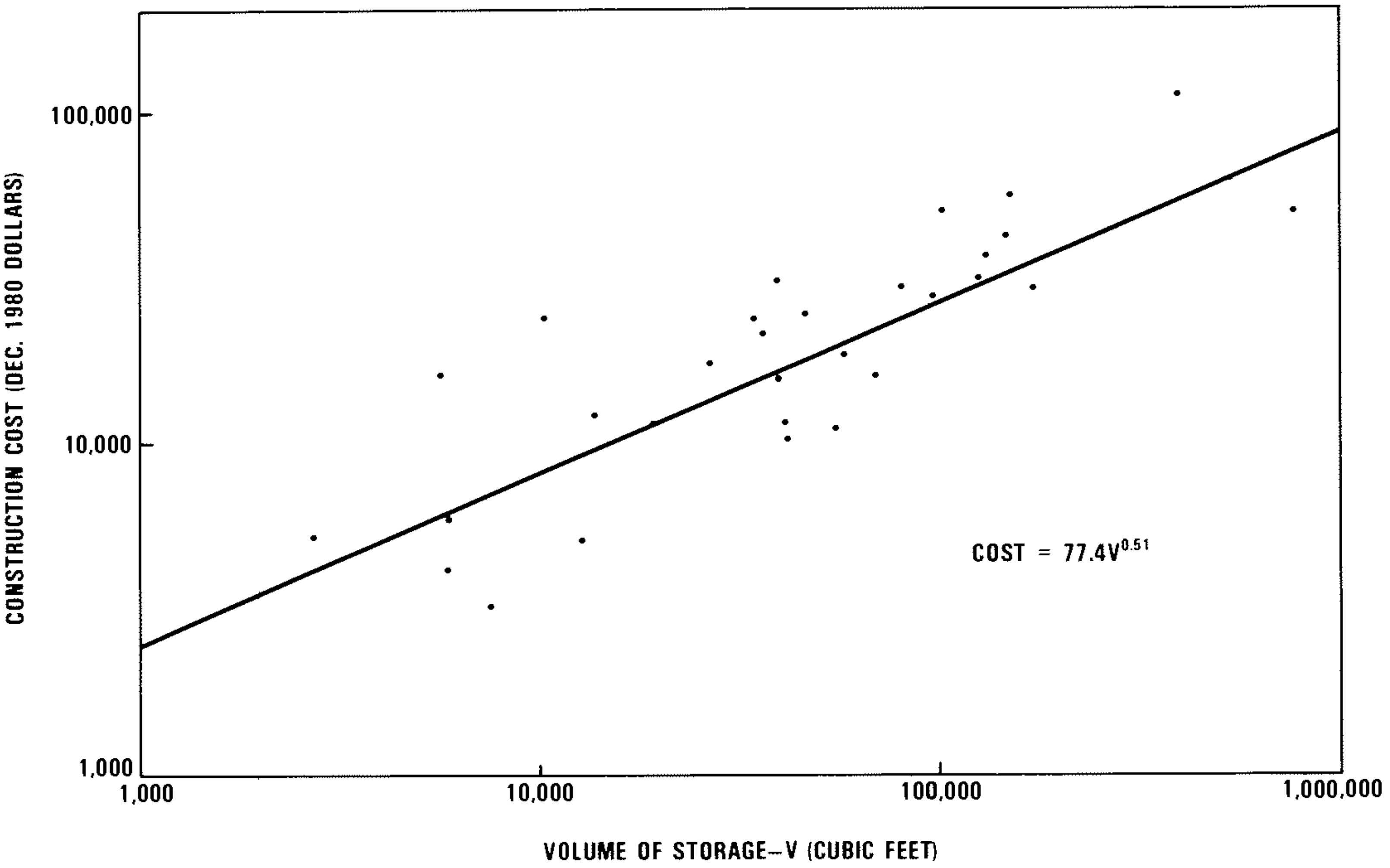


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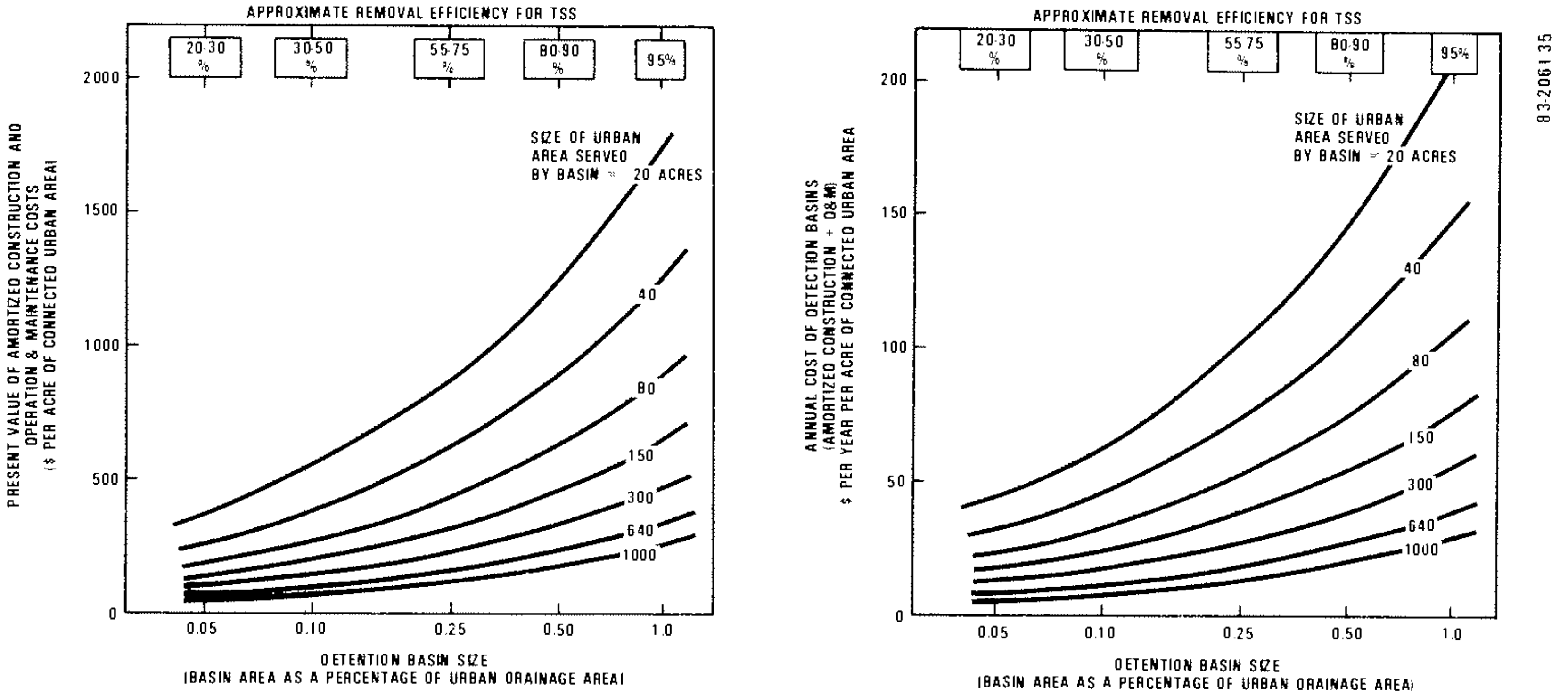
Figure 8-2. Average Stormwater Management (Dry) Pond Construction Cost Estimates Vs. Volume of Storage



BASIS WET BASINS--CONSTRUCTION COSTS 40% GREATER THAN FIGURE 8 2
ANNUAL O&M COST--5% OF BASE CONSTRUCTION COST
BASIN AVG DEPTH 3.5 FEET
INTEREST RATE 10%
BASIN LIFE 20 YEARS

Figure 8-3. Cost of Urban Runoff Control Using Wet Detention Basins

The performance levels associated with a particular basin size are shown at the top of the plots as a range for long-term average removal efficiencies for TSS. The range associated with a particular size reflects the regional differences in performance which can be expected (Figure 8-1) as a result of regional differences in storm characteristics. Approximate removal efficiencies for pollutants other than TSS can be estimated by factoring the indicated TSS removal by the particulate fraction of the pollutant of interest. The supplementary NURP document dealing with detention basins provides information to permit further refinement. A more concise local summary of cost/performance relationships can be developed using the NURP data and analysis methods, if local rainfall and land use characteristics, and design and planning preferences are utilized.

The generalized relationships shown by Figure 8-3 can be summarized as follows, if an urban catchment size of 20 to 40 acres is taken to represent a typical "on-site" control application, and an "off-site" application is reflected by detention basins serving 640 to 1000 acres.

Control Application	Approximate Level of Control (% TSS Reduction)	Cost Per Acre of Urban Area (Approximate)	
		Present Value	Annual Cost
On-site	50	\$500 - \$700	\$60 - \$80
	90	\$1000 - \$1500	\$125 - \$175
Off-site	50	\$100	\$10
	90	\$250	\$25

RECHARGE DEVICES

Control measures which enhance the infiltration of urban runoff are indicated by the NURP studies to be techniques which are practical to apply and capable of effective reductions in urban runoff quantity and quality. This finding is based on project reports and on the results of a screening analysis using a probabilistic methodology described in a supplementary NURP document on detention basins.

The issue of the potential contamination of groundwater aquifers due to enhanced infiltration of urban storm runoff has been discussed in the previous chapter dealing with receiving water impacts. The favorable findings support further consideration of this technique. At the same time, it must be emphasized that specific local conditions may make recharge inappropriate. Such conditions can include steep slopes, soil conditions, depth to groundwater, and the proximity of water supply wells. Sound planning and engineering judgement must be applied to determine the acceptability of this control approach in a local situation.

However, where local conditions premit, a wide variety of design concepts are available for use. These range from off-site applications consisting of large retention basins, to small individual on-site units which include infiltration pits and trenches, percolating catch basins, and porous pavement. The operating principle is the same regardless of size or design concept. The important elements are the surface area provided for sub-surface percolation and the storage volume of the device. Overall performance will be related to the size of the recharge device relative to the urban catchment it serves and the permeability (infiltration rate) of the soil.

The context in which the performance capabilities of recharge devices are evaluated is the extent to which urban runoff is "captured" and prevented from discharging directly to surface waters. Pollutant removals are reduced in direct proportion to the runoff volume which is intercepted and recharged. Load reductions will be further enhanced if quality improvements occur in the portion of the runoff which is not captured. The combination of soil infiltration rate and percolating area provided determines the "treatment rate" of a specific recharge device. When storm runoff is applied to the device at rates of flow equal to or less than this rate, 100 percent of the runoff is captured during that event. At higher applied rates, the fraction of the runoff flow in excess of the treatment rate will escape and discharge to surface waters.

Most recharge devices other than porous pavement also provide storage volume. This improves performance capability because portions of the excess runoff can be retained for subsequent percolation when applied rates subside. Overflow to surface water occurs only when the available storage is exceeded.

The Long Island and Metropolitan Washington, D.C. (WASHCOG) NURP projects examined the performance of on-site recharge devices. An interconnected system of percolating catch basins in Long Island was estimated to reduce surface water discharges of storm runoff by more than 99 percent. The WASHCOG project found that a porous pavement site produced pollutant load reductions on the order of 85 to 95 percent depending on the specific pollutant considered. An infiltration trench studied by this project produced reductions in the order of 50 percent.

The NURP analysis methodology was employed in a screening analysis to assist planning evaluations by establishing the relationship between performance level and device size and soil percolation rates. Figure 8-4 presents a planning level estimate of the influence of size, soil characteristics, and regional rainfall differences on the performance of recharge devices.

The upper plot illustrates the significant effect regional differences in rainfall characteristics can have on the performance of identical recharge devices. Basin depth, soil percolation rate, and runoff coefficient for the urban catchment are the same for each case. The performance differences result from differences in the intensity and volume of the average storms in each region. Basin size is represented on the horizontal axis by expressing the percolation area that is provided as a percentage of the area of the contributing urban catchment. For example, a recharge device with a percolating surface area equal to 0.10 percent of an urban catchment represents a design which provides (43,560 sq ft/acre x 0.10/100% =) 43.5 square feet of

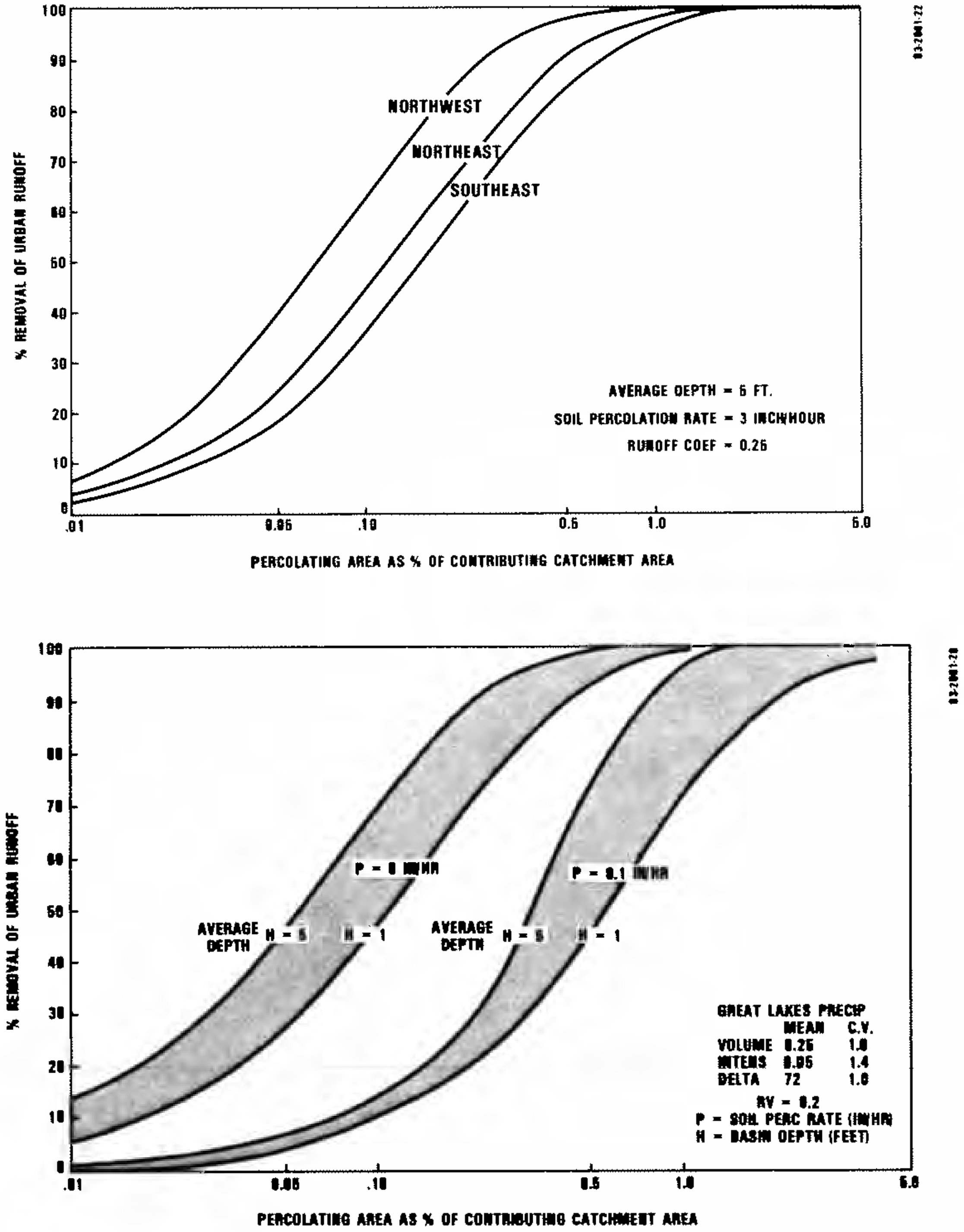


Figure 8-4. Long Term Average Performance of Recharge Devices

percolating surface area for each acre of urban catchment it serves. The long-term average reductions in urban runoff volume and pollutant load which can be expected will be approximately 35 percent in the southeast, 45 percent in the northeast and 65 percent in the Pacific northwest.

The lower plot illustrates the much more significant influence of the amount of storage volume provided (incidated by basin average depth), and the permeability of the soil through which the storm runoff must percolate. The rainfall characteristics used in this analysis are typical of the Great Lakes region of the United States and are roughly comparable to those in the northeastern part of the country. As might be expected, the permeability of the soil in which the recharge device is constructed has a dominant influence on performance capability. However significant compensation for low percolation rates can be achieved by increases in percolation area and storage volume.

When the screening analysis results are considered along with the favorable results from the NURP studies, the NURP findings indicate that with a reasonable degree of design flexibility to compensate for soils with lower percolation rates, recharge devices provide a very effective method for control of urban runoff.

STREET SWEEPING

End-of-pipe urban runoff pollutant concentrations have been commonly viewed as being a function of two prime factors -- accumulation of contaminants on street surfaces and rainfall/runoff washoff. The postulated beneficial effect of street sweeping was to reduce contaminant accumulation. Prior to NURP, emphasis of street sweeping investigations was placed on street surface mechanisms (e.g., accumulation and washoff) and sweeper equipment performance in removing street dirt. While these studies provided valuable insights into the possible benefits of street sweeping, measurements of end-of-pipe concentrations are the only direct measures of street sweeping effectiveness in water quality terms.

Recognizing this, NURP was designed to provide a large data base of urban runoff water quality concentrations for both swept and unswept conditions. In addition, the NURP street sweeping projects gathered and evaluated data on atmospheric deposition (i.e., wetfall and dryfall), street surface accumulation and washoff, and street sweeper removal rates and costs. The individual project reports look at these other issues, and the results are not repeated herein. Of prime interest and provided below is the effectiveness of street sweeping in reducing end-of-pipe urban runoff pollutant concentrations (and ultimately receiving water impacts). The findings presented below are based upon the analyses performed by the individual projects, as well as other statistical techniques, and are generally consistent with the projects' conclusions.

Five of the 28 NURP prototype projects had the evaluation of street sweeping as a central element of their work plans. These projects were as follows:

Project	Number of Sites
Castro Valley, CA	1
Milwaukee, WI	8
Champaign-Urbana, IL	4
Winston-Salem, NC	2
Bellevue, WA	2

Long Island, NY and Baltimore, MD also collected limited street sweeping data. The experimental designs of the projects varied in detail, but essentially followed either a paired basin or serial basin approach to gather test and control data, with some projects using both approaches. The general concept was that during a test period street sweeping would be more intensive (up to daily) and thorough (e.g., with operator training, parking bans, etc.) than during control periods when the streets were to be swept as usual or not at all.

In the paired basin approach, two adjacent or close-by basins were operated in a "control" or unswept mode for certain periods of time to establish a baseline comparison, and then street sweeping was performed in a "test" basin while the other remained as a control. The data provided an overall comparison between basins as well as a series of synoptic events for both basins. In the serial approach, a basin was periodically operated in either a control or test mode, with the periods adjusted so that all seasons of the year were represented in each mode. Here, rather than synoptic data pairs, one has data strings for both "swept" and "unswept" conditions.

There are no well established or prescribed procedures for evaluating the possible reduction in runoff concentrations due to street sweeping. Issues of concern include storm size and intensity effects, time since last rain, ability to select truly paired basins, seasonal effects, etc. In an attempt to sort out these issues, an exploratory data analysis was performed, and the following findings were established:

- Street sweeping has not been found to change the basic probability distribution of event mean concentrations. That is, the fundamental assumption of random, lognormal behavior is valid during sweeping operations.

- The runoff quality characteristics of a basin during swept or unswept conditions is best measured by the maximum likelihood estimator of the median EMC, with the uncertainty indicated by the 90 percent confidence interval of the median.

- There is in most cases no significant correlation (and in a few cases a weak negative correlation) between EMCs and storm runoff volume. EMCs and storm runoff intensities are also generally uncorrelated (but in isolated cases exhibit a weak positive correlation). The implication of these findings is that differences in concentrations between swept and unswept conditions will be largely unaffected by the size of the storms during the monitoring periods. Because of this independence between concentration and volume, effects of sweeping on EMCs will also indicate effects on mass pollutant loads.

- EMCs for synoptic events on paired basins are, in general, not significantly correlated or in some cases are weakly correlated; however, over the longer term (e.g., mean, frequency distribution, etc.), there are no significant differences between the distribution of EMCs of paired basins. These results show that basins are independent from storm to storm, and thus, comparisons between basins should not be attempted using synoptic events, but the basins do have similar statistical properties and thus can be considered paired.

To evaluate the effectiveness of street sweeping, a series of bivariate plots were constructed for projects using the serial basin approach. The site median EMCs for swept and unswept conditions form the data pairs of the plots. Bivariate plots are presented in Figure 8-5 for TSS, COD, TP, TKN, and Pb concentrations, respectively. Each plot contains swept or unswept conditions for multiple project sites. The assumption of the analysis is that a large enough data base was collected to negate any temporal effects such as seasonal, land use conditions, parking patterns, and other possible factors (as noted earlier, storm volume and intensity effects are not believed to be significant). Examining the bivariate plots, it is observed that, for the NURP data, the median concentrations are as likely to be increased as decreased by street sweeping. Further, street sweeping never produced a dramatic (e.g., >50 percent) reduction in concentrations (or loads).

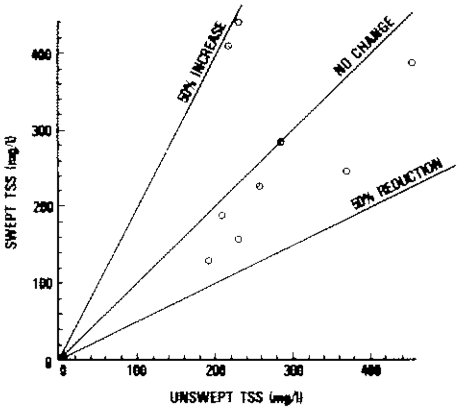
Street sweeping performance, as measured by the percent change in the site median EMC, for selected NURP sites is graphically displayed in Figure 8-6. The results are for five constituents (TSS, COD, TP, TKN, and Pb) at 10 sites nationwide). For each site, the median EMC is based on data from between 10 and 60 events, with 30 events typical. Based on Figure 8-6 a number of important observations are evident.

- Performance as measured by change in site median EMC is highly variable.

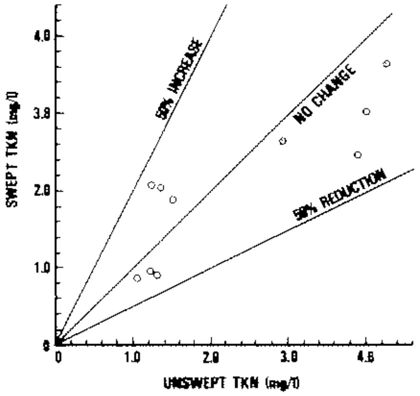
- Where reductions occur, they generally occur for all constituents.

- Reductions never exceed 50 percent.

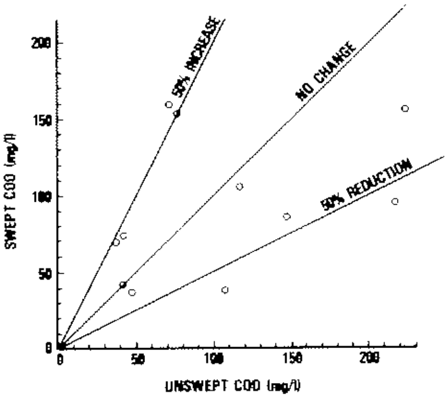
(TSS Concentrations)



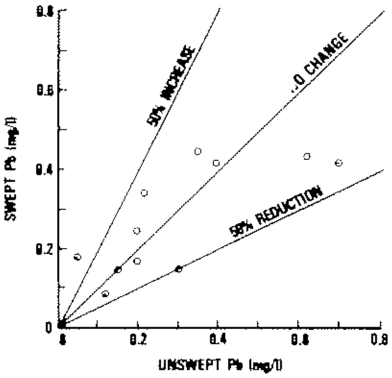
(TKN Concentrations)



(COD Concentrations)



(Pb Concentrations)



(TP Concentrations)

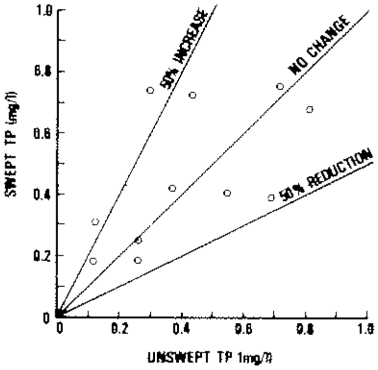


Figure 8-5. Bivariate Plots of Median EMCs for Swept and Unswept Conditions

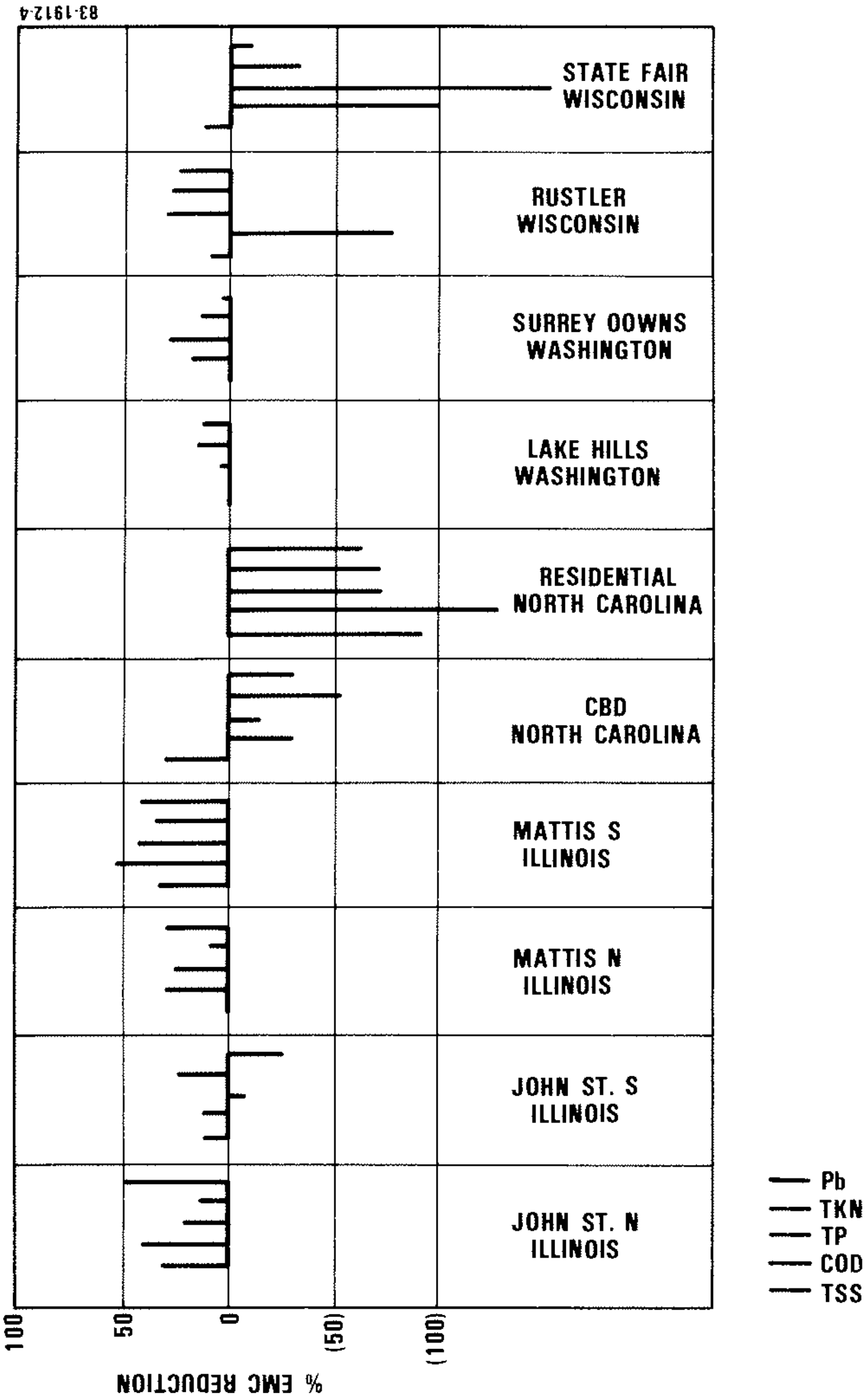


Figure 8-6. Street Sweeping Performance

In evaluating the results, it is critical that the uncertainty in the estimate of median EMCs based on limited observed data, and thus the uncertainty in performance estimates, be assessed. This is especially true for the cases of apparent increases in concentrations indicated by Figure 8-6.

For each of the 10 sites considered, the 90 percent confidence intervals of the site median EMCs were computed as indicated in Figure 8-7. This analysis indicates that there is generally no significant difference between median EMCs for swept and unswept conditions. The implications of this analysis of uncertainty are as follows:

- Based on statistical testing, no significant reductions in EMCs are realized by street sweeping.

- The indicated changes in site median EMCs (increases or decreases) are much more likely due to random sampling than actual effects of sweeping operations.

- Benefits of street sweeping (if any) are masked by the large variability of the EMCs, therefore the benefit is certainly not large (e.g., >50 percent), and an even larger site data base is required to further identify the possible effect.

- In the above context, the hypothesis that street sweeping increases EMCs is generally not shown by the data, though it could occur in isolated, site specific cases.

Urban runoff loads are the product of long term (e.g., annual) runoff volume and event mean concentration. Under this definition, statements concerning EMCs also hold for loads.

OTHER CONTROL APPROACHES

Several best management practices (BMPs) in addition to those discussed above should be identified on the basis that local planning efforts determined them to be practical to apply and to have the potential to provide significant improvements in the quality characteristics of urban runoff. They are grouped together in this section and discussed only briefly, principally because, for one reason or another, sufficient data to characterize their performance capabilities was not developed during the NURP program.

Grass Swales

Three grass swales were monitored by the Washington, D.C. area NURP project. No significant improvement is urban runoff quality was indicated for pollutants analyzed. Increases in zinc concentration which were observed were attributed to mobilization of zinc from the galvanized culverts which carried runoff under the driveways at the monitored residential sites. However the project study report concluded that modifications which would increase residence of runoff in the swales and enhance infiltration capability could make this BMP effective for control of urban runoff.

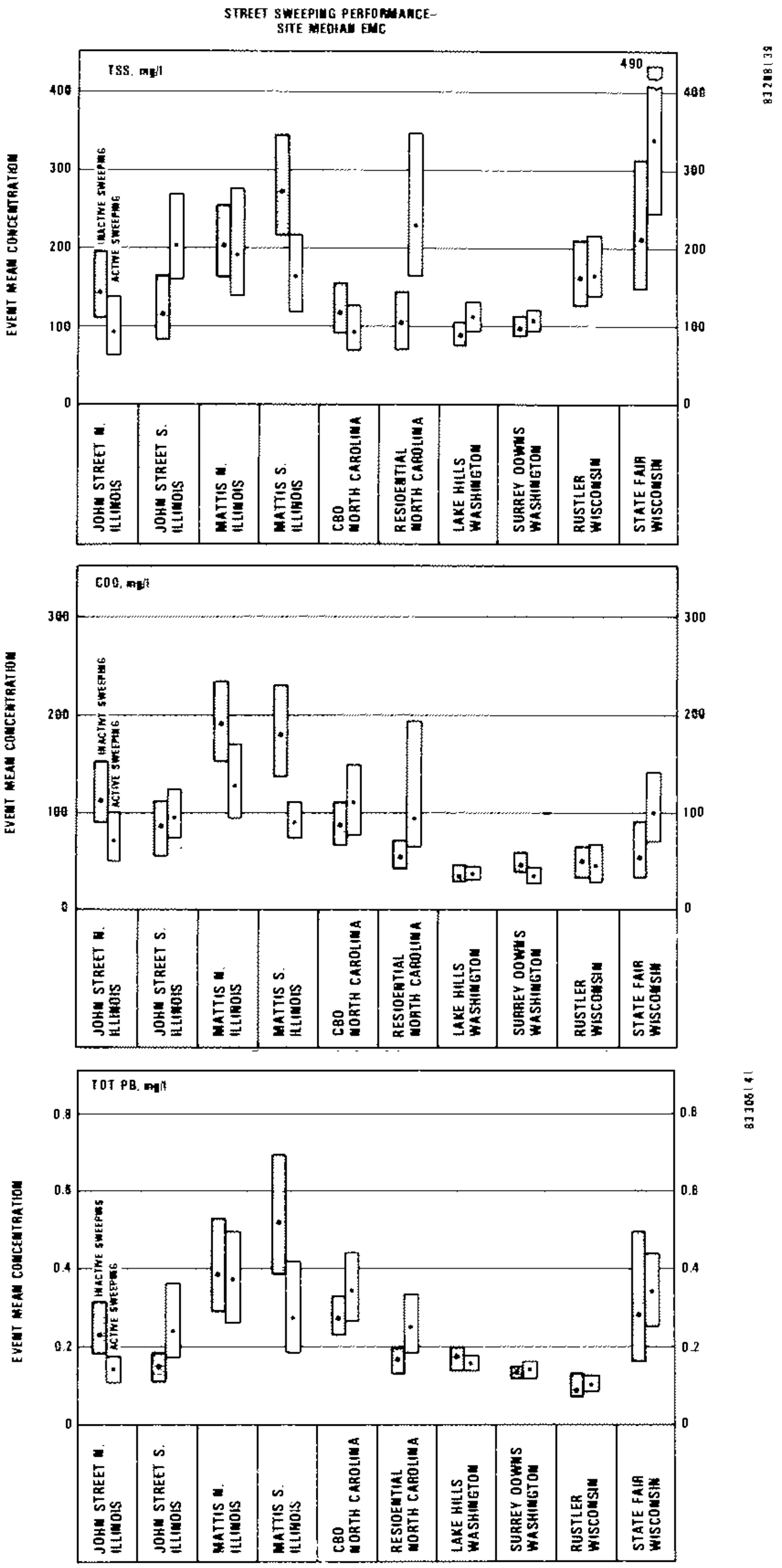


Figure 8-7. Effect of Street Sweeping on Site Median EMC Values

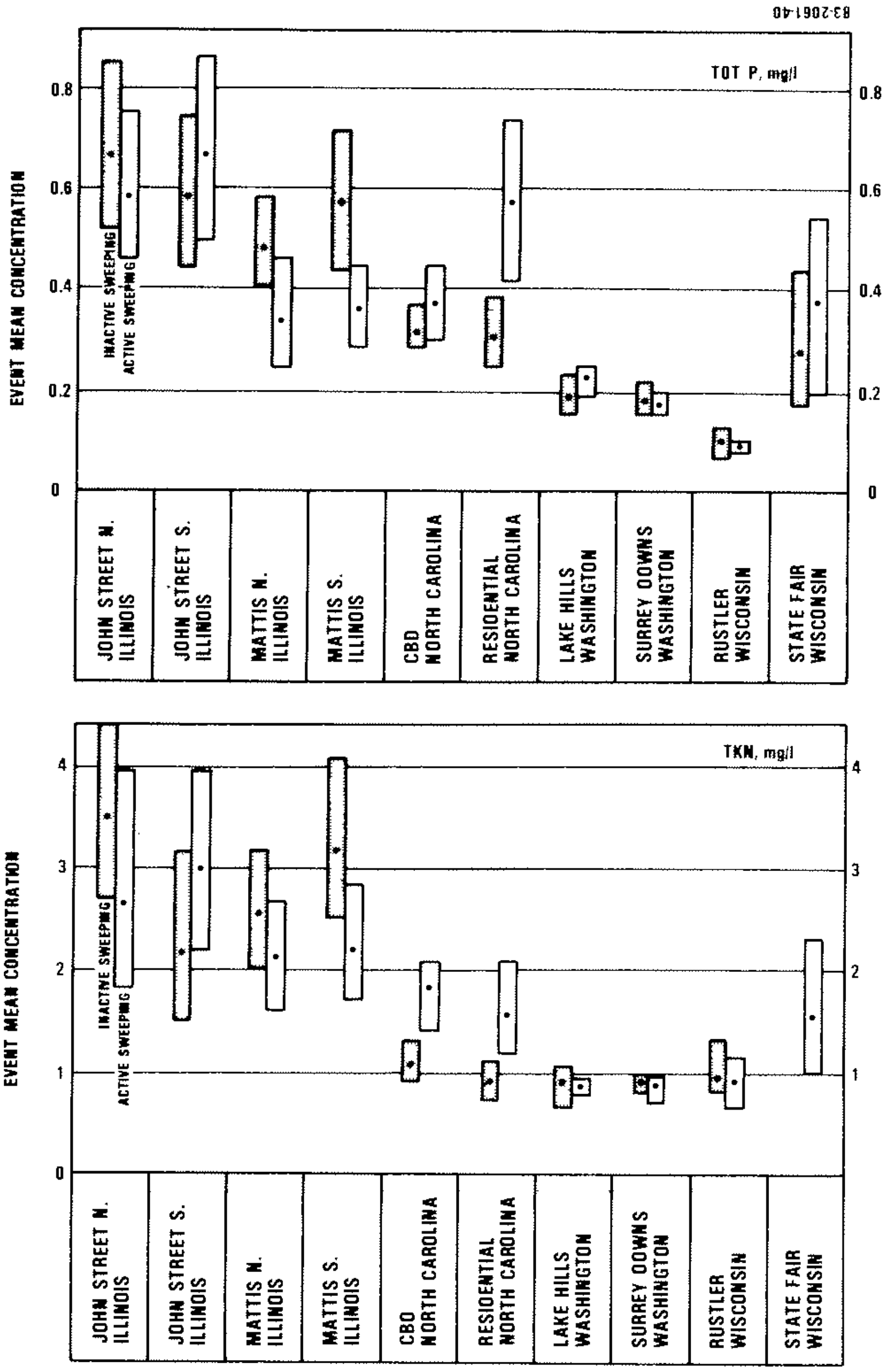


Figure 8-7. Effect of Street Sweeping on Site Median EMC Values (Cont'd)

The Durham, New Hampshire NURP project monitored performance of a carefully designed artificial swale which received runoff from a commercial parking lot. Over 11 monitored storms, both soluble and particulate fractions of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. Reductions in COD, nitrate, and ammonia were on the order of 25 percent. The swale did not prove to be effective in reducing concentrations or organic nitrogen, phosphorus, or bacterial species. It should be noted that the performance capabilities indicated are based only on the concentration changes produced in the stormwater which passes completely through the swale. To the extent that infiltration of a portion of the runoff is effected by a swale, load reductions would be increased in proportion.

The NURP results suggest that grass swales represent a practical and potentially effective technique for control of urban runoff quality; that design conditions are of major significance; and that additional study is necessary to establish such parameters.

Wetlands

The potential of either natural or artificially created wetland areas to effect favorable modification of urban runoff pollutant loads (particularly sediment, nutrients, and heavy metals) has been widely suggested. The NURP experience reinforces this expectation, but has not developed the detailed performance data to permit either characterizing general performance capabilities or identifying general design principles and parameters. Additional study will be required to develop such information.

Miscellaneous

This category encompasses a variety of BMPs which were identified at the local level as techniques of quality control which appeared to be relevant for the circumstances which were operative. They are grouped under this category because (a) their applicability tends to be site-specific rather than general, and (b) while their effectiveness as a BMP may be substantial on a relatively small spatial scale, the broad-scale effect on urban runoff loads has not been possible to document.

BMPs in this category include erosion control practices and urban housekeeping practices. As an example of the former, the Little Rock, Arkansas NURP project widened and stabilized (with rip rap) a segment of an urban stream to reduce erosion potential. The Baltimore NURP project data clearly indicated the substantial difference in urban runoff quality that can result from the general level of cleanliness maintained in an urban neighborhood.

CHAPTER 9
CONCLUSIONS

INTRODUCTION

The Nationwide Urban Runoff Program has addressed such issues as quantifying the characteristic of urban runoff, assessing the water quality effects on receiving water bodies attributable to urban runoff discharges, and examining the effectiveness of control practices in removing the pollutants found in urban runoff. This chapter summarizes NURP's conclusion relating to these issues and is based on the results presented in Chapters 6, 7, and 8 of this report. Conclusions reached by the individual NURP projects are also presented to further support the results of the national level analysis.

URBAN RUNOFF CHARACTERISTICS

General

Field monitoring was conducted to characterize urban runoff flows and pollutant concentrations. This was done for a variety of pollutants at a substantial number of sites distributed throughout the country. The resultant data represent a cross-section of regional climatology, land use types, slopes, and soil conditions and thereby provide a basis for identifying patterns of similarities or differences and testing their significance.

Urban runoff flows and concentrations of contaminants are quite variable. Experience shows that substantial variations occur within a particular event and from one event to the next at a particular site. Due to the high variability of urban runoff, a large number of sites and storm events were monitored, and a statistical approach was used to analyze the data. Procedures are available for characterizing variable data without requiring knowledge of or existence of any underlying probability distribution (nonparametric statistical procedures). However, where a specific type of probability distribution is known to exist, the information content and efficiency of statistical analysis is enhanced. Standard statistical procedures allowed probability distributions or frequency of occurrence to be examined and tested. Since the underlying distributions were determined to be adequately represented by the lognormal distribution, the log (base e) transforms of all urban runoff data were used in developing the statistical characterizations.

The event mean concentration (EMC), defined as the total constituent mass discharge divided by the total runoff volume, was chosen as the primary water quality statistic. Event mean concentrations were based on flow weighted composite samples for each event at each site in the accessible data base. EMCs were chosen as the primary water quality characteristic subjected to detailed analysis, even though it is recognized that mass loading characteristics of urban runoff (e.g., pounds/acre for a specified time interval) is ultimately the relevant factor in many situations. The reason is that, unlike EMCs, mass loadings are very strongly influenced by the amount of precipitation and runoff, and estimates of typical annual mass loads will be biased by the size of monitored storm events. The most reliable basis for characterizing annual or seasonal mass loads is on the basis of EMC and site-specific rainfall/runoff characteristics.

Establishing the fundamental distribution as lognormal and the availability of a sufficiently large population of EMCs to provide reliability to the statistics derived has yielded a number of benefits, including the ability to provide:

- Concise summaries of highly variable data
- Meaningful comparisons of results from different sites, events, etc.
- Statements concerning frequency of occurrence. One can express how often values will be expected to exceed various magnitudes of interest.
- A more useful method of reporting data than the use of ranges; one which is less subject to misinterpretation
- A framework for examining "transferability" of data in a quantitative manner

Conclusions

1. Heavy metals (especially copper, lead and zinc) are by far the most prevalent priority pollutant constituents found in urban runoff. End-of-pipe concentrations exceed EPA ambient water quality criteria and drinking water standards in many instances. Some of the metals are present often enough and in high enough concentrations to be potential threats to beneficial uses.

   All 13 metals on EPA's priority pollutant list were detected in urban runoff samples, and all but three at frequencies of detection greater than 10 percent. Most often detected among the metals were copper, lead, and zinc, all of which were found in at least 91 percent of the samples.

   Metal concentrations in end-of-pipe urban runoff samples (i.e., before dilution by receiving water) exceeded EPA's water quality criteria and drinking water standards numerous times. For example, freshwater acute criteria were exceeded by copper concentrations in 47 percent of the samples and by lead in 23 percent. Freshwater chronic exceedances were common for lead (94 percent), copper (82 percent), zinc (77 percent), and cadmium (48 percent). Regarding human toxicity, the most significant pollutants were lead and nickel, and for human carcinogenesis, arsenic and beryllium. Lead concentrations violated drinking water criteria in 73 percent of the samples.

It should be stressed that the exceedances noted above do not necessarily imply that an actual violation of standards will exist in the receiving water body in question. Rather, the enumeration of exceedances serves a screening function to identify those heavy metals whose presence in urban runoff warrants high priority for further evaluation.

Based upon the much more extensive NURP data set for total copper, lead, and zinc, the site median EMC values for the median urban site are: Cu = 34 µg/l, Pb = 144 µg/l, and Zn = 160 µg/l. For the 90th percentile urban site the values are: Cu = 93 µg/l, Pb = 350 µg/l, and Zn = 500 µg/l. These values are suggested to be appropriate for planning level screening analyses where data are not available.

Some individual NURP project sites (e.g., at DC1, MD1, NH1) found unusually high concentrations of certain heavy metals (especially copper and zinc) in urban runoff. This was attributed by the projects to the effect of acid rain on materials used for gutters, culverts, etc.

2. The organic priority pollutants were detected less frequently and at lower concentrations than the heavy metals.

Sixty-three of a possible 106 organics were detected in urban runoff samples. The most commonly found organic was the plasticizer bis (2-ethylhexl) phthalate (22 percent), followed by the pesticide α-hexachlorocyclohexane (α-BHC) (20 percent). An additional 11 organic pollutants were reported at frequencies between 10 and 20 percent; 3 pesticides, 3 phenols, 4 polycyclic aromatics, and a single halogenated aliphatic.

Criteria exceedances were less frequently observed among the organics than the heavy metals. One unusually high pentachlorophenol concentration of 115 µg/l resulted in exceedances of the freshwater acute and organoleptic criteria. This observation and one for chlordane also exceeded the freshwater acute criteria. Freshwater chronic criteria exceedances were observed for pentachlorophenol, bis (2-ethylhexyl) phthalate, gamma-BHC, chlordane, and alpha-endosulfan. All other organic exceedances were in the human carcinogen category and were most serious for alpha-hexachlorocyclohexane (alpha-BHC), gamma-hexachlorocyclohexane (gamma-BHC or Lindane), chlordane, phenanthrene, pyrene, and chrysene.

The fact that the NURP priority pollutant monitoring effort was limited to two samples at each site leaves us unable to make many generalizations about those organic pollutants which occurred only rarely. We can speculate that their occurrences tend to be very site specific as opposed to being a generally widespread phenomena, but much more data would be required to conclusively prove this point.

3. Coliform bacteria are present at high levels in urban runoff and can be expected to exceed EPA water quality criteria during and immediately after storm events in many surface waters, even those providing high degrees of dilution.

Fecal coliform counts in urban runoff are typically in the tens to hundreds of thousand per 100 ml during warm weather conditions, with the median for all sites being around 21,000/100 ml. During cold weather, fecal coliform counts are more typically in the 1,000/100 ml range, which is the median for all sites. Thus, violations of fecal coliform standards were reported by a number of NURP projects. High fecal coliform counts may not cause actual use impairments, in some instances, due to the location of the urban runoff discharges relative to swimming areas or shellfish beds and the degree of dilution/dispersal and rate of die off. The same is true of total coliform counts, which were found to exceed EPA water quality criteria in undiluted urban runoff at virtually every site every time it rained.

The substantial seasonal differences noted above do not correspond with comparable variations in urban activities. The NURP analyses as well as current literature suggest that fecal coliform may not be the most appropriate indicator organism for identifying potential health risks when the source is stormwater runoff.

4. Nutrients are generally present in urban runoff, but with a few individual site exceptions, concentrations do not appear to be high in comparison with other possible discharges to receiving water bodies.

   NURP data for total phosphorus, soluble phosphorus, total kjeldahl nitrogen, and nitrate plus nitrite as nitrogen were carefully examined. Median site EMC median concentrations in urban runoff were TP = 0.33 mg/l, SP = 0.12 mg/l, TKN = 1.5 mg/l, and NO2+3 - N = 0.68 mg/l. On an annual load basis, comparison with typical monitoring data, literature values, and design objectives for discharges from a well run secondary treatment plant suggests that mean annual nutrient loads from urban runoff are around an order of magnitude less than those from a POTW.

5. Oxygen demanding substances are present in urban runoff at concentrations approximating those in secondary treatment plant discharges. If dissolved oxygen problems are present in receiving waters of interest, consideration of urban runoff controls as well as advanced waste treatment appears to be warranted.

   Urban runoff median site EMC median concentrations of 9 mg/l BOD5 and 65 mg/l COD are reflected in the NURP data, with 90th percentile site EMC median values being 15 mg/l BOD5 and 140 mg/l COD. These concentrations suggest that, on an annual load basis, urban runoff is comparable in magnitude to secondary treatment plant discharges.

   It can be argued that urban runoff is typically well oxygenated and provides increased stream flow and, hence, in view of relatively long travel times to the critical point, that dissolved oxygen problems attributable solely to urban runoff should not be widespread occurrences. No NURP project specifically identified a low DO condition resulting from urban runoff. Nonetheless, there will be some situations where consideration of urban runoff controls for oxygen demanding substances in an overall water quality management strategy would seem appropriate.

6. Total suspended solids concentrations in urban runoff are fairly high in comparison with treatment plant discharges. Urban runoff control is strongly indicated where water quality problems associated with TSS, including build-up of contaminated sediments, exist.

   There are no formal water quality criteria for TSS relating to either human health or aquatic life. The nature of the suspended solids in urban runoff is different from those in treatment plant discharges, being higher in mineral and man-made products (e.g., tire and street surface wear particles) and somewhat lower in organic particulates. Also, the solids in urban runoff are more likely to have other contaminants adsorbed onto them. Thus, they cannot be simply considered as benign, nor do they only pose an aesthetic issue. NURP did not examine the problem of contaminated sediment build-up due to urban runoff, but it undeniably exists, at least at some locations.

   The suspended solids in urban runoff can also exert deleterious physical effects by sedimenting over egg deposition sites, smothering juveniles, and altering benthic communities.

   On an annual load basis, suspended solids contributions from urban runoff are around an order of magnitude or more greater than those from secondary treatment plants. Control of urban runoff, as opposed to advanced waste treatment, should be considered where TSS-associated water quality problems exist.

7. A summary characterization of urban runoff has been developed and is believed to be appropriate for use in estimating urban runoff pollutant discharges from sites where monitoring data are scant or lacking, at least for planning level purposes.

   As a result of extensive examination, it was concluded that geographic location, land use category (residential, commercial, industrial park, or mixed), or other factors (e.g., slope, population density, precipitation characteristics) appear to be of little utility in consistently explaining overall site-to-site variability in urban runoff EMCs or predicting the characteristics of urban runoff discharges from unmonitored sites. Uncertainty in site urban runoff characteristics caused by high event-to-event variability at most sites eclipsed any site-to-site variability that might have been present. The finding that EMC values are essentially not correlated with storm runoff volumes facilitates the transfer of urban runoff characteristics to unmonitored sites. Although there tend to be exceptions to any generalization, the suggested summary urban runoff characteristics given in Table 6-17 of the report are recommended for planning level purposes as the best estimates, lacking local information to the contrary.

RECEIVING WATER EFFECTS

General

The effects of urban runoff on receiving water quality are highly site-specific. They depend on the type, size, and hydrology of the water body; the urban runoff quantity and quality characteristics; the designated beneficial use; and the concentration levels of the specific pollutants that affect that use.

The conclusions which follow are based on screening analyses performed by NURP, observations and conclusions drawn by individual NURP projects that examined receiving water effects in differing levels of detail and rigor, and NURP's three levels of problem definition. Conclusions are organized on the basis of water body type: rivers and streams, lakes, estuaries and embayments, and groundwater aquifers. Site-specific exceptions should be expected, but the statements presented are believed to provide an accurate perspective on the general tendency of urban runoff to contribute significantly to water quality problems.

Rivers and Streams

1. Frequent exceedances of heavy metals ambient water quality criteria for freshwater aquatic life are produced by urban runoff.

   The Denver NURP project found that in-stream concentrations of copper, lead, zinc, and cadmium exceeded State ambient water quality standards for the South Platte River during essentially all storm events.

   NURP screening analyses suggest that frequent exceedances of both EPA 24-hour and maximum water quality criteria for heavy metals should be expected on a relatively general basis.

2. Although a significant number of problem situations could result from heavy metals in urban runoff, levels of freshwater aquatic life use impairment suggested by the magnitude and frequency of ambient criteria exceedances were not observed.

   Based upon the magnitude and frequency of freshwater aquatic life ambient criteria exceedances, one would expect to observe impairment of this beneficial use in most streams that receive urban runoff discharges. However, those NURP project studies which examined this issue did not report significant use impairment problems associated with urban runoff.

   The Bellevue, Washington NURP project concluded that toxic effects of urban runoff pollutants did not appear to be a significant factor.

   The Tampa, Florida NURP project conducted biological studies of the impact of stormwater runoff upon the biological community of the Hillsborough River. They conducted animal bioassay experiments on five sensitive species in two samples of urban runoff from the Arctic Street drainage basin. Thirty-two bioassay experiments were completed including 22 acute tests and 10 chronic tests. Neither sample of stormwater was acutely toxic to test organisms. Long-term chronic experiments were undertaken with two species and resulted in no significant effects attributable to stormwater exposure.

NURP screening analyses suggest that the potential of urban runoff to seriously impair this beneficial use will be strongly influenced by local conditions and the frequency of occurrence of concentration levels which produce toxic effects under the intermittent, short duration exposures typically produced by urban runoff.

While the application of the screening analysis to the Bellevue and Tampa situations supports the absence of a problem situation in these cases, it also suggests that a significant number of problem situations should be expected. Therefore, although not the general, ubiquitous problem situation that criteria exceedances would suggest, there are site-specific situations in which urban runoff could be expected to cause significant impairment of freshwater aquatic life uses.

Because of the inconsistency between criteria exceedances and observed use impairments due to urban runoff, adaptation of current ambient quality criteria to better reflect use impacts where pollutant exposures are intermittent and short duration appears to be a useful area for further investigation.

3. <u>Copper, lead and zinc appear to pose a significant threat to aquatic life uses in some areas of the country. Copper is suggested to be the most significant of the three</u>.

   Regional differences in surface water hardness, which has a strong influence on toxicity, in conjunction with regional variations in stream flow and rainfall result in significant differences in susceptibility to adverse impacts around the nation.

   The southern and southeastern regions of the country are the most susceptible to aquatic life effects due to heavy metals, with the northeast also a sensitive area, although somewhat less so.

   Copper is the major toxic metal in urban runoff, with lead and zinc also prevalent but a problem in more restricted cases. Copper discharges in urban runoff are, in all but the most favorable cases, a significant threat to aquatic life uses in the southeast and southern regions of the country. In the northeast, problems would be expected only in rather unfavorable conditions (large urban area contribution and high site concentrations). In the remainder of the country (and for the other metals) problems would only be expected under quite unfavorable site conditions. These statements are based on total metal concentrations.

4. <u>Organic priority pollutants in urban runoff do not appear to pose a general threat to freshwater aquatic life</u>.

   This conclusion is based on limited data on the frequency with which organics are found in urban runoff discharges and measured end-of-pipe concentrations relative to published toxic criteria. One unusually high pentachlorophenol concentration of 115 µg/l resulted in the only exceedance of the organoleptic criteria. This observation and one for chlordane exceeded the freshwater acute criteria. Freshwater chronic criteria exceedances were observed for pentochlorophenol, bis (2-ethylhexyl) phlhalate, γ-hexachlorocyclohexane (lindane), α-endosulfan, and chlordane.

5. The physical aspects of urban runoff, e.g., erosion and scour, can be a significant cause of habitat disruption and can affect the type of fishery present. However, this area was studied only incidentally by several of the projects under the NURP program and more concentrated study is necessary.

The Metropolitan Washington Council of Governments (MWCOG) NURP project did an analysis of fish diversity in the Seneca Creek Watershed, 20 miles northwest of Washington, D.C. In this study, specific changes in fishery diversity were identified due to urbanization in some of the sub-watersheds. Specifically, the number of fish species present are reduced and the types of species present changed dramatically, e.g., environmentally sensitive species were replaced with more tolerant species. For example, the Blacknose Dace replaced the Mottled Sculpin. MWCOG concluded that the changes in fish diversity were due to habitat deterioration caused by the physical aspects of urban runoff.

The Bellevue, Washington NURP project concluded that habitat changes (streambed scour and sedimentation) had a more significant effect than pollutant concentrations, for the changes produced by urbanization.

6. Several projects identified possible problems in the sediments because of the build-up of priority pollutants contributed wholly or in part by urban runoff. However, the NURP studies in this area were few in number and limited in scope, and the findings must be considered only indicative of the need for further study, particularly as to long-term impacts.

The Denver NURP project found significant quantities of copper, lead, zinc, and cadmium in river sediments. The Denver Regional Council of Governments is concerned that during periods of continuous low flow, lead may reach levels capable of adversely affecting fish.

The Milwaukee NURP project reported the observation of elevated levels of heavy metals, particularly lead, in the sediments of a river receiving urban runoff.

7. Coliform bacteria are present at high levels in urban runoff and can be expected to exceed EPA water quality criteria during and immediately after storm events in most rivers and streams.

Violations of the fecal coliform standard were reported by a number of NURP projects. In some instances, high fecal coliform counts may not cause actual use impairments due to the location of the urban runoff discharge relative to swimming areas and the degree of dilution or dispersal and rate of die off.

Coliform bacteria are generally accepted to be a useful indicator of the possible presence of human pathogens when the source of contamination is sanitary sewage. However, no such relationship has been demonstrated for urban runoff. Therefore, the use of coliforms as an indicator of human health risk when the sole source of contamination is urban runoff, warrants further investigation.

8. Domestic water supply systems with intakes located on streams in close proximity to urban runoff discharges are encouraged to check for priority pollutants which have been detected in urban runoff, particularly those in the organic category.

   Sixty-three of a possible 106 organics were detected in urban runoff samples. The most commonly found organic was the plasticizer bis (2-ethylhexl) phthalate (22 percent), followed by the pesticide α-hexachlorocyclohexane (α-BHC) (20 percent). An additional 11 organic pollutants were reported at frequencies between 10 and 20 percent; 3 pesticides, 3 phenols, 4 polycyclic aromatics, and a single halogenated aliphatic.

Lakes

1. Nutrients in urban runoff may accelerate eutrophication problems and severely limit recreational uses, especially in lakes. However, NURP's lake projects indicate that the degree of beneficial use impairment varies widely, as does the significance of the urban runoff component.

   The Lake Quinsigamond NURP project in Massachusetts identified eutrophication as a major problem in the lake, with urban runoff being a prime contributor of the critical nutrient phosphorus. Point source discharges to the lake have been eliminated almost entirely. However, in spite of the abatement of point sources, survey data indicate that the lake has shown little improvement over the abatement period. In particular, the trophic status of the lake has shown no change, i.e., it is still classified as late mesotrophic-early eutrophic. Substantial growth is projected in the basin, and there is concern that Lake Quinsigamond will become more eutrophic. A proposed water quality management plan for the lake includes the objective of reducing urban runoff pollutant loads.

   The Lake George NURP project in New York State also identified increasing eutrophication as a potential problem if current development trends continue. Lake George is not classified as eutrophic, but from 1974 to 1978 algae production in the lake increased logarithmically. Lake George is a very long lake, and the limnological differences between the north and south basins provide evidence of human impact. The more developed, southern portion of the lake exhibits lower transparencies, lower hypolimnetic dissolved oxygen concentrations, higher phosphorus and chlorophyll a concentrations, and a trend toward seasonal blooms of blue-green algae. These differences in water quality indicators are associated with higher levels of cultural activities (e.g., increased sources of phosphorus) in the southern portion of the lake's watershed, and continued development will tend to accentuate the differences.

The Lake George NURP project estimated that urban runoff from developed areas currently accounts for only 13.6 percent of the annual phosphorus loadings to Lake George as a whole. In contrast, developed areas contribute 28.9 percent of the annual phosphorus load to the NURP study areas at the south end of the Lake. Since there are no point source discharges, this phosphorus loading is due solely to urban runoff. These data illustrate the significant impact of urbanization on phosphorus loads.

The NURP screening analysis suggests that lakes for which the contributions of urban runoff are significant in relation to other nonpoint sources (even in the absence of point source discharges) are indicated to be highly susceptible to eutrophication and that urban runoff control may be warranted in such situations.

2. <u>Coliform bacteria discharges in urban runoff have a significant negative impact on the recreational uses of lakes.</u>

As was the case with rivers and streams, coliform bacteria in urban runoff can cause violations of criteria for the recreational use of lakes. When unusually high fecal coliform counts are observed, they may be partially attributable to sanitary sewage contamination, in which case significant health risks may be involved.

The Lake Quinsigamond NURP project in Massachusetts found that bacterial pollution was widespread throughout the drainage basin. In all cases where samples were taken, fecal coliforms were in excess of 10,000 counts per 100 ml, with conditions worse in the Belmont street storm drains. This project concluded that the very high fecal coliform counts in their stormwater are at least partially due to sewage contamination apparently entering the stormwater system throughout the local catchment.

The sources of sewage contamination are leaking septic tanks, infiltration from sanitary sewers into storm sewers, and leakage at manholes. In the northern basin, the high fecal coliform counts are attributed to known sewage contamination sources on Poor Farm Brook. The data from the project suggest that it would be unwise to permit body contact recreation in the northern basin of the lake during or immediately following significant storm events. The project concluded that disinfection at selected storm drains should be considered in the future, especially if the sewage contamination cannot be eliminated.

The Mystic River NURP project in Massachusetts found various areas where fecal coliform counts were extremely high in urban stormwater. Fecal coliform levels of up to one million with an average of 178,000/100 ml were recorded in Sweetwater Brook, a tributary to Mystic River, during wet weather. These high fecal coliform levels were specifically attributed to surcharging in their sanitary sewers, which caused sanitary sewage to overflow into their storm drains via the combined manholes present in this catchment. Fecal coliform levels above the class B fecal coliform standard of 200 per 100 ml were found in approximately one-third of the samples tested in the upper and lower forebays of the Upper Mystic Lake and occasionally near the lake's outlet. In addition, Sandy Beach, a public swimming area on Upper Mystic Lake, exceeded the State fecal coliform criteria in July of 1982, and warnings that swimming may be hazardous to public health were posted for several days. It is important to note that sewage contamination of surface waters is a major problem in the watershed. The project concluded that urban runoff contributes to the bacteria load during wet weather but, comparatively, is much less significant than the sanitary sources.

Estuaries and Embayments

1. Adverse effects of urban runoff in marine waters will be a highly specific local situation. Though estuaries and embayments were studied to a very limited extent in NURP, they are not believed to be generally threatened by urban runoff, though specific instances where use is impaired or denied can be of significant local and even regional importance. Coliform bacteria present in urban runoff is the primary pollutant of concern, causing direct impacts on shellfish harvesting and beach closures.

   The significant impact of urban runoff on shellfish harvesting has been well documented by the Long Island, New York NURP project. In this project, stormwater runoff was identified as the major source of bacterial loading to marine waters and, thus, the indirect cause of the denial of certification by the New York State Department of Conservation for about one-fourth of the shellfishing area. Much of this area is along the south shore, where the annual commercial shellfish harvest is valued at approximately $17.5 million.

   The Myrtle Beach, South Carolina NURP project found that stormwater discharges from the City of Myrtle Beach directly onto the beach showed high bacterial counts for short durations immediately after storm events. In many instances these counts violated EPA water quality criteria for aquatic life and contact recreation. The high bacteria counts, however, were associated with standing pools formed at the end of collectors for brief periods following the cessation of rainfall and before the runoff percolated into the sand. Consequently, the threat to public health was not considered great enough to warrant closure of the beach.

Groundwater Aquifers

1. Groundwater aquifers that receive deliberate recharge of urban runoff do not appear to be imminently threatened by this practice at the two locations where it was investigated.

   Two NURP projects (Long Island and Fresno) are situated over sole source acquifers. They have been practicing recharge with urban runoff for two decades or more at some sites, and extensively investigated the impact of this practice on the quality of their groundwater. They both found that soil processes are efficient in retaining urban runoff pollutants quite close to the land surface, and concluded that no change in the use of recharge basins is warranted.

   Despite the fact that some of these basins have been in service for relatively long periods of time and pollutant breakthrough of the upper soil layers has not occurred, the ability of the soil to continue to retain pollutants is unknown. Further attention to this issue is recommended.

CONTROL EFFECTIVENESS

General

A limited number of techniques for the control of urban runoff quality were evaluated by the NURP program. The set is considerably smaller than previously published lists of potential management practices. Since the control approaches that were investigated were selected at the local level, the choices may be taken as an initial indication of local perceptions regarding practicality and feasibility from the standpoint of implementation.

Conclusions

1. There is a strong preference for detention devices, street sweeping, and recharge devices as reflected by the control measures selected at the local level for detailed investigation. Interest was also shown in grass swales and wetlands.

   Six NURP projects monitored the performance of a total of 14 detention devices. Five separate projects conducted in-depth studies of the effectiveness of street sweeping on the control of urban runoff quality. A total of 17 separate study catchments were involved in this effort. Three NURP projects examined either the potential of recharge devices to reduce discharges of urban runoff to surface waters or the potential of the practice to contaminate groundwaters. A total of 12 separate sites were covered by this effort.

   Grass swales were studied by two NURP projects. Two swales in existing residential areas, and one experimental swale constructed to serve a commercial parking lot were studied.

   A number of NURP projects indicated interest in wetlands for improving urban runoff quality at early stages of the program. Only one allocated monitoring activity to this control measure, however.

   Various other management practices were identified as having local interest by individual NURP projects, but none of them was allocated the necessary resources to be pursued to a point which allowed an evaluation of their ability to control pollution from urban runoff. Management practices in this category included urban housekeeping (e.g., litter programs, catch basin cleaning, pet ordinances) and public information programs.

2. Detention basins are capable of providing very effective removal of pollutants in urban runoff. Both the design concept and the size of the basin in relation to the urban area served have a critical influence on performance capability.

   Wet basins (designs which maintain a permanent water pool) have the greatest performance capabilities. Observed pollutant reductions varied from excellent to very poor in the basins which were monitored. However, when basins are adequately sized, particulate removals in excess of 90 percent (TSS, lead) can be obtained. Pollutants with significant soluble fractions in urban runoff show lower reductions; on the order of 65 percent for total P and approximately 50 percent for BOD, COD, TKN, Copper, and Zinc. Results indicate that biological processes which are operative in the permanent pool produce significant reductions (50 percent or more) in soluble nutrients, nitrate and soluble phosphorus. These performance characteristics are indicated by both the NURP analysis results and conclusions reached by individual projects.

Dry basins, (conventional stormwater management basins), which are designed to attenuate peak runoff rates and hence only very briefly detain portions of flow from the larger storms, are indicated by NURP data to be essentially ineffective for reducing pollutant loads.

Dual-purpose basins (conventional dry basins with modified outlet structures which significantly extend detention time) are suggested by limited NURP data to provide effective reductions in urban runoff loads. Performance may approach that of wet ponds; however, the additional processes which reduce soluble nutrient forms do not appear to be operative in these basins. This design concept is particularly promising because it represents a cost effective approach to combining flood control and runoff quality control and because of the potential for converting existing conventional stormwater management ponds.

Approximate costs of wet pond designs are estimated to be in the order of \$500 to \$1500 per acre of urban area served, for on-site applications serving relatively small urban areas, and about \$100 to \$250 per acre of urban area for off-site applications serving relatively large urban areas. The costs reflect present value amounts which include both capital and operating costs. The difference is due to an economy of scale associated with large basin volumes. The range reflects differences in size required to produce particulate removals in the order of 50 percent or 90 percent. Annual costs per acre of urban area served are estimated at \$60 to \$175, and \$10 to \$25 respectively.

3. Recharge Devices are capable of providing very effective control of urban runoff pollutant discharges to surface waters. Although continued attention is warranted, present evidence does not indicate that significant groundwater contamination will result from this practice.

Both individual project results and NURP screening analyses indicate that adequately sized recharge devices are capable of providing high levels of reduction in direct discharges of urban runoff to surface waters. The level of performance will depend on both the size of the unit and the soil permeability.

Application will be restricted to areas where conditions are favorable. Soil type, depth to groundwater, land slopes, and proximity of water supply wells will all influence the appropriateness of this control technique.

Surface accumulations which result from the high efficiency of soils to retain pollutants, suggest further attention in applications where dual purpose recharge areas also serve as recreational fields or playground areas.

4. Street sweeping is generally ineffective as a technique for improving the quality of urban runoff.

Five NURP projects evaluated street sweeping as a management practice to control pollutants in urban runoff. Four of these projects concluded that street sweeping was not effective for this purpose. The fifth, which had pronounced wet and dry seasons, believed that sweeping just prior to the rainy season could produce some benefit in terms of reduced pollution in urban runoff.

A large data base on the quality of urban runoff from street sweeping test sites was obtained. At 10 study sites selected for detailed analysis, a total of 381 storm events were monitored under control conditions, and an additional 277 events during periods when street sweeping operations were in effect. Analysis of these data indicated that no significant reductions in pollutant concentrations in urban runoff were produced by street sweeping.

There may be special cases in which street cleaning applied at restricted locations or times of year could provide improvements in urban runoff quality. Some examples that have been suggested, though not demonstrated by the NURP program, include periods following snow melt or leaf fall, or urban neighborhoods where the general level of cleanliness could be significantly improved.

5. Grass swales can provide moderate improvements in urban runoff quality. Design conditions are important. Additional study could significantly enhance the performance capabilities of swales.

Concentration reductions of about 50 percent for heavy metals, and 25 percent for COD, nitrate, and ammonia were observed in one of the swales studied. However the swale was ineffective in reducing concentrations of organic nitrogen, phosphorus, or bacterial species. Two other swales studied failed to demonstrate any quality improvements in the urban runoff passing through them.

Evaluations by the NURP projects involved concluded, however, that this was an attractive control technique whose performance could be improved substantially by application of appropriate design considerations. Additional study to develop such information was recommended.

Design considerations cited included slope, vegetation type and maintenance, control of flow velocity and residence time, and enhancement of infiltration. The latter factor could produce load reductions greater than those inferred from concentration changes and effect reductions in those pollutant species which are not attenuated by flow through the swale.

6. Wetlands are considered to be a promising technique for control of urban runoff quality. However, neither performance characteristics nor design characteristics in relation to performance were developed by NURP.

   Although a number of projects indicated interest, only one assigned NURP monitoring activity to a wetland. This was a natural wetland, and flows passing though it were uncontrolled. Results suggest its potential to improve quality, but the investigation was not adequate to associate necessary design factors to performance capability. Additional attention to this control technique would be useful, and should include factors such as the need for maintenance harvesting to prevent constituent recycling.

ISSUES

A number of issues with respect to managing and controlling urban runoff emerge from the conclusions summarized above. In some instances they represent the need for additional data/information or for further study. In others they point to the need for follow-up activity by EPA, State, or local officials to assemble and disseminate what is already known regarding water quality problems caused by urban runoff and solutions.

Sediments

The nature and scope of the potential long-term threat posed by nutrient and toxic pollutant accumulation in the sediments of urban lakes and streams requires further study. A related issue is the safe and environmentally sound disposal of sediments collected in detention basins used to control urban runoff.

Priority Pollutants

NURP clearly demonstrated that many priority pollutants can be found in urban runoff and noted that a serious human health risk could exist when water supply intakes are in close proximity to urban stormwater discharges. However, questions related to the sources, fate, and transport mechanisms of priority pollutants borne by urban runoff and their frequencies of occurrence will require further study.

Rainfall pH Effects

The relationship between pH and heavy metal values in urban runoff has not been established and needs further study. Several NURP projects (mostly in the northeastern states) attributed high heavy metals concentrations in urban runoff to the effects of acid rain. Although it is quite plausible that acid rain increases the level of pollutants in urban runoff and may transform them to more toxic and more easily assimilated forms, further study is required to support this speculation.

Industrial Runoff

No truly industrial sites (as opposed to industrial parks) were included in any of the NURP projects. A very limited body of data suggests, however, that runoff from industrial sites may have significantly higher contaminant levels than runoff from other urban land use sites, and this issue should be investigated further.

Central Business Districts

Data on the characteristics of urban runoff from central business districts are quite limited as opposed to other land use categories investigated by NURP. The data do suggest, however, that some sites may produce pollutant concentrations in runoff that are significantly higher than those from other sites in a given urban area. When combined with their typically high degrees of imperviousness, the pollutant loads from central business districts can be quite high indeed. The opportunities for control in central business districts are quite limited, however.

Physical Effects

Several projects concluded that the physical impacts of urban runoff upon receiving waters have received too little attention and, in some cases, are more important determinants of beneficial use attainment than chemical pollutants. This contention requires much more detailed documentation.

Synergy

NURP did not evaluate the synergistic effects that might result from pollutant concentrations experienced in stormwater runoff, in association with pH and temperature ranges that occur in the receiving waters. This type of investigation might reveal that control of a specific parameter, such as pH, would adequately reduce an adverse synergistic effect caused by the presence of other pollutants in combination and be the most cost effective solution. Further investigations should include this issue.

Opportunities for Control

Based upon the results of NURP's evaluation of the performance of urban runoff controls, opportunities for significant control of urban runoff quality are much greater for newly developing areas. Institutional considerations and availability of space are the key factors. Guidance on this issue in a form useful to States and urban planning authorities should be prepared and issued.

Wet Weather Water Quality Standards

The NURP experience suggests that EPA should evaluate the possible need to develop "wet weather" standards, criteria, or modifications to ambient criteria to reflect differences in impact due to the intermittent, short duration exposures characteristic of urban runoff and other nonpoint source discharges.

Coliform Bacteria

The appropriateness of using coliform bacteria as indicator organisms for human health risk where the source is exclusively urban runoff warrants further investigation.

Wetlands

The use of wetlands as a control measure is of great interest in many areas, but the necessary information on design performance relationships required before cost effective applications can be considered has not been adequately documented. The environmental impacts of such use upon wetlands is a critical issue which, at present, has been addressed marginally, if at all.

Swales

The use of grass swales was suggested by two NURP projects to represent a very promising control opportunity. However, their performance is very dependent upon design features about which information is lacking. Further work to address this deficiency and appropriate maintenance practices appears warranted.

Illicit Connections

A number of the NURP projects identified what appeared to be illicit connections of sanitary discharges to stormwater sewer systems, resulting in high bacterial counts and dangers to public health. The costs and complications of locating and eliminating such connections may pose a substantial problem in urban areas, but the opportunities for dramatic improvement in the quality of urban stormwater discharges certainly exist where this can be accomplished. Although not emphasized in the NURP effort, other than to assure that the selected monitoring sites were free from sanitary sewage contamination, this BMP is clearly a desirable one to pursue.

Erosion Controls

NURP did not consider conventional erosion control measures because the information base concerning them was considered to be adequate. They are effective, and their use should be encouraged.

Combined Sewer Overflows

In order to address urban runoff from separate storm sewers, NURP avoided any sites where combined sewers existed. However, in view of their relative levels of contamination, priority should be given to control of combined sewer overflows.

Implementation Guidance

The NURP studies have greatly increased our knowledge of the characteristics of urban runoff, its effects upon designated uses, and of the performance efficiencies of selected control measures. They have also confirmed earlier impressions that some States and local communities have actually begun to develop and implement stormwater management programs incorporating water quality objectives. However, such management initiatives are, at present, scattered and localized. The experience gained from such efforts is both needed and sought after by many other States and localities. Documentation, evaluation, refinement and transfer of management and financing mechanisms/ arrangements, of simple and reliable problem assessment methodologies, and of implementation guidance which can be used by planners and officials at the State and local level are urgently needed as is a forum for the sharing of experiences by those already involved, both among themselves and with those who are about to address nonpoint source issues.

*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-421-082/520

The Quality of Our Nation's Water

Introduction

The 1992 Report to Congress describes the geographic extent of water pollution across the country and identifies specific pollutants and sources of pollutants contaminating our waters. This national snapshot of water quality conditions summarizes information submitted by the States, the District of Columbia, Territories, Interstate Water Basin Commissions, and one American Indian Tribe in their 1992 water quality assessment reports (required under Clean Water Act Section 305(b)). The 1992 Section 305(b) reports contain assessments of each State's water quality during 1990 and 1991.

This report displays and summarizes data provided by the States to EPA. EPA has not determined the accuracy of these data. It is important to note that these State-reported data are intended to provide a snapshot of the quality of the waters they assessed and cannot be used to determine trends in our Nation's water resources. These limitations are due to major differences from year to year in assessment methods within and between States as well as differences in the waters assessed in each 2-year period. In addition, not all States follow EPA's guidance on procedures for determining whether waters are supporting the uses designated in their water quality standards. EPA and the States are taking many steps toward transforming the 305(b) process into one that provides comparable data with known accuracy. These steps include implementing the recommendations of the National 305(b) Consistency Workgroup and the Intergovernmental Task Force on Monitoring Water Quality, as well as improving the Section 305(b) guidelines and implementing the Office of Water's Monitoring Strategy. These efforts will foster consistency and accuracy among the States and allow better sharing of data for watershed protection and across political boundaries.

Why Is It Important To Learn About Water Pollution?

The EPA encourages each citizen to become a steward of our precious natural resources. Complex environmental threats and diminishing funds for pollution control force us to jointly solve the pollution problems that foul our beaches and lakes or close our favorite fishing sites. We need to understand these problems and become a part of their solution. Once we understand these pollution problems and what is needed to combat them, we will be better able to prioritize our efforts, devise sound solutions, take appropriate action, monitor progress after solutions are implemented, and modify behavior that contributes to the problems.

This document provides fundamental water quality information needed to resolve our persistent water pollution problems. This Report to Congress:

- Defines key water quality concepts
- Discusses the leading pollution problems in rivers and streams, lakes, estuaries, coastal waters, wetlands, and ground water as reported to EPA by the States
- Briefly describes major State and Federal activities to control water pollution
- Offers several water quality protection actions for every citizen to adopt.

Key Concepts

Measuring Water Quality

The States assess the quality of their waters by determining if their waters attain State water quality standards. Water quality standards consist of beneficial uses, numeric and narrative criteria for supporting each use, and an antidegradation statement:

- Designated beneficial uses are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States may designate an individual waterbody for multiple beneficial uses.

- Numeric water quality criteria establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters, and minimum concentrations of desirable parameters, such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.
- Narrative water quality criteria define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody; for example, "Ambient water quality shall be sufficient to support life stages of all indigenous aquatic species." Narrative criteria may also describe conditions that are desired in a waterbody, such as, "Waters must be free of substances that are toxic to humans, aquatic life, and wildlife."
- Antidegradation statements protect existing designated uses and prevent high-quality waterbodies from deteriorating below the water quality necessary to maintain existing or anticipated designated beneficial uses.

The Clean Water Act provides primary authority to States to set their own standards but requires that all State beneficial uses and their criteria comply with the "fishable and swimmable" goals of the Act. At a minimum, State beneficial uses must support aquatic life and recreational use. In effect, States cannot designate "waste assimilation" as a beneficial use, as some States did prior to 1972.

The EPA recommends that States assess support of the following individual beneficial uses:

- **Aquatic Life Support**
  The waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.
- **Fish Consumption**
  The waterbody supports a population of fish free from contamination that could pose a human health risk to consumers.

- **Shellfish Harvesting**
  The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.
- **Drinking Water Supply**
  The waterbody can supply safe drinking water with conventional treatment.
- **Primary Contact Recreation - Swimming**
  People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).
- **Secondary Contact Recreation**
  People can perform activities on the water (such as canoeing) without risk of adverse human health effects from occasional contact with the water.
- **Agriculture**
  The water quality is suitable for irrigating fields or watering livestock.

EPA recognizes five levels of use support. If possible, the States determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State may determine the level of use support with qualitative information. Valid qualitative information includes land use data, fish and game surveys, and predictive model results. **Monitored assessments** are based on monitoring data. **Evaluated assessments** are based on qualitative information or monitored data more than 5 years old.

After the States determine the level of use support for each individual designated use in each waterbody, the States consolidate individual use support assessments to determine the level of overall use support for each waterbody.

- Fully Supporting Overall Use All designated beneficial uses are fully supported.
- Threatened Overall Use One or more designated beneficial uses are threatened and the remaining uses are fully supported.
- Partially Supporting Overall Use One or more designated beneficial uses are partially supported and the remaining uses are fully supported.
- Not Supporting Overall Use One or more designated beneficial uses are not supported.
- Not Attainable The State has performed a use-attainability study and

documented that use support of one or more designated beneficial uses is not achievable due to natural conditions or human activity that cannot be reversed without imposing widespread economic and social impacts.
- Impaired Waters The sum of waterbodies partially supporting uses and not supporting uses.

Water Quality Monitoring Inset

The EPA then aggregates the State use support information into a national assessment of the Nation's water quality.

How Many of Our Waters Were Assessed for 1992?

National estimates of the total waters of our country provide the foundation for determining the percentage of waters assessed by the States and the portion impaired by pollution. In 1992, EPA provided the States with estimates of total river miles and lake acres derived from the EPA Reach File, a database containing traces of waterbodies adapted from 1:100,000 scale maps prepared by the U.S. Geological Survey. The States modified these total water estimates where necessary. Based on the new EPA/State figures, the national estimate of total river miles doubled in 1992 in large part because the EPA/State estimates included nonperennial streams, canals, and ditches that were previously excluded from estimates of total stream miles.

Current estimates indicate that the United States has:

- More than 3.5 million miles of rivers and streams, which range in size from the Mississippi River to small streams that flow only when wet weather conditions exist (i.e., intermittent streams)
- Approximately 40 million acres of lakes, ponds, and reservoirs
- About 37,000 square miles of estuaries (excluding Alaska)
- More than 56,000 miles of ocean shoreline, including 36,000 miles in Alaska
- 5,382 miles of Great Lakes shoreline
- More than 277 million acres of wetlands such as marshes, swamps, bogs, and fens, including 170 million acres of wetlands in Alaska.

Due to factors such as funding limitations, most States assess a subset of their total water resources during each 2-year reporting cycle required under Clean Water Act Section 305(b). States are more capable of assessing all of their waters over a 5- to 10-year period. The figure to the right presents the percentage of total waters assessed by the States for the 1992 report. It should be noted that the percentage of perennial rivers and streams assessed is much greater than the percentage of total rivers and streams assessed.

The summary information based on assessed waters may not represent overall conditions in the Nation's total waters because States often focus on monitoring and assessing major perennial rivers, estuaries, and public lakes with suspected pollution problems. Many States lack the resources to collect use support information for intermittent streams, small tributaries, and private ponds. EPA cannot predict the health of these unassessed waters.

The Intergovernmental Task Force on Monitoring Water Quality Inset

Pollutants That Degrade Water Quality

Where possible, States identify the pollutants or processes that degrade water quality and indicators that document impacts of water quality degradation. Pollutants include sediment, nutrients, and chemical contaminants (such as dioxin and metals). Processes that degrade waters include habitat modification (such as destruction of streamside vegetation) and hydrologic modification (such as flow reduction). Indicators of water quality degradation include physical, chemical, and biological parameters. Examples of biological parameters include species diversity and abundance. Examples of physical and chemical parameters include pH, turbidity, and temperature. Following are descriptions of the effects of the pollutants and processes most commonly identified in rivers, lakes, estuaries, coastal waters, wetlands, and ground water.

> **Nutrients** include nitrates found in sewage and fertilizers and phosphates found in detergents and fertilizers. In excess levels, nutrients overstimulate the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog navigable waters, use up dissolved oxygen as they decompose, and block light to deeper waters. This seriously affects the respiration of fish and aquatic invertebrates, leads to a decrease in animal and plant diversity, and affects our use of the water for fishing, swimming, and boating. In ground water, fertilizers and

nitrates are among the principal contaminants that can lead to drinking water well closures.

Silt and other suspended solids wash off plowed fields, construction and logging sites, urban areas, strip-mined land, and eroded stream banks when it rains. As these sediments enter rivers, lakes, coastal waters, and wetlands, fish respiration is impaired, plant productivity and water depth are reduced, aquatic organisms and their habitats are smothered, and our aesthetic enjoyment of the water is reduced.

Pathogens (certain waterborne bacteria, viruses, and protozoans) can cause human illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. These organisms can enter waterways through a number of routes, including inadequately treated sewage, storm water drains, septic systems, runoff from livestock pens, and boats that dump sewage. Because it is impossible to test water for every type of disease-causing organism, States usually measure indicator bacteria such as fecal coliforms that suggest the water may be contaminated with untreated sewage and that other, more dangerous, organisms may be present.

Organic material may enter waterways in many different forms as sewage, as leaves and grass clippings, or as runoff from livestock feedlots and pastures. When natural bacteria and protozoans in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below 2 to 5 parts per million.

Metals (such as mercury, lead, and cadmium) and **toxic organic chemicals** (such as PCBs and dioxin) may originate in industrial discharges, runoff from city streets, mining activities, leachate from landfills, and a variety of other sources. These toxic chemicals, which are generally persistent in the environment, can cause death or reproductive failure in fish, shellfish, and wildlife. In addition, they can accumulate in animal and fish tissue, be absorbed in sediments, or find their way into drinking water supplies, posing long-term health risks to humans.

Pesticides and herbicides used on croplands, lawns, and in termite control can be washed into ground and surface waters by rainfall, snowmelt, and irrigation practices. These contaminants are generally very persistent in the environment and may accumulate in fish, shellfish, and wildlife to levels that pose a risk to human health and the environment. Pesticides are among the principal contaminants causing drinking water well closures in the southern and western regions of the country.

Habitat modification results from activities such as grazing, farming, channelization, dam construction, and dredging. Typical examples of the effects of hydrologic modification include loss of streamside vegetation, siltation, smothering of bottom-dwelling organisms, and increased water temperatures.

Other pollutants include salts, acidic contaminants, and oil and grease. Fresh waters may become unfit for aquatic life and some human uses when they become contaminated by salts. Sources of salinity include irrigation runoff, brine used in oil extraction, road deicing operations, and the intrusion of sea water into ground and surface waters in coastal areas. Acidity problems are of concern in areas with many abandoned mines (acid mine drainage) and areas susceptible to acid rain. Changes in acidity (measured as pH) can alter the toxicity of other chemicals in water and can render lakes and streams unfit for aquatic life.

Other pollutants of concern include crude oil and processed petroleum products spilled during extraction, processing, or transport or leaked from underground storage tanks; noxious aquatic plants, particularly introduced species that compete against native plants; and increased water temperatures resulting from industrial cooling processes or habitat modification.

Fish Kills Inset

Sources of Water Pollution

Often we associate water pollution with images of oil spills or raw sewage and toxic chemicals spewing from pipes at industrial facilities and sewage treatment plants. Although point source discharges still produce some pollution, most are controlled with specific permit conditions that they usually meet. Currently, less visible nonpoint sources of pollution are more widespread and introduce vast quantities of pollutants into our surface and ground waters. Nonpoint sources deliver pollutants to waterbodies in a dispersed manner rather than from a discrete pipe or other conveyance. Nonpoint sources include atmospheric deposition, contaminated sediments, and many land activities that generate polluted runoff, such as agriculture, logging, and onsite sewage disposal.

In contrast, point sources discharge wastes into waterbodies from a discrete point that is easily identified. The most common point sources are industrial facilities, municipal treatment plants, and combined sewers. Diffuse runoff is a point source if it enters and is discharged from a conveyance such as those described in CWA Section 502(14) (such as pipes, ditches, and canals). The table on the previous page defines the categories of pollution sources most frequently cited in this document. The table on this page lists the leading sources of impairment reported by States for their rivers, lakes, and estuaries. Other sources cited less frequently include atmospheric deposition, in-place contaminants, and natural sources. Atmospheric deposition refers to contaminants entering waters from polluted air. In-place contaminants were generated by past activities, such as discontinued industrial discharges, logging, or one-time spills. In-place contaminants often reside in sediments but continue to release pollutants back into the water column. Natural sources refer to an assortment of water quality problems:

- Natural deposits of salts, gypsum, nutrients, and metals in soils that leach into surface and ground waters
- Warm weather and dry conditions that raise water temperatures, depress dissolved oxygen concen-trations, and dry up shallow waterbodies
- Low-flow conditions and tannic acids from decaying leaves that lower pH and dissolved oxygen concentrations in swamps draining into streams.

With so many potential sources of pollution, it is difficult and expensive for States to identify specific sources responsible for water quality impairments. Many States lack funding for monitoring to identify all but the most apparent sources degrading waterbodies. State management priorities may focus monitoring budgets on other water quality issues, such as identification of contaminated fish populations that pose a human health risk. Management priorities may also direct monitoring efforts to larger waterbodies and overlook sources impairing smaller waterbodies. As a result, the States do not associate every impacted waterbody with a source of impairment in their 305(b) reports, and the summary cause and source information presented in this report applies exclusively to a subset of the Nation's impaired waters.

Rivers and Streams

Pollutants discharged upstream often become the problem of someone who lives downstream (or of the aquatic life that exists instream), and all of the activities that take place in a watershed can have a water quality impact elsewhere in the watershed. The term watershed simply refers to a geographic area in which water, sediments, and dissolved materials (contaminants) drain to a common outlet such as a point on a larger river, lake, ground water aquifer, or ocean. It is therefore important to remember that rivers and streams are connected by hydrology, ecology, geology, and social and economic considerations to the lakes, wetlands, and coastal and ground waters we discuss later in this document.

Do Our Rivers and Streams Support Uses?

For the 1992 Report, 54 States, Territories, Tribes, Commissions, and the District of Columbia (hereafter collectively referred to as "States") assessed 642,881 miles (18%) of the Nation's total 3.5 million miles of rivers and streams.

The States assessed about 4,000 fewer river miles in 1992 than in 1990. EPA expected the percentage and amount of waters assessed to decline in 1992 because EPA advised the States to no longer include waters in the assessed categories for which the State lacked specific information. The percentage of waters assessed dropped because the baseline estimate of total waters increased.

Conditions in unassessed rivers cannot be estimated with summary information based on assessed waters because unassessed rivers include an unknown combination of pristine and impaired rivers. Therefore, the following discussion applies exclusively to assessed waters and cannot be extrapolated to describe conditions in the Nation's rivers as a whole. EPA is working with the States to expand assessment coverage of the Nation's waters and expects future assessment information to cover a greater portion of the Nation's rivers and streams.

Of the Nation's 642,881 assessed river miles, the States found that 56% fully support their designated uses, and an additional 6% support uses but are threatened and may become impaired if pollution control actions are not taken. The States reported that 25% of the assessed river miles partially support uses, and 13% of the assessed river miles do not support designated uses. Only 125 miles (less than one-tenth of 1%) of the assessed waters could not attain designated uses.

What Is Polluting Our Rivers and Streams?

The States reported that siltation and nutrients impair more miles of rivers and streams than any other pollutants, affecting 45% and 37% of impaired stream miles in the States reporting causes, respectively. Other leading causes of impairment include indicators of pathogens, affecting 27%; pesticides, affecting 26%; and organic enrichment and resultant low levels of dissolved oxygen, affecting 24% of impaired stream miles.

Where Does This Pollution Come From?

Forty-eight States identified sources contributing to the impairment of 221,877 miles of their rivers and streams not fully supporting designated uses. These States reported that agricultural runoff is the leading source of pollutants in rivers and streams. Forty-five States identified almost 160,000 river miles impaired by agricultural sources, including nonirrigated crop production, irrigated crop production, rangeland, and animal holding areas. These States found that agricultural activities contribute substantially to the impairment of 72% of the impaired stream miles in the 48 States reporting sources. The States identified other sources of impairment far less frequently, such as municipal point sources, affecting 15%; urban runoff and storm sewers, affecting 11%; and resource extraction, affecting 11% of the impaired waters.

Although this summary provides the best picture of national impacts from sources available to EPA at this time, it has limitations. The information provided applies to only 18% of our Nation's total rivers and streams because the States cannot assess all 3.5 million miles of this Nation's rivers and streams in a 2-year period and they cannot specify the source of pollution impairing each waterbody assessed. In addition, national summary information can obscure sources with regional or State significance. For example, Oregon reports that silviculture (forestry activity) contributes to the impairment of 46% of their rivers and streams that do not fully support designated uses. Nationally, silviculture impacts only 7% of the impaired rivers and streams. Therefore, it is important to refer to the individual State data presented in the *National Water Quality Inventory: 1992 Report to Congress* for detailed information on significant sources in individual States.

Lakes, Ponds, and Reservoirs

Lakes are sensitive to pollution inputs because lakes flush out their contents relatively slowly. Even under natural conditions, lakes undergo eutrophication, an aging process that slowly fills in the lake with sediment and organic matter (see following sidebar). The eutrophication process alters basic lake characteristics such as depth, biological productivity, oxygen levels, and water clarity. The eutrophication process is commonly defined by a series of trophic states as described in the sidebar.

Do Our Lakes and Reservoirs Support Uses?

Forty-nine States assessed overall use support in more than 18 million lake acres representing 46% of the approximately 40 million total acres of lakes, reservoirs, and ponds in the Nation. For 1992, the States assessed about 180,000 fewer lake acres than in 1990. Overall, 43% of the assessed lake acres fully support designated uses such as swimming, fishing, and drinking water supply. An additional 13% were identified as threatened and could soon become impaired if pollution control actions are not taken. The States reported that 35% of assessed lake acres partially support designated uses, 9% do not support uses, and less than 1% cannot attain uses.

Trophic States Inset

What Is Polluting Our Lakes, Reservoirs, and Ponds?

Forty-seven States reported causes of impairment in their lakes. Overall, these States reported that metals and nutrients are the most common causes of nonsupport in assessed lakes, affecting 47% and 40% of impaired lake acres, respectively. However, impairments due to metals were concentrated in several States with large numbers of lakes (primarily Minnesota), while nutrient problems were widely reported by 41 States. Other leading causes of lake impairment were organic enrichment, affecting 24% of impaired lake acres; siltation, affecting 22%; and priority organics, affecting 20% of impaired lake acres.

Acid Effects on Lakes Inset

Forty-one States also assessed trophic status, which is associated with nutrient enrichment, in 11,477 of their lakes. Nutrient enrichment tends to increase the proportion of lakes in the eutrophic and hypereutrophic categories. These States reported that 17% of the lakes they assessed for trophic status were oligotrophic, 35% were mesotrophic, 32% were eutrophic, 7.5% were hypereutrophic, and 8.5% were dystrophic. This information may not be representative of national lake conditions because States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes which are probably less impaired are underrepresented in these assessments.

Where Does This Pollution Come From?

Forty-five States identified individual sources degrading some of their 5.5 million impaired lake acres. These States reported that agriculture impairs more lake acres than any other source. Thirty-eight States found that agriculture contributes to the impairment of 3 million lake acres, or 56% of the impaired lake acres in the 45 States reporting sources of pollution in lakes.

The States also reported that urban runoff and storm sewers contribute to impairments in 24% of their impaired lake acres, hydrologic modifications and habitat modifications affect 23%, municipal point sources affect 21%, and onsite wastewater disposal (such as septic systems) affect 16% of the impaired lake acres.

The Great Lakes

The Great Lakes contain one-fifth of the world's fresh surface water and are stressed by a wide range of pollution sources associated with the large urban centers located on their shores. Many of the pollutants that reach the Great Lakes remain in the system indefinitely because the Great Lakes are a relatively closed water system.

Do the Great Lakes Support Uses?

The States assessed 99% of the Great Lakes shoreline miles in 1992. Less than 3% of the assessed shoreline miles fully support uses due to conditions that also generate fish consumption advisories issued by the Great Lakes States and the Province of Ontario for the nearshore waters of the Great Lakes. Thirty percent of assessed shoreline miles partially support uses, and the remaining 67% do not support uses. These figures do not address water quality conditions in the deeper, cleaner, central waters of the Lakes.

What Is Polluting the Great Lakes?

Most of the Great Lakes shoreline is polluted by toxic organic chemicals primarily PCBs and DDT that are often found in fish tissue samples. The Great Lakes States reported that toxic organic chemicals impact 99% of the impaired Great Lakes shoreline miles. Other leading causes of impairment include metals, affecting 11%; organic enrichment and low dissolved oxygen, affecting 7%; nutrients, affecting 5%; and siltation, affecting 3%.

Where Does This Pollution Come From?

Although information on sources of pollution in the Great Lakes is sketchy, the reported information suggests that atmospheric deposition and contaminated sediments are the leading sources impairing Great Lakes waters. Sediment contamination is a major problem in nearshore waters and harbors. Other sources cited by the States include landfills, urban runoff, and combined sewer overflows.

Estuaries

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity, complex water movements affected by ocean tides and river currents, and high turbidity levels. They are also highly productive ecosystems with a range of habitats for many different species of plants, shellfish, fish, and animals.

Many species permanently inhabit the estuarine ecosystem; others, such as shrimp, use the nutrient-rich estuarine waters as nurseries before traveling to the sea.

Estuaries are stressed by the particularly wide range of activities located within their watersheds. They receive pollutants carried by rivers from agricultural lands and cities; they often support marinas, harbors, and commercial fishing fleets; and their surrounding lands are highly prized for development. These stresses pose a continuing threat to the survival of these bountiful waters.

Do Our Estuaries Support Uses?

Twenty-five coastal States assessed roughly three-quarters of the Nation's total estuarine waters in 1992. Of these, 56% were found to fully support designated uses. An additional 12% are fully supporting uses but are threatened and could become impaired if pollution control actions are not taken. Twenty-three percent of assessed estuarine square miles partially support uses, and the remaining 9% do not support uses.

What Is Polluting Our Estuaries?

States report that the most common causes of nonsupport of designated uses in our Nation's estuaries are nutrients, affecting 55% of the 8,572 impaired square miles; followed by pathogens, affecting 42%; organic enrichment and resulting low levels of dissolved oxygen, affecting 34%; and siltation, affecting 12%. Pathogen contamination is responsible for the closure of shellfishing beds in many areas of the country.

Where Does This Pollution Come From?

States report that municipal sewage treatment plants, urban runoff/storm sewers, and agriculture are the leading sources of pollution in their estuarine waters, affecting 53%, 43%, and 43% of impaired estuarine square miles, respectively. Other leading sources cited by the States include industrial point sources, affecting 23%, and resource extraction, affecting 12%. Point sources continue to have a significant impact on estuarine water quality because concentrated population centers and industrial operations are located adjacent to major estuarine systems. In contrast, rivers and lakes are more dispersed in rural and urban areas throughout the country and tend to support more diverse land uses that generate nonpoint source pollution.

The Chesapeake Bay

Since its inception in 1975, the Chesapeake Bay Program has coordinated numerous studies by the Chesapeake Bay States, the EPA, and other Federal agencies (see page 35 for programmatic information). These studies have defined water quality problems in the Bay, identified sources of water quality degradation, and documented water quality improvements in the Bay.

The Problem

Studies completed in the 1970s substantiated that increases in agricultural development, population growth, and sewage treatment plant flows were generating large quantities of nutrients (primarily phosphorus and nitrogen) flowing into the Bay. The nutrients cause excessive algae growth that initiates a chain reaction with two effects:

- In shallow areas, the excess algae shade underwater bay grasses, blocking light essential for plant growth. The habitat degradation causes the eventual loss of grass beds that provide food for waterfowl and critical habitat for other creatures, such as juvenile blue crabs and Bay scallops.
- In deeper areas, the algae die and sink to the bottom where their

> decomposition consumes oxygen. During the warm summer months, oxygen in the bottom waters can be depleted. Bottom-dwelling organisms, such as oysters, clams, and worms, which provide food for fish and crabs, cannot survive this prolonged period of low oxgen concentrations.

The Sources

Point sources, nonpoint sources, and atmospheric deposition generate the nutrients that enter Chesapeake Bay. The Chesapeake Bay Program developed a model to estimate the 1985 base load of nutrients entering the Bay because it was not feasible to monitor the wide array of nonpoint sources generating nutrients. The model estimates that nonpoint sources contribute 51% of the total nitrogen load into the Chesapeake Bay, followed by atmospheric deposition (26%) and point sources (23%). Atmospheric loads of nitrogen include nitrogen deposited on the tidal waters of the Bay (9%) and nitrogen deposited on the watershed lands surrounding the Bay that wash into Bay waters (17%). The model also estimates that nonpoint sources contribute 61% of the phosphorus load entering the Bay, followed by point sources (34%) and atmospheric deposition (5%).

Improvements in Bay Water Quality

Annual discharges of phosphorus into Chesapeake Bay dropped by 40% (4.7 million pounds) between 1985 and 1991 as a result of wastewater plant upgrades, enhanced compliance with permits, and bans on phosphorus detergents in the Bay watersheds. Overall, water quality monitoring data confirm that the reduction in phosphorus loading is reducing phosphorus concentrations in Bay waters. Total phosphorus concentrations in the Bay decreased by 16% between 1984 and 1992. However, total nitrogen concentrations have remained stable in the mainstem of the Bay and increased in some tributaries.

Ocean Coastal Waters

We know less about the condition of our ocean coastal waters than we do about our estuarine or inland waters. In part, this may be because we tend to think that only oil spills or similar disastrous events could possibly affect a resource as vast as an ocean.

In fact, we are seeing evidence that our ocean waters particularly the waters near our coasts suffer from the same pollution problems that affect our inland waters. Beach debris cleanups are cataloging tons of trash carried into the oceans by rivers, washed in from city storm sewers, thrown in by beach visitors, or dumped overboard by boaters. Beaches are closed to swimming every summer due to pathogens from inadequately treated wastes. Marine mammals are suffering from pollution-related stresses. Fragile coral reefs in Florida and Hawaii show signs of pollution impacts. Coastal development is increasing at a rapid rate. Clearly we can no longer assume that the oceans can take care of themselves.

Do Ocean Shores Support Uses?

Twelve of the 29 coastal States assessed only 6% of the Nation's estimated 56,121 miles of ocean coastline. Of these, 80% were found to fully support their designated uses, and 7% are supporting uses but are threatened and likely to become impaired if pollution control actions are not taken. Nine percent of assessed ocean shore miles partially support designated uses, and 5% do not support uses. These figures do not necessarily represent water quality conditions in the Nation's ocean coastal waters as a whole because they apply to only 6% of the Nation's coastline miles. Data on pollutants and sources of pollution are too sparse to be included in this report.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Often in the past, wetlands were considered wastelands the source of mosquitoes, flies, and unpleasant odors to be filled or drained and put to "better use." When European settlers first arrived in America, over 200 million acres of wetlands existed in the conterminous States. Today, half of our Nation's wetlands have been destroyed by filling, draining, polluting, channelizing, grazing, clearing, and other modifications resulting from human activity.

Wetlands are now recognized as some of the most unique and important natural areas on earth. They vary in type according to differences in local and regional hydrology, vegetation, water chemistry, soils, topography, and climate. Coastal wetlands include estuarine marshes; mangrove swamps found in Puerto Rico, Hawaii, and Florida; and Great Lakes coastal wetlands. Inland wetlands, which may be adjacent to a waterbody or isolated, include marshes and wet meadows, bottomland hardwood forests, Great Plains prairie potholes, cypress-gum swamps, and southwestern playa lakes.

Wetlands provide food and shelter to countless animal species including many fishes, birds, reptiles, and mammals. A high percentage of federally listed threatened or endangered animals and plants depend directly or indirectly on wetlands for their survival. Wetlands also provide spawning habitat and nursery grounds for an estimated 71% of commercially valuable fish and shellfish consumed in this country. In addition, they also serve as feeding areas along migration routes for waterfowl and other wildlife.

Wetlands soil and vegetation help in flood control by acting as natural sponges that attenuate flooding water. Wetlands plants also help control erosion in two ways: their roots bind the soil and their leaves slow the movement of water. Wetlands help purify water by processing nutrients and other pollutants and filtering suspended materials. They also help regulate water quantity by absorbing water in wet seasons and releasing it through seeps, springs, and open outlets during dry seasons.

In addition, wetlands are widely enjoyed by hikers, birdwatchers, hunters, fishermen, photographers, and boaters and play an important role in our Nation's natural and cultural heritage. Millions of people spend nearly $10 billion each year observing and photographing wetlands-dependent wildlife.

Do Our Wetlands Support Uses?

In 1992, most States could not assess use support in wetlands because they were still developing wetlands water quality standards. As a result, only eight States (California, Colorado, Hawaii, Iowa, Kansas, Nevada, North Carolina, and Oklahoma) reported use support for 10.5 million acres of their wetlands. These States assessed use support in approximately 4% of the Nation's 277 million acres of wetlands. North Carolina assessed 98% of the assessed wetlands; therefore, the summary information on use support describes conditions primarily in North Carolina's wetlands rather than the Nation's wetlands as a whole.

These States reported that 50% of the assessed wetlands fully support designated uses, less than 1% are threatened, 26% partially support uses, and 24% do not support designated uses. However, this information does not accurately reflect water quality conditions in the Nation's wetlands due to the skewed distribution of the assessed wetlands. Despite limitations in the data, the summary information suggests that water quality problems exist in our remaining wetlands.

What is Polluting Our Wetlands?

Of the eight States reporting overall use support in wetlands, only three States (Iowa, Kansas, and Nevada) quantified the wetlands acreage degraded by specific pollutants or processes causing wetlands impairment. Although the data submitted by these States are not representative of national conditions in wetlands, these States did report that metals impair over 60,000 acres of wetlands, salinity and chlorides impair over 42,000 acres of wetlands, and siltation impairs almost 29,000 acres of wetlands. Fourteen States did not quantify the acreage affected but did identify pollutants and processes that degrade some unknown quantity of their wetlands. Most of these States cited sediment and nutrients as pollutants of concern in wetlands. Fewer States reported that water diversions, pesticides, salinity, heavy metals, ponding, weeds, low dissolved oxygen, and pH impact their wetlands.

Where Does This Pollution Come From?

Iowa, Kansas, and Nevada also reported that agriculture impairs 76,000 acres of wetlands, hydrologic habitat modification impairs 48,000 acres, and municipal point sources impair over 11,000 acres of wetlands. Fourteen States did not quantify the acreage affected but did identify sources of pollutants that degrade some unknown quantity of wetlands. Most of these States reported that agriculture, development, channelization, and road construction degrade wetlands integrity. These States also reported that urban runoff, resource extraction, landfills, natural conditions, industrial runoff, onsite systems, irrigation, recreation, point sources, and silviculture impact wetlands.

Wetlands Loss: A Continuing Problem

Despite what we have learned about the value of our wetlands, these national treasures continue to be threatened by a variety of human activities. A U.S. Fish and Wildlife Service study of wetlands loss found that 2.6 million acres of wetlands were lost over the 9-year study period from the mid-1970s to the mid-1980s, or 290,000 acres a year. This is an improvement from the 1950s to the 1970s when wetlands were lost at a rate of 458,000 acres per year. Serious consequences have resulted nationwide from the loss and degradation of wetlands, including species decline and extinction, water quality decline, and increased incidences of flooding.

In 1992, 27 States reported on sources of current wetlands losses. These include agriculture, commercial development, residential development, highway construction, impoundments, resource extraction, industry, and dredge disposal.

More information on wetlands
can be obtained from the
EPA Wetlands Hotline at
1-800-832-7828

Ground Water

Ninety-five percent of all fresh water available on earth (exclusive of icecaps) is ground water. Ground water water found in natural underground rock formations called aquifers is a vital natural resource with many uses. The extent of the Nation's ground water resources is enormous. At least 60% of the land area in the conterminous United States overlies aquifers. Usable ground water exists in every State.

Aquifers can range in size from thin surficial formations that yield small quantities of ground water to large systems such as the High Plains aquifer that underlies eight western States and provides water to millions. Although most of the Nation's ground water is considered to be of good quality, an increasing number of pollution events have threatened the integrity of the resource.

Ground Water Use

Nationally, 53% of the population relies to some extent on ground water as a source of drinking water. This percentage is even higher in rural areas where most residents rely on potable or treatable ground water as an economical source of drinking water. Eighty-one percent of community water systems are dependent on ground water. Seventy-four percent of community water systems are small ground water systems serving 3,300 people or less. Ninety-five percent of the approximately 200,000 noncommunity water systems (serving schools, parks, etc.) are ground water systems.

Irrigation accounts for approximately 64% of national ground water withdrawals. Public drinking water supplies account for approximately 19% of the Nation's total ground water withdrawals. Domestic, commercial, livestock, industrial, mining, and thermoelectric withdrawals together account for approximately 17% of national ground water withdrawals.

Ground Water Quality

Although the 1992 Section 305(b) State Water Quality Reports indicate that, overall, the Nation's ground water quality is good to excellent, many local areas have experienced significant ground water contamination. Although the sources and types of ground water contamination vary depending upon the region of the country, those most frequently reported by States include:

- Leaking underground storage tanks. About 400,000 of an estimated 5 to 6 million underground storage tanks in the United States are thought to be leaking. About 30% of all tanks store petroleum or hazardous materials.
- Septic tanks. Approximately 23 million domestic septic systems are in operation in the United States. About half a million new systems are installed each year.

- Municipal landfills. Of the quarter million solid waste disposal facilities in the United States, about 6,000 are municipal solid waste facilities. Approximately 25% of these municipal facilities have ground water monitoring capabilities.
- Agricultural activities. Seventy-seven percent of the 1.1 billion pounds of pesticides produced annually in the United States is applied to land in agricultural production, which often overlies aquifers.
- Abandoned hazardous waste sites. Approximately 33,000 sites have been identified as abandoned hazardous waste sites, of which 42% involve ground water contamination.

The most common contaminants associated with these sources include nitrates, metals, volatile organic compounds (VOCs), and pesticides.

EPA has been working with States to develop a set of ground water quality indicators. These indicators will allow the characterization of trends in ground water quality over space and time. Examples of preliminary indicators include the number of maximum contaminant level violations in public water systems, detections of VOCs in ground water, and the extent of leachable agricultural pesticide use. EPA will continue to work with the States to refine these ground water quality indicators.

Additional ground water monitoring initiatives have been undertaken in numerous States. These initiatives are aimed at characterizing the overall quality of ground water resources and typically include the establishment of ambient monitoring networks, regional monitoring networks that focus on sensitive aquifers, or site-specific monitoring efforts that focus on known or suspected contamination sources.

Water Quality Protection Programs

The EPA works in partnership with State and local governments to improve and protect water quality. Since the 1990 Report to Congress, EPA and many States have moved toward a more geographically oriented approach to water quality management. They share a growing consensus that the Nation's remaining water quality problems can be solved most effectively at the basin or watershed level.

In 1991, EPA highlighted the Watershed Protection Approach (WPA), a framework for focusing and integrating water quality monitoring and management activities in a watershed of concern. The WPA is not a new government program, but rather a means of pulling together the resources and expertise of existing programs at all levels, from Federal to State and local levels.

The EPA, other Federal agencies, State pollution control agencies, and local governments are applying the WPA to existing monitoring and assessment programs as well as water quality protection programs (see sidebar next page). A number of laws provide the authority to develop and implement pollution control programs. The primary statute providing for water quality protection in the Nation's rivers, lakes, wetlands, estuaries, and coastal waters is the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act (CWA).

The Clean Water Act

The Clean Water Act of 1972 and its amendments are the driving force behind many of the water quality improvements we have witnessed in recent years. Key provisions of the Clean Water Act provide the following pollution control programs.

> **Water quality standards and criteria -** States adopt EPA-approved standards for their waters that define water quality goals for individual waterbodies. Standards consist of designated beneficial uses to be made of the water, criteria to protect those uses, and antidegradation provisions to protect existing water quality.
>
> **Effluent guidelines -** The EPA develops nationally consistent guidelines limiting pollutants in discharges from industrial facilities and municipal sewage treatment plants. These guidelines are then used in permits issued to dischargers under the National Pollutant Discharge Elimination System (NPDES) program. Additional controls may be required if receiving waters are still affected by water quality problems after permit limits are met.

Total Maximum Daily Loads - The development of Total Maximum Daily Loads, or TMDLs, establishes the link between water quality standards and point/NPS source pollution control actions such as permits or Best Management Practices (BMPs). A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides the quantitative basis for pollution reduction necessary to meet water quality standards. States develop and implement TMDLs for high-priority impaired or threatened waterbodies.

Permits and enforcement - All industrial and municipal facilities that discharge wastewater must have an NPDES permit and are responsible for monitoring and reporting levels of pollutants in their discharges. EPA issues these permits or can delegate that permitting authority to qualifying States. The States and EPA inspect facilities to determine if their discharges comply with permit limits. If dischargers are not in compliance, enforcement action is taken.

In 1990, EPA promulgated permit application requirements for municipal sewers that carry storm water separately from other wastes and serve populations of 100,000 or more and for storm water discharges associated with some industrial activities. The EPA is developing regulations to establish a comprehensive program to regulate storm sewers, including requirements for State storm water management programs.

Grants - The EPA provides States with financial assistance to help support many of their pollution control programs. These programs include the State Revolving Fund program for construction and upgrading of municipal sewage treatment plants; water quality monitoring, permitting, and enforcement; and developing and implementing nonpoint source pollution controls, combined sewer and storm water controls, ground water strategies, lake assessment, protection, and restoration activities, estuary and near coastal management programs, and wetlands protection activities.

Nonpoint source control - The EPA provides program guidance, technical support, and funding to help the States control nonpoint source pollution. The States are responsible for analyzing the extent and severity of their nonpoint source pollution problems and developing and implementing needed water quality management actions.

Control of combined sewer overflows - Under the National Combined Sewer Overflow Control Strategy of 1989, States develop and implement measures to reduce pollution discharges from combined storm and sanitary sewers. The EPA works with the States to implement the national strategy.

The Watershed Protection Approach (WPA) Inset

The CWA also established pollution control and prevention programs for specific waterbody categories, such as the Clean Lakes Program. Other statutes that also guide the development of water quality protection programs include:

- The Safe Drinking Water Act, under which States establish standards for drinking water quality, monitor wells and local water supply systems, implement drinking water protection programs, and implement Underground Injection Control (UIC) programs.
- The Resource Conservation and Recovery Act, which establishes State and EPA programs for ground water and surface water protection and cleanup and emphasizes prevention of releases through management standards in addition to other waste management activities.
- The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Program), which provides EPA with the authority to clean up contaminated waters during remediation at contaminated sites.
- The Pollution Prevention Act of 1990, which requires EPA to promote pollutant source reduction rather than focus on controlling pollutants after they enter the environment.

The Clean Lakes Program

EPA's Clean Lakes Program provides Federal funds to help States carry out diagnostic studies of lake problems, determine necessary protection and restoration measures, implement those measures, and monitor the long-term impacts and effectiveness of those measures. The Clean Lakes Program provides grants for four types of cooperative agreements:

Lake Water Quality Assessments strengthen State lake management programs and improve water quality information.

Phase I Diagnostic/Feasibility Studies investigate the causes of water quality decline in a publicly owned lake and determine the most feasible procedures for controlling pollutants and restoring the lake.

Phase II Projects implement the restoration and pollution control methods identified in a Phase I study.

Phase III Postrestoration Monitoring Projects sponsor long-term monitoring to verify the longevity and effectiveness of restoration and control measures implemented during a Phase II project.

Managing lake quality often requires a combination of in-lake restoration measures and pollution controls, including watershed management measures:

Restoration measures are implemented to reduce existing pollution problems. Examples of in-lake restoration measures include harvesting aquatic weeds, dredging sediment, and adding chemicals to precipitate nutrients out of the water column. Restoration measures focus on restoring uses of a lake and may not address the source of the pollution.

Pollution control measures deal with the sources of pollutants degrading lake water quality or threatening to impair lake water quality. Control measures include planning activities, regulatory actions, and implementation of BMPs to reduce nonpoint sources of pollutants.

During the 1980s, most States implemented chemical and mechanical in-lake restoration measures to control aquatic weeds and algae. In their 1992 Section 305(b) reports, the States report a shift toward watershed planning techniques and nonpoint source controls to reduce pollutant loads responsible for aquatic weed growth and algal blooms. Watershed management plans simultaneously address multiple sources of pollutants, such as runoff from urbanized areas, agricultural activities, and failing septic systems along the lake shore. Although the States reported that they still use in-lake treatments, the States recognize that source controls are needed in addition to in-lake treatments to restore lake water quality.

The States reported that they most frequently rely on their NPDES permit programs and their Section 319 nonpoint source (NPS) management programs to control pollutants entering lakes. Through the State NPDES permit programs, States often impose stricter nutrient limits for effluents discharged into lakes than into rivers and streams. Seven States reported that phosphorus detergent restrictions enhanced sewage treatment plant compliance with NPDES nutrient limits. Twenty-two States reported that they use their Section 319 NPS programs to implement BMPs in watersheds surrounding impaired or threatened lakes.

Successful lake programs require strong commitment from local citizens and cooperation from natural resource agencies at the local, State, and Federal levels. Forty-nine States, Puerto Rico, and 18 American Indian Tribes have established cooperative frameworks for managing lakes under the Clean Lakes Program.

The National Estuary Program

Section 320 of the Clean Water Act (as amended by the Water Quality Act of 1987) established the National Estuary Program (NEP) to protect and restore water quality and living resources in estuaries. The NEP adopts a geographic or watershed approach by planning and implementing pollution abatement activities for the estuary and its surrounding land area as a whole.

Through the NEP, States nominate estuaries of national signifi-cance that are threatened or impaired by pollution, development, or overuse. EPA evaluates the nominations and selects those that show evidence of a committed citizenry, political support, a range of government involvement (State, Federal, regional, and local), and available scientific and technical expertise to tackle the problem. The EPA convenes management conferences with representatives from all interested groups (e.g., industry, agriculture, conservation organizations, and State agencies) to more fully characterize the problems and seek solutions.

The NEP is also a national demonstration program. There are more than 150 estuaries in the United States and only a small fraction can be targeted for action through the NEP. It is therefore important that the lessons learned through the NEP be communicated to estuarine water quality managers throughout the country. As of June 1993, 21 estuaries are included in the NEP.

Protecting Wetlands

Section 404 of the CWA remains the primary Federal vehicle for protecting wetlands. Section 404 regulates the discharge of dredged or fill material into waters of the United States, including wetlands. EPA continues to promote other mechanisms to protect wetlands including:

- Incorporating wetlands considerations into traditional water programs and other EPA programs
- Working with other Federal agencies
- Helping to build State and local government programs to protect wetlands
- Improving wetlands science
- Promoting outreach and education
- Developing voluntary partnerships with landowners
- Coordinating international wetlands protection.

In addition, EPA has awarded wetlands grants since 1990 to support the development of State and Tribal wetlands protection programs. States and Tribes have used these grants to develop water quality standards, monitor trends in wetlands loss, coordinate State and local planning agencies, and disseminate educational materials on wetlands.

Overall, States reported that they are making considerable progress in protecting the quantity and quality of their wetlands through regulatory and nonregula-tory approaches. States were asked to report on several key areas, including the application of Section 401 certification authority to protect wetlands, their progress in developing water quality standards for wetlands, and efforts to incorporate wetlands considerations into other programs. In addition, 18 States and one Territory reported on efforts to inventory the physical acreage of their wetlands.

According to State-reported information, no State is currently operating a statewide wetlands monitoring program. However, five States did describe water quality and habitat monitoring efforts for some portion of their wetlands.

EPA recognizes that the development of biological monitoring and assessment methods for wetlands is a critical need for State wetlands managers so that they can begin to monitor their wetlands. To this end, EPA is developing assessment protocols for freshwater emergent wetlands as part of its 5-year research plan. However, more research on other wetlands systems is needed on both the Federal and State levels.

State monitoring programs are critical for determining whether wetlands are meeting their designated and existing uses as well as for prioritizing restoration once impairment is identified. Wetlands monitoring information is also important for making Section 401 certification decisions, determining mitigation success for Section 404, and supporting other management decisions.

Protecting the Great Lakes

The Great Lakes are cooperatively managed by the United States and Canada under the Great Lakes Water Quality Agreement of 1978 (as amended in 1987). The International Joint Commission, established by the 1909 Boundary Waters Treaty, is responsible for identifying actions to protect the Great Lakes. Representatives from State and Federal agencies and universities work together on the Commission's two boards to identify problem areas, plan programs to reduce pollution, and publish findings and issue papers.

Since 1973, 43 Areas of Concern have been identified in the Great Lakes basin where environmental quality is substantially degraded. Most Areas of Concern are harbors, bays, and river mouths. Remedial Action Plans are being developed for each Area of Concern. These plans identify impaired uses and examine management options to restore the areas.

In 1989, the EPA launched the Great Lakes Initiative to provide a framework for Federal assistance in pursuing the goal of whole-system restoration based on an ecosystem perspective. The Initiative emphasizes areas in which EPA can provide State governments and other stakeholders with technical support. The Initiative envisions EPA making the following technical contributions:

- Develop guidance for identifying toxic hot spots
- Develop guidance for tracking the relative contributions of toxic and acidic pollutants from surface water and atmospheric sources
- Develop guidance for determining the relative roles of point and nonpoint source contributions to conventional and toxic pollutant burdens

- Suggest innovative approaches for the protection of critical habitat areas
- Support the development of special wildlife standards.

To help implement the goals of the Great Lakes Initiative, EPA Region 5 and the EPA Great Lakes National Program Office coordinate a Steering Committee, Technical Workgroup, and Public Participation Group. The States have played an active role in the development of draft criteria and policies.

By late 1992, EPA had reviewed a draft of the Great Lakes Initiative Guidance. When issued in final form, this major guidance document will assist in updating the Great Lakes Strategy, which provides the framework for implementing the Great Lakes Water Quality Agreement. Specific policies under the Great Lakes Initiative will help integrate the development of Remedial Action Plans for designated Areas of Concern with the more holistic goals of Lakewide Management Plans and pollution prevention strategies for the Great Lakes as a whole.

The Chesapeake Bay Program

In 1975, the Chesapeake Bay became the Nation's first estuary targeted for protection and restoration when Congress directed EPA to study the causes of environmental declines in the Bay. Section 117(a) of the 1987 CWA amendments required that the EPA Administrator continue the Chesapeake Bay Program to:

- Collect and distribute information about the Bay's environmental quality . Coordinate Federal and State efforts to improve the Bay's water quality
- Determine impacts from environmental changes such as inputs of nutrients, chlorine, oxygen- demanding substances, toxic pollutants, and acid precipitation.

A system of committees, subcommittees, work groups, and task forces have evolved under the Chesapeake Executive Council, which consists of the Governors of Maryland, Virginia, and Pennsylvania, the Administrator of EPA, the Mayor of the District of Columbia, and the Chairman of the Chesapeake Bay Commission. The Council coordinates program implementation, establishes policy directions, and provides oversight for the restoration and protection of the Bay and its living resources. On August 6, 1991, the Chesapeake Executive

Council adopted four action steps, building on the 1987 Chesapeake Bay Agreement to reduce nitrogen and phosphorus loads entering the Bay by 40%. The four action steps commit the Council to:

- Reevaluating and accelerating the nutrient reduction program
- Adopting pollution prevention
- Restoring and enhancing living resources and their habitats, such as submerged aquatic vegetation beds
- Broadening participation in the Bay Program.

The Chesapeake Bay Program has implemented programs to reduce impacts from nutrients, oxygen-demanding substances, and pathogens. To date, three elements of the Chesapeake Bay Program's point source control strategy are responsible for reductions in nutrient loadings:

- Upgrading wastewater treatment plants
- Improving compliance with discharge and pretreatment permits
- Pollution prevention actions such as prohibiting the sale of detergents containing phosphorus.

As a result of these measures, annual discharges of phosphorus into the Bay dropped by 40% (4.7 million pounds) between 1985 and 1991.

The Chesapeake Bay Program's nonpoint source program emphasizes controls for runoff generated by agricultural activities, paved surfaces, and construction in urban areas. The program includes nutrient management for applying animal wastes and fertilizers to cropland in amounts calculated to meet crop requirements without contaminating ground and surface waters. Overall, water quality monitoring data confirm significant progress in reducing phosphorus loads into Chesapeake Bay. Total phosphorus concentrations in the Bay decreased by 16% between 1984 and 1992. However, total nitrogen concentrations have remained stable in the mainstem of the Bay and increased in some tributaries, indicating a need for additional progress in reducing nitrogen loadings.

The Gulf of Mexico Program

In 1988, the Gulf of Mexico Program (GMP) was established with EPA as the lead Federal agency to develop and help implement a strategy to protect, restore, and maintain the health and productivity of the Gulf. The GMP is a grass roots program that serves as a catalyst to promote sharing of information, pooling of resources, and coordination of efforts to restore and reclaim wetlands and wildlife habitat, clean up existing pollution, and prevent future contamination and destruction of the Gulf. The GMP mobilizes State, Federal, and local government; business and industry; academia; and the community at large through public awareness and information dissemination programs, forum discussions, citizen committees, and technology applications.

A Policy Review Board and a newly formed Management Committee determine the scope and focus of GMP activities. The program also receives input from a Technical Advisory Committee and a Citizen's Advisory Committee. The GMP Office and 10 Issue Committees coordinate the collection, integration, and reporting of pertinent data and information. The Issue Committees are responsible for documenting environmental problems and management goals, available resources, and potential solutions for a broad range of issues, including habitat degradation, public health, freshwater inflow, marine debris, shoreline erosion, nutrients, toxic pollutants, and living aquatic resources. The Issue Committees publish their findings in Action Agendas. Two additional committees provide operational support and information transfer activities for the entire GMP.

On December 10, 1992, the Governors of Alabama, Florida, Louisiana, Mississippi, and Texas; EPA; the Chair of the Citizen's Advisory Committee; and representatives of 10 other Federal agencies signed the Gulf of Mexico Program Partnership for Action agreement for protecting, restoring, and enhancing the Gulf of Mexico and adjacent lands. The agreement commits the signatory agencies to pledge their efforts, over the next 5 years, to obtain the knowledge and resources to:

- Significantly reduce the rate of loss of coastal wetlands
- Achieve an increase in Gulf Coast seagrass beds
- Enhance the sustainability of Gulf commercial and recreational fisheries . Protect human health and food supply by reducing input of nutrients, toxic substances, and pathogens to the Gulf
- Increase Gulf shellfish beds available for safe harvesting by 10%
- Ensure that all Gulf beaches are safe for swimming and recreational uses

- Reduce by at least 10% the amount of trash on beaches
- Improve and expand coastal habitats that support migratory birds, fish, and other living resources
- Expand public education/outreach tailored for each Gulf Coast county or parish.

During 1992, the GMP also launched Take-Action Projects in each of the five Gulf States to demonstrate that program strategies and methods could achieve rapid results. The Take-Action Projects primarily address inadequate sewage treatment, pollution prevention, and habitat protection and restoration. Several projects aim to demonstrate the effectiveness of innovative sewage treatment technologies to control pathogenic contamination of shellfish harvesting areas. Other projects aim to restore wetlands, sea grass beds, and oyster reefs. The Take-Action Projects are designed to have Gulf-wide application.

Comprehensive State Ground Water Protection Programs Inset

Ground Water Protection Programs

Numerous laws, regulations, and programs play a role in protecting ground water. The following Federal laws and programs enable, or provide incentives for, EPA and/or States to regulate or voluntarily manage and monitor sources of ground water pollution:

- The Resource Conservation and Recovery Act (RCRA) regulates solid and hazardous waste treatment, storage, and disposal as well as underground storage tanks, the source of ground water contamination most frequently cited by the States.
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulates cleanup of abandoned waste sites, many of which contain contaminated ground water.
- The Safe Drinking Water Act (SDWA) regulates subsurface injection of fluids that can contaminate ground water. . The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) controls the use and disposal of pesticides, some of which have been detected in ground water wells in rural communities.
- The Toxic Substances Control Act (TSCA) controls the use and disposal of additional toxic substances, thereby minimizing their entry into ground

water. Other Federal laws establish State grants that may be used to protect ground water.

- Clean Water Act Sections 319(h) and (i) and 518 provide funds to State agencies to implement EPA-approved nonpoint source management programs that include ground water protection activities. Several States have developed programs that focus on ground water contamination resulting from agriculture and septic tanks.
- The Pollution Prevention Act of 1990 allows grants for research projects to demonstrate agricultural practices that emphasize ground water protection and reduce the excessive use of fertilizers and pesticides.

Comprehensive State Ground Water Protection Programs (CSGWPPs) will integrate all of the above efforts and emphasize contamination prevention. CSGWPPs will improve coordination of Federal, State, Tribal, and local ground water programs and enable distribution of resources to established priorities. Once EPA endorses a CSGWPP, the Agency will seek to provide more consistent deference to State priorities.

EPA's Pesticides and Ground Water Strategy emphasizes prevention and protection of the Nation's ground water resources and provides a flexible framework for tailoring State Management Plans for the management and control of pesticide use to the needs of each State. In addition, EPA has established a Restricted Use classification for pesticides, which is intended to reduce both the risks of point source causes of ground water contamination and nonpoint source causes of contamination.

A number of mechanisms have been developed to manage the ever-growing volume of information on the Nation's ground water resources. These include the development of standard elements for collecting ground water data called the Minimum Set of Data Elements (MSDE) for Ground Water Quality. The MSDE is intended to improve access to ground water data and to increase information- sharing capabilities by standardizing the elements used in databases that contain ground water data. Additional mechanisms include the development of a geographic information system (GIS) to integrate ground water data that have been collected under different programs, the development and management of two databases concerning pesticides and ground water, and the inclusion of ground water data in a modernized STORET (EPA's water database).

What You Can Do

Federal and State programs have helped clean up many waters and slow the degradation of others. But government alone cannot solve the entire problem, and water quality concerns persist. Nonpoint source pollution, in particular, is everybody's problem, and everybody needs to solve it.

Examine your everyday activities and think about how you are contributing to the pollution problem. Here are some suggestions on how you can make a difference.

Be Informed

You should learn about water quality issues that affect the communities in which you live and work. Become familiar with your local water resources. Where does your drinking water come from? What activities in your area might affect the water you drink or the rivers, lakes, beaches, or wetlands you use for recreation?

Learn about procedures for disposing of harmful household wastes so they do not end up in sewage treatment plants that cannot handle them or in landfills not designed to receive hazardous materials.

Be Responsible

In your yard, determine whether additional nutrients are needed before you apply fertilizers, and look for alternatives where fertilizers might run off into surface waters. Consider selecting plants and grasses that have low maintenance requirements. Water your lawn conservatively. Preserve existing trees and plant new trees and shrubs to help prevent erosion and promote infiltration of water into the soil. Restore bare patches in your lawn to prevent erosion. If you own or manage land through which a stream flows, you may wish to consult your local county extension office about methods of restoring stream banks in your area by planting buffer strips of native vegetation.

Around your house, keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Use the minimum amount of water needed when you wash your car. Never dispose of any household, automotive, or gardening wastes in a storm drain. Keep your septic tank in good working order.

Within your home, fix any dripping faucets or leaky pipes and install water-saving devices in shower heads and toilets. Always follow directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal sites such as approved service stations or designated landfills.

Be Involved

As a citizen and a voter there is much you can do at the community level to help preserve and protect our Nation's water resources. Look around. Is soil erosion being controlled at construction sites? Is the community sewage plant being operated efficiently and correctly? Is the community trash dump in or along a stream? Is road deicing salt being stored properly?

Become involved in your community election processes. Listen and respond to candidates' views on water quality and environmental issues. Many communities have recycling programs; find out about them, learn how to recycle, and volunteer to help out if you can. One of the most important things you can do is find out how your community protects water quality, and speak out if you see problems.

Volunteer Monitoring: You Can Become Part of the Solution

In many areas of the country, citizens are becoming personally involved in monitoring the quality of our Nation's water. As a volunteer monitor, you might be involved in taking ongoing water quality measurements, tracking the progress of protection and restoration projects, or reporting special events, such as fish kills and storm damage.

Volunteer monitoring can be of great benefit to State and local governments. Some States stretch their monitoring budgets by using data collected by volunteers, particularly in remote areas that otherwise might not be monitored at all. Because you are familiar with the water resources in your own neighborhood, you are also more likely to spot unusual occurrences such as fish kills.

The benefits to you of becoming a volunteer are also great. You will learn about your local water resources and have the opportunity to become personally involved in a nationwide campaign to protect a vital, and mutually shared, resource. If you would like to find out more about organizing or joining volunteer monitoring programs in your State, contact your State department of environmental quality, or write to:

Alice Mayio
U.S. EPA
Volunteer Monitoring (4503F)
401 M St. SW
Washington, DC 20460
(202) 260-7018

For further information on water quality in your State, write to your State department of environmental quality. Additional water quality information may be obtained from the Regional offices of the U.S. Environmental Protection Agency (see inside front cover).

For Further Reading

U.S. EPA. 1988. *America's Wetlands: Our Vital Link Between Land and Water*. Office of Water. EPA 87-016.

U.S. EPA. 1988. *Environmental Backgrounder: Wetlands*. Office of Water.

U.S. EPA. 1989. *EPA Journal: Can Our Coasts Survive More Growth?* Volume 15, Number 5.

U.S. EPA. 1991. *EPA Journal: Nonpoint Source Pollution: Runoff of Rain and Snowmelt, Our Biggest Water Quality Problem*. Volume 17, Number 5.

U.S. EPA. 1992. *National Water Quality Inventory: 1990 Report to Congress*. Office of Water. EPA 503/99-92-006.

Section I

National Summary of Water Quality Conditions

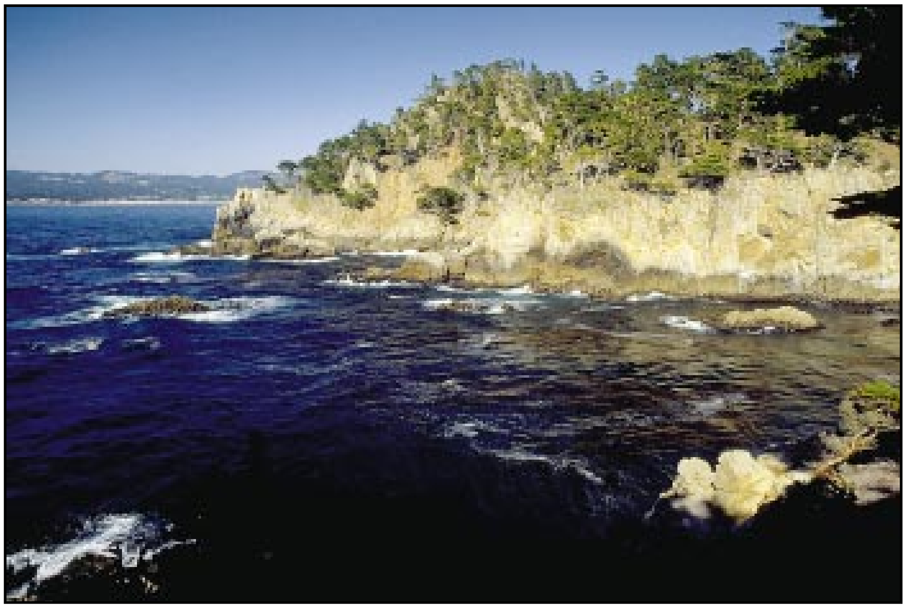
The Quality of Our Nation's Water

Introduction

The contents of this section summarize the information contained in the *National Water Quality Inventory: 1994 Report to Congress*. The National Water Quality Inventory Report to Congress is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters.

The National Water Quality Inventory Report to Congress summarizes the water quality information submitted by 61 States, American Indian Tribes, Territories, Interstate Water Commissions, and the District of Columbia (hereafter referred to as States, Tribes, and other jurisdictions) in their 1994 water quality assessment reports. As such, the report identifies water quality issues of concern to the States, Tribes, and other jurisdictions, not just the issues of concern to the U.S. Environmental Protection Agency (EPA). Section 305(b) of the Clean Water Act (CWA) requires that the States and other participating jurisdictions submit water quality assessment reports every 2 years. Most of the survey information in the 1994 Section 305(b) reports is based on water quality information collected and evaluated by the States, Tribes, and other jurisdictions during 1992 and 1993.

It is important to note that this report is based on information submitted by States, Tribes, and other jurisdictions that do not use identical survey methods and criteria to rate their water quality. The States, Tribes, and other jurisdictions favor flexibility in the 305(b) process to accommodate natural variability in their waters, but there is a trade-off between flexibility and consistency. Without known and consistent survey methods in place, EPA must use caution in comparing data or determining the accuracy of data submitted by different States and jurisdictions. Also, EPA must use caution when comparing water quality information submitted during different 305(b) reporting periods because States and other jurisdictions may modify their criteria or survey different waterbodies every 2 years.


Paul Goetz, Cary, NC

For over 10 years, EPA has pursued a balance between flexibility and consistency in the Section 305(b) process. Recent actions by EPA, the States, Tribes, and other jurisdictions include implementing the recommendations of the National 305(b) Consistency Workgroup and the Intergovernmental Task Force on Monitoring Water Quality. These actions will enable States and other jurisdictions to share data across political boundaries as they develop watershed protection strategies.

EPA recognizes that national initiatives alone cannot clean up our waters; water quality protection and restoration must happen at the local watershed level, in conjunction with State, Tribal, and Federal activities. Similarly, this document alone cannot provide the detailed information needed to manage water quality at all levels. This document should be used together with the individual Section 305(b) reports (see the inside back cover for information on obtaining the State and Tribal Section 305(b) reports), watershed management plans, and other local documents to develop integrated water quality management options.

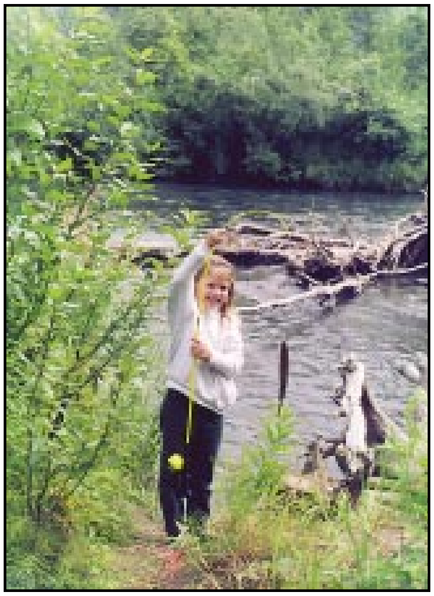
Key Concepts

Measuring Water Quality

The States, participating Tribes, and other jurisdictions survey the quality of their waters by determining if their waters attain the water quality standards they established. Water quality standards consist of beneficial uses, numeric and narrative criteria for supporting each use, and an antidegradation statement:

- **Designated beneficial uses** are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States, Tribes, and other jurisdictions may designate an individual waterbody for multiple beneficial uses.

- **Numeric water quality criteria** establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters, and minimum concentrations of desirable parameters, such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.



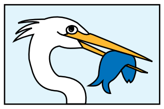
Barry Burgan, U.S. EPA

- **Narrative water quality criteria** define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody. For example, “Ambient water quality shall be sufficient to support life stages of all native aquatic species.” Narrative criteria may also describe conditions that are desired in a waterbody, such as “Waters must be free of substances that are toxic to humans, aquatic life, and wildlife.”

- **Antidegradation statements**, where possible, protect existing uses and prevent waterbodies from deteriorating, even if their water quality is better than the fishable and swimmable water quality goals of the Act.

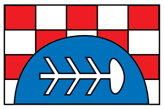
The CWA allows States, Tribes, and other jurisdictions to set their own standards but requires that all beneficial uses and their criteria comply with the goals of the Act. At a minimum, beneficial uses must provide for “the protection and propagation of fish, shellfish, and wildlife” and provide for “recreation in and on the water” (i.e., the fishable and swimmable goals of the Act), where attainable. The Act prohibits States and other jurisdictions from designating waste transport or waste assimilation as a beneficial use, as some States did prior to 1972.

Section 305(b) of the CWA requires that the States biennially survey their water quality for attainment of the fishable and swimmable goals of the Act and report the results to EPA. The States, participating Tribes, and other jurisdictions measure attainment of the CWA goals by determining how well their waters support their designated beneficial uses. EPA encourages the surveying of waterbodies for support of the following individual beneficial uses:



Aquatic Life Support

The waterbody provides suitable habitat for protection and propagation of desirable fish, shellfish, and other aquatic organisms.

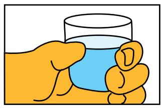


Fish Consumption

The waterbody supports fish free from contamination that could pose a human health risk to consumers.

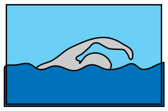
Shellfish Harvesting

The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.



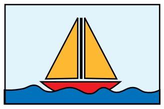
Drinking Water Supply

The waterbody can supply safe drinking water with conventional treatment.



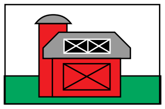
Primary Contact Recreation – Swimming

People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).



Secondary Contact Recreation

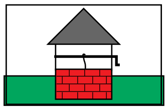
People can perform activities on the water (such as boating) without risk of adverse human health effects from ingestion or contact with the water.



Agriculture

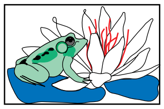
The water quality is suitable for irrigating fields or watering livestock.

States, Tribes, and other jurisdictions may also define their own individual uses to address special concerns. For example, many Tribes and States designate their waters for the following beneficial uses:



Ground Water Recharge

The surface waterbody plays a significant role in replenishing ground water, and surface water supply and quality are adequate to protect existing or potential uses of ground water.



Wildlife Habitat

Water quality supports the waterbody's role in providing habitat and resources for land-based wildlife as well as aquatic life.

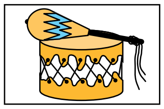
Tribes may designate their waters for special cultural and ceremonial uses:

Water Quality Monitoring

Water quality monitoring consists of data collection and sample analysis performed using accepted protocols and quality control procedures. Monitoring also includes subsequent analysis of the body of data to support decisionmaking. Federal, Interstate, State, Territorial, Tribal, Regional, and local agencies, industry, and volunteer groups with approved quality assurance programs monitor a combination of chemical, physical, and biological water quality parameters throughout the country.

- Chemical data often measure concentrations of pollutants and other chemical conditions that influence aquatic life, such as pH (i.e., acidity) and dissolved oxygen concentrations. The chemical data may be analyzed in water samples, fish tissue samples, or sediment samples.
- Physical data include measurements of temperature, turbidity (i.e., light penetration through the water column), and solids in the water column.
- Biological data measure the health of aquatic communities. Biological data include counts of aquatic species that indicate healthy ecological conditions.
- Habitat and ancillary data (such as land use data) help interpret the above monitoring information.

Monitoring agencies vary parameters, sampling frequency, and sampling site selection to meet program objectives and funding constraints. Sampling may occur at regular intervals (such as monthly, quarterly, or annually), irregular intervals, or during one-time intensive surveys. Sampling may be conducted at fixed sampling stations, randomly selected stations, stations near suspected water quality problems, or stations in pristine waters.

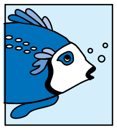


Culture

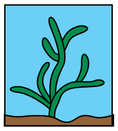
Water quality supports the waterbody's role in Tribal culture and preserves the waterbody's religious, ceremonial, or subsistence significance.

The States, Tribes, and other jurisdictions assign one of five levels of use support categories to each of their waterbodies (Table 1). If possible, the States, Tribes, and other jurisdictions determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State, Tribe, or other jurisdiction may determine the level of use support with qualitative information. Valid qualitative information includes land use data, fish and game surveys, and predictive model results. Monitored assessments are based on monitoring data. Evaluated assessments are based on qualitative information or monitored information more than 5 years old.

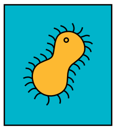
For waterbodies with more than one designated use, the States, Tribes, and other jurisdictions consolidate the individual use support information into a single overall use support determination:



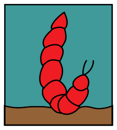
Good/Fully Supporting Overall Use – All designated beneficial uses are fully supported.



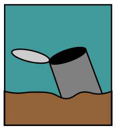
Good/Threatened Overall Use – One or more designated beneficial uses are threatened and the remaining uses are fully supported.



Fair/Partially Supporting Overall Use – One or more designated beneficial uses are partially supported and the remaining uses are fully supported or threatened. These waterbodies are considered impaired.

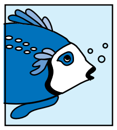
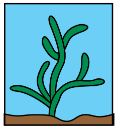
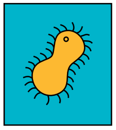
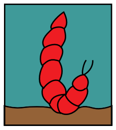
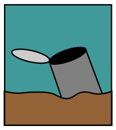


Poor/Not Supporting Overall Use – One or more designated beneficial uses are not supported. These waterbodies are considered impaired.



Poor/Not Attainable – The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support of one or more designated beneficial uses is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations* (40 CFR Section 131.10). These conditions include naturally high concentrations of pollutants (such as metals); other natural physical features that create unsuitable

Table 1. Levels of Use Support

Symbol	Use Support Level	Water Quality Condition	Definition
	**Fully Supporting**	**Good**	Water quality meets designated use criteria.
	**Threatened**	**Good**	Water quality supports beneficial uses now but may not in the future unless action is taken.
	**Partially Supporting**	**Fair** (Impaired)	Water quality fails to meet designated use criteria at times.
	**Not Supporting**	**Poor** (Impaired)	Water quality frequently fails to meet designated use criteria.
	**Not Attainable**	**Poor**	The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations.*

aquatic life habitat (such as inadequate substrate, riffles, or pools); low flows or water levels; dams and other hydrologic modifications that permanently alter waterbody characteristics; poor water quality resulting from human activities that cannot be reversed without causing further environmental degradation; and poor water quality that cannot be improved without imposing more stringent controls than those required in the CWA, which would result in widespread economic and social impacts.

- **Impaired Waters** – The sum of waterbodies partially supporting uses and not supporting uses.

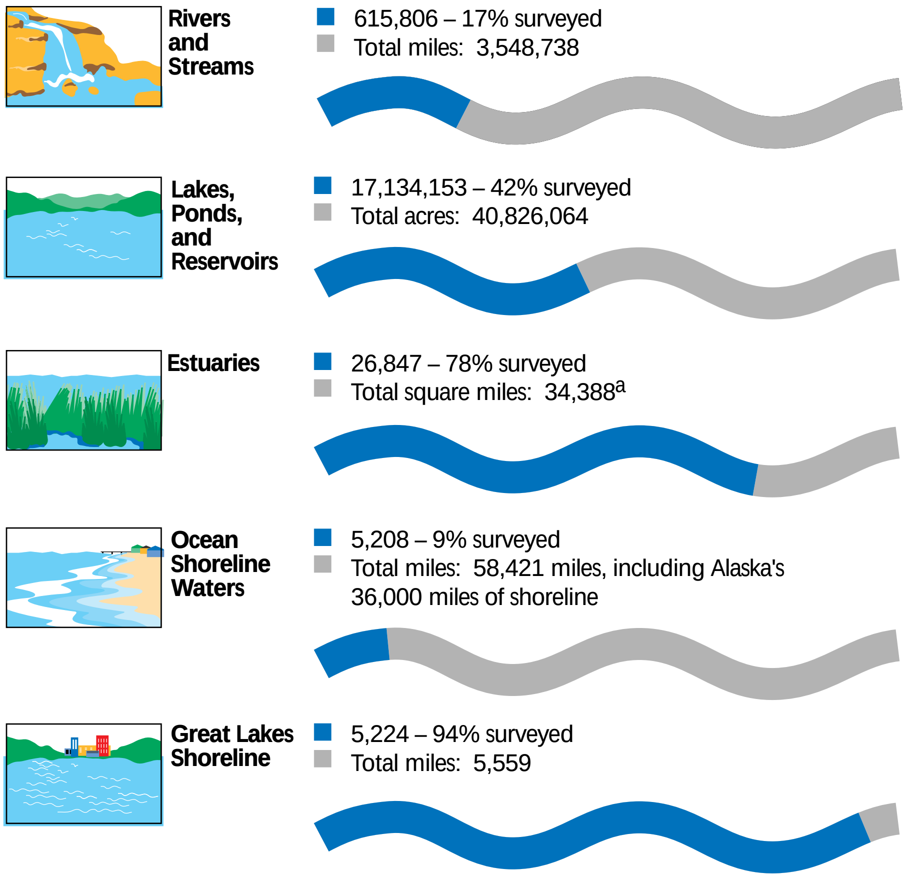
The EPA then aggregates the use support information submitted by the States, Tribes, and other jurisdictions into a national assessment of the Nation's water quality.

How Many of Our Waters Were Surveyed for 1994?

National estimates of the total waters of our country provide the foundation for determining the percentage of waters surveyed by the States, Tribes, and other jurisdictions and the portion impaired by pollution. For the 1992 reporting period, EPA provided the States with estimates of total river miles and lake acres derived from the EPA Reach File, a database containing traces of waterbodies adapted from 1:100,000 scale maps prepared by the U.S. Geological Survey. The States modified these total water estimates where necessary. Based on the 1992 EPA/State figures, the national estimate of total river miles doubled in large part because the EPA/State estimates included nonperennial streams, canals, and ditches that were previously excluded from estimates of total stream miles.

Estimates for the 1994 reporting cycle are a minor refinement of the 1992 figures and indicate that the United States has:

Figure 1. Percentage of Total Waters Surveyed for the 1994 Report



Source: 1994 Section 305(b) reports submitted by the States, Tribes, Territories, and Commissions.

[a] Excluding estuarine waters in Alaska because no estimate was available.

- More than 3.5 million miles of rivers and streams, which range in size from the Mississippi River to small streams that flow only when wet weather conditions exist (i.e., nonperennial streams)

- Approximately 40.8 million acres of lakes, ponds, and reservoirs

- About 34,388 square miles of estuaries (excluding Alaska)

- More than 58,000 miles of ocean shoreline, including 36,000 miles in Alaska

- 5,559 miles of Great Lakes shoreline

- More than 277 million acres of wetlands such as marshes, swamps, bogs, and fens, including 170 million acres of wetlands in Alaska.

Most States do not survey all of their waterbodies during the 2-year reporting cycle required under CWA Section 305(b). Thus, the surveyed waters reported in Figure 1 are a subset of the Nation's total waters. In addition, the summary information based on surveyed waters may not represent general conditions in the Nation's total waters because States, Tribes, and other jurisdictions often focus on surveying major perennial rivers, estuaries, and public lakes with suspected pollution problems in order to direct scarce resources to areas that could pose the greatest risk. Many States, Tribes, and other jurisdictions lack the resources to collect use support information for nonperennial streams, small tributaries, and private ponds. This report does not predict the health of these unassessed waters, which include an unknown ratio of pristine waters to polluted waters.

Pollutants and Processes That Degrade Water Quality

Where possible, States, Tribes, and other jurisdictions identify the pollutants or processes that degrade water quality and indicators that document impacts of water quality degradation. The most widespread pollutants and processes identified in rivers, lakes, and estuaries are presented in Table 2. Pollutants include sediment, nutrients, and chemical contaminants (such as dioxins and metals). Processes that

The Intergovernmental Task Force on Monitoring Water Quality

In 1992, the Intergovernmental Task Force on Monitoring Water Quality (ITFM) convened to prepare a strategy for improving water quality monitoring nationwide. The ITFM is a Federal/State partnership of 10 Federal agencies, 9 State and Interstate agencies, and 1 American Indian Tribe. The EPA chairs the ITFM with the USGS as vice chair and Executive Secretariat as part of their Water Information Coordination Program pursuant to OMB memo 92-01.

The mission of the ITFM is to develop and aid implementation of a national strategic plan to achieve effective collection, interpretation, and presentation of water quality data and to improve the availability of existing information for decisionmaking at all levels of government and the private sector. A permanent successor to the ITFM, the National Monitoring Council will provide guidelines and support for institutional collaboration, comparable field and laboratory methods, quality assurance/quality control, environmental indicators, data management and sharing, ancillary data, interpretation and techniques, and training.

The ITFM and its successor, the National Monitoring Council, are also producing products that can be used by monitoring programs nationwide, such as an outline for a recommended monitoring program, environmental indicator selection criteria, and a matrix of indicators to support assessment of State and Tribal designated uses.

For a copy of the first, second, and final ITFM reports, contact:

The U.S. Geological Survey
417 National Center
Reston, VA 22092
1-800-426-9000

degrade waters include habitat modification (such as destruction of streamside vegetation) and hydrologic modification (such as flow reduction). Indicators of water quality degradation include physical, chemical, and biological parameters. Examples of biological parameters include species diversity and abundance. Examples of physical and chemical parameters include pH, turbidity, and temperature. Following are descriptions of the effects of the pollutants and processes most commonly identified in rivers, lakes, estuaries, coastal waters, wetlands, and ground water.

Low Dissolved Oxygen

Dissolved oxygen is a basic requirement for a healthy aquatic ecosystem. Most fish and beneficial aquatic insects "breathe" oxygen dissolved in the water column. Some fish and aquatic organisms (such as carp and sludge worms) are adapted to low oxygen conditions, but most desirable fish species (such as trout and salmon) suffer if dissolved oxygen concentrations fall below 3 to 4 mg/L (3 to 4 milligrams of oxygen dissolved in 1 liter of water, or 3 to 4 parts of oxygen per million parts of water). Larvae and juvenile fish are more sensitive and require even higher concentrations of dissolved oxygen.

Many fish and other aquatic organisms can recover from short periods of low dissolved oxygen availability. However, prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/L or less can result in "dead" waterbodies. Prolonged exposure to low dissolved oxygen conditions can suffocate adult fish or reduce their reproductive survival by suffocating sensitive eggs and larvae or can starve fish by killing aquatic insect larvae and other prey. Low dissolved oxygen concentrations also favor anaerobic bacterial activity that produces noxious gases or foul odors often associated with polluted waterbodies.

Table 2. Five Leading Causes of Water Quality Impairment

Rank	Rivers	Lakes	Estuaries
1	Bacteria	Nutrients	Nutrients
2	Siltation	Siltation	Bacteria
3	Nutrients	Oxygen-Depleting Substances	Oxygen-Depleting Substances
4	Oxygen-Depleting Substances	Metals	Habitat Alterations
5	Metals	Suspended Solids	Oil and Grease

Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Fish Kills

Fish kill reporting is a voluntary process; States, Tribes, and other jurisdictions are not required to report on how many fish kills occur, or what might have caused them. In many cases it is the public–anglers, and hunters, recreational boaters, or hikers–who first notice fish kills and report them to game wardens or other State officials. Many fish kills go undetected or unreported, and others may be difficult to investigate, especially if they occur in remote areas. This is because dead fish may be carried quickly downstream or may be difficult to count because of turbid conditions. It is therefore likely that the statistics presented by the States, Tribes, and other jurisdictions underestimate the total number of fish kills that occurred nationwide between 1992 and 1994.

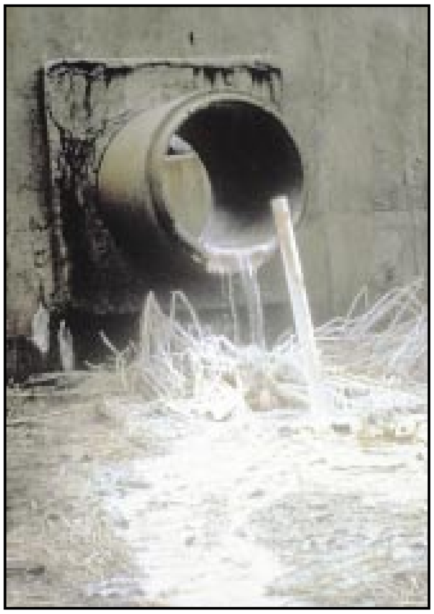
Despite these problems, fish kills are an important consideration in water quality assessments. In 1994, 32 States, Tribes, and other jurisdictions reported a total of 1,454 fish kill incidents. These States attributed 737 of the fish kills to pollution, 257 to unknown causes, 263 to natural conditions (such as low flow and high temperatures), and 229 kills to ambiguous causes. Pollutants most often cited as the cause of kills include oxygen-depleting substances, sewage, pesticides, manure and silage, oil and gas, chlorine, and ammonia. Leading sources of fish kills include agricultural activities, industrial discharges, municipal sewage treatment plant discharges, spills, runoff, and pesticide applications.

Oxygen concentrations in the water column fluctuate under natural conditions, but severe oxygen depletion usually results from human activities that introduce large quantities of biodegradable organic materials into surface waters. Biodegradable organic materials contain plant, fish, or animal matter. Leaves, lawn clippings, sewage, manure, shellfish processing waste, milk solids, and other food processing wastes are examples of oxygen-depleting organic materials that enter our surface waters.

In both pristine and polluted waters, beneficial bacteria use oxygen to break apart (or decompose) organic materials. Pollution-containing organic wastes provide a continuous glut of food for the bacteria, which accelerates bacterial activity and population growth. In polluted waters, bacterial consumption of oxygen can rapidly outpace oxygen replenishment from the atmosphere and photosynthesis performed by algae and aquatic plants. The result is a net decline in oxygen concentrations in the water.

Toxic pollutants can indirectly lower oxygen concentrations by killing algae, aquatic weeds, or fish, which provides an abundance of food for oxygen-consuming bacteria. Oxygen depletion can also result from chemical reactions that do not involve bacteria. Some pollutants trigger chemical reactions that place a chemical oxygen demand on receiving waters.

Other factors (such as temperature and salinity) influence the amount of oxygen dissolved in water. Prolonged hot weather will depress oxygen concentrations and may cause fish kills even in clean waters because warm water cannot hold as much oxygen as cold water. Warm conditions further aggravate oxygen depletion by stimulating bacterial activity and respiration in fish, which consumes oxygen. Removal of streamside vegetation eliminates shade, thereby raising water temperatures, and accelerates runoff of organic debris. Under such conditions, minor additions of pollution-containing organic materials can severely deplete oxygen.


Chesapeake Bay Foundation, Richmond, VA

Nutrients

Nutrients are essential building blocks for healthy aquatic communities, but excess nutrients (especially nitrogen and phosphorus compounds) overstimulate the growth of aquatic weeds and algae. Excessive growth of these organisms, in turn, can clog navigable waters, interfere with swimming and boating, outcompete native submerged aquatic vegetation (SAV), and lead to oxygen depletion. Oxygen concentrations can fluctuate daily during algal blooms, rising during the day as algae perform photosynthesis, and falling at night as algae continue to respire, which consumes oxygen. Beneficial bacteria also consume oxygen as they decompose the abundant organic food supply in dying algae cells.

Lawn and crop fertilizers, sewage, manure, and detergents contain nitrogen and phosphorus, the nutrients most often responsible for water quality degradation. Rural areas are vulnerable to ground water contamination from nitrates (a compound containing nitrogen) found in fertilizer and manure. Very high concentrations of nitrate (>10 mg/L) in drinking water cause methemoglobinemia, or blue baby syndrome, an inability to fix oxygen in the blood.

Nutrients are difficult to control because lake and estuarine ecosystems recycle nutrients. Rather than leaving the ecosystem, the nutrients cycle among the water column, algae and plant tissues, and the bottom sediments. For example, algae may temporarily remove all the nitrogen from the water column, but the nutrients will return to the water column when the algae die and are decomposed by bacteria. Therefore, gradual inputs of nutrients tend to accumulate over time rather than leave the system.

Sediment and Siltation

In a water quality context, sediment usually refers to soil particles that enter the water column from eroding land. Sediment consists of particles of all sizes, including fine clay particles, silt, sand, and gravel. Water quality managers use the term "siltation" to describe the suspension and deposition of small sediment particles in waterbodies.

Sediment and siltation can severely alter aquatic communities. Sediment may clog and abrade fish gills, suffocate eggs and aquatic insect larvae on the bottom, and fill in the pore space between bottom cobbles where fish lay eggs. Silt and sediment interfere with recreational activities and aesthetic enjoyment at waterbodies by reducing water clarity and filling in waterbodies. Sediment may also carry other pollutants into waterbodies. Nutrients and toxic chemicals may attach to sediment particles on land and ride the particles into surface waters where the pollutants may settle with the sediment or detach and become soluble in the water column.

Rain washes silt and other soil particles off of plowed fields, construction sites, logging sites, urban areas, and strip-mined lands into waterbodies. Eroding stream banks also deposit silt and sediment in waterbodies. Removal of vegetation on shore can accelerate streambank erosion.

Chesapeake Bay Foundation, Richmond, VA

Bacteria and Pathogens

Some waterborne bacteria, viruses, and protozoa cause human illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. These organisms may enter waters through a number of routes, including inadequately treated sewage, stormwater drains, septic systems, runoff from livestock pens, and sewage dumped overboard from recreational boats. Because it is impossible to test waters for every possible disease-causing organism, States and other jurisdictions usually measure indicator bacteria that are found in great numbers in the stomachs and intestines of warm-blooded animals and people. The presence of indicator bacteria suggests that the waterbody may be contaminated with untreated sewage and that other, more dangerous organisms may be present. The States, Tribes, and other jurisdictions use bacterial criteria to determine if waters are safe for recreation and shellfish harvesting.

Toxic Organic Chemicals and Metals

Toxic organic chemicals are synthetic compounds that contain carbon, such as polychlorinated biphenyls (PCBs), dioxins, and the pesticide DDT. These synthesized compounds often persist and accumulate in the environment because they do not readily break down in natural ecosystems. Many of these compounds cause cancer in people and birth defects in other predators near the top of the food chain, such as birds and fish.

Metals occur naturally in the environment, but human activities (such as industrial processes and mining) have altered the distribution of metals in the environment. In most reported cases of metals contamination, high concentrations of metals appear in fish tissues rather than the water column because the metals accumulate in greater concentrations in predators near the top of the food chain.

pH

Acidity, the concentration of hydrogen ions, drives many chemical reactions in living organisms. The standard measure of acidity is pH, and a pH value of 7 represents a neutral condition. A low pH value (less than 5) indicates acidic conditions; a high pH (greater than 9) indicates alkaline conditions. Many biological processes, such as reproduction, cannot function in acidic or alkaline waters. Acidic conditions also aggravate toxic contamination problems because sediments release toxicants in acidic waters. Common sources of acidity include mine drainage, runoff from mine tailings, and atmospheric deposition.

Habitat Modification/ Hydrologic Modification

Habitat modifications include activities in the landscape, on shore, and in waterbodies that alter the physical structure of aquatic ecosystems and have adverse impacts on aquatic life. Examples of habitat modifications include:

- Removal of streamside vegetation that stabilizes the shoreline and provides shade, which moderates instream temperatures
- Excavation of cobbles from a stream bed that provide nesting habitat for fish
- Stream burial
- Excessive suburban sprawl that alters the natural drainage patterns by increasing the intensity, magnitude, and energy of runoff waters.

Hydrologic modifications alter the flow of water. Examples of hydrologic modifications include channelization, dewatering, damming, and dredging.

Other pollutants include salts and oil and grease. Fresh waters may become unfit for aquatic life and some human uses when they become contaminated by salts. Sources of salinity include irrigation runoff, brine used in oil extraction, road deicing operations, and the intrusion of sea water into ground and surface waters in coastal areas. Crude oil and processed petroleum products may be spilled during extraction, processing, or transport or leaked from underground storage tanks.

Table 3. Pollution Source Categories Used in This Report

Category	Examples
Industrial	Pulp and paper mills, chemical manufacturers, steel plants, metal process and product manufacturers, textile manufacturers, food processing plants
Municipal	Publicly owned sewage treatment plants that may receive indirect discharges from industrial facilities or businesses
Combined Sewers	Single facilities that treat both storm water and sanitary sewage, which may become overloaded during storm events and discharge untreated wastes into surface waters.
Storm Sewers/ Urban Runoff	Runoff from impervious surfaces including streets, parking lots, buildings, lawns, and other paved areas.
Agricultural	Crop production, pastures, rangeland, feedlots, other animal holding areas
Silvicultural	Forest management, tree harvesting, logging road construction
Construction	Land development, road construction
Resource Extraction	Mining, petroleum drilling, runoff from mine tailing sites
Land Disposal	Leachate or discharge from septic tanks, landfills, and hazardous waste sites
Hydrologic Modification	Channelization, dredging, dam construction, streambank modification

Sources of Water Pollution

Sources of impairment generate the pollutants that violate use support criteria (Table 3). Point sources discharge pollutants directly into surface waters from a conveyance. Point sources include industrial facilities, municipal sewage treatment plants, and combined sewer overflows. Nonpoint sources deliver pollutants to surface waters from diffuse origins. Nonpoint sources include urban runoff, agricultural runoff, and atmospheric deposition of contaminants in air pollution. Habitat alterations, such as hydromodification, dredging, and streambank destabilization, can also degrade water quality.

Throughout this document, EPA rates the significance of causes and sources of pollution by the percentage of impaired waters impacted by each individual cause or source (obtained from the Section 305(b) reports submitted by the States, Tribes, and other jurisdictions). Note that the cause and source rankings do not describe the condition of all waters in the United States because the States identify the causes and sources degrading some of their impaired waters, which are a small subset of surveyed waters, which are a subset of the Nation's total waters. For example, the States identified sources degrading some of the 224,236 impaired river miles, which represent 36% of the surveyed river miles and only 6% of the Nation's total stream miles.

> **"The term 'point source' means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture."**
>
> Clean Water Act, Section 502(14)

Table 4 lists the leading sources of impairment related to human activities as reported by States, Tribes, and other jurisdictions for their rivers, lakes, and estuaries. Other sources cited include removal of riparian vegetation, forestry activities, land disposal, petroleum extraction and processing activities, and construction. In addition to human activities, the States, Tribes, and other jurisdictions also reported impairments from natural sources. Natural sources refer to an assortment of water quality problems:

- Natural deposits of salts, gypsum, nutrients, and metals in soils that leach into surface and ground waters
- Warm weather and dry conditions that raise water temperatures, depress dissolved oxygen concentrations, and dry up shallow waterbodies
- Low-flow conditions and tannic acids from decaying leaves that lower pH and dissolved oxygen concentrations in swamps draining into streams.

With so many potential sources of pollution, it is difficult and expensive for States, Tribes, and other jurisdictions to identify specific sources responsible for water quality impairments. Many States and other jurisdictions lack funding for monitoring to identify all but the most apparent sources degrading waterbodies. Local management priorities may focus monitoring budgets on other water quality issues, such as identification of contaminated fish populations that pose a human health risk. Management priorities may also direct monitoring efforts to larger waterbodies and overlook sources impairing smaller waterbodies. As a result, the States, Tribes, and other jurisdictions do not associate every impacted waterbody with a source of impairment in their 305(b) reports, and the summary cause and source information presented in this report applies exclusively to a subset of the Nation's impaired waters.

Table 4. Five Leading Sources of Water Quality Impairment Related to Human Activities

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Urban Runoff/ Storm Sewers
2	Municipal Sewage Treatment Plants	Municipal Sewage Treatment Plants	Municipal Sewage Treatment Plants
3	Hydrologic/Habitat Modification	Urban Runoff/ Storm Sewers	Agriculture
4	Urban Runoff/ Storm Sewers	Unspecified Nonpoint Sources	Industrial Point Sources
5	Resource Extraction	Hydrologic/Habitat Modification	Petroleum Activities

Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Rivers and Streams

Rivers and streams are characterized by flow. **Perennial** rivers and streams flow continuously, all year round. **Nonperennial** rivers and streams stop flowing for some period of time, usually due to dry conditions or upstream withdrawals. Many rivers and streams originate in nonperennial headwaters that flow only during snowmelt or heavy showers. Nonperennial streams provide critical habitats for nonfish species, such as amphibians and dragonflies, as well as safe havens for juvenile fish to escape from predation by larger fish.

The health of rivers and streams is directly linked to habitat integrity on shore and in adjacent wetlands. Stream quality will deteriorate if activities damage shoreline (i.e., riparian) vegetation and wetlands, which filter pollutants from runoff and bind soils. Removal of vegetation also eliminates shade that moderates stream temperature as well as the land temperature that can warm runoff entering surface waters. Stream temperature, in turn, affects the availability of dissolved oxygen in the water column for fish and other aquatic organisms.

Overall Water Quality

For the 1994 Report, 58 States, Territories, Tribes, Commissions, and the District of Columbia surveyed 615,806 miles (17%) of the Nation's total 3.5 million miles of rivers and streams (Figure 2). The surveyed rivers and streams represent 48% of the 1.3 million miles of perennial rivers and streams that flow year round in the lower 48 States.

Barry Burgan, U.S. EPA

Altogether, the States and Tribes surveyed 27,075 fewer river miles in 1994 than in 1992. Individually, most States reported that they surveyed more river miles in 1994, but their increases were offset by a decline of 85,000 surveyed river miles reported by Montana, Mississippi, and Maryland. For 1994, these States reported use support status for only those river miles that they surveyed in direct monitoring programs or evaluations rather than using inferences for unsurveyed waters.

The following discussion applies exclusively to surveyed waters and cannot be extrapolated to describe conditions in the Nation's rivers as a whole because the States, Tribes, and other jurisdictions do not consistently use statistical or probabilistic survey methods to characterize all their waters at this time. EPA is working with the States, Tribes, and other jurisdictions to expand survey coverage of the Nation's waters and expects future survey information to cover a greater portion of the Nation's rivers and streams.

Figure 2. River Miles Surveyed

Total rivers = 3.5 million miles
Total surveyed = 615,806 miles

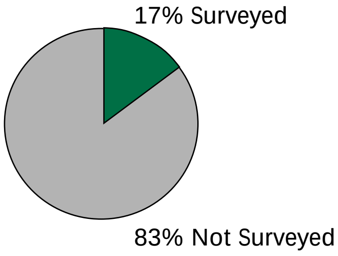
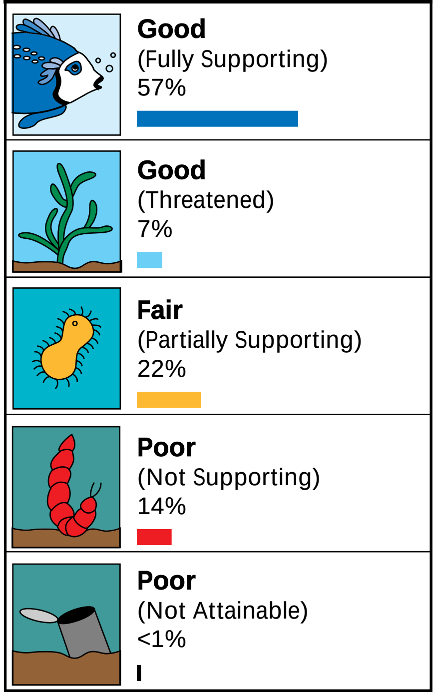


Figure 3. Levels of Overall Use Support – Rivers



Source: Based on 1994 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Of the Nation's 615,806 surveyed river miles, the States, Tribes, and other jurisdictions found that 64% have good water quality. Of these waters, 57% fully support their designated uses, and an additional 7% support uses but are threatened and may become impaired if pollution control actions are not taken (Figure 3).

Some form of pollution or habitat degradation prevents the remaining 36% (224,236 miles) of the surveyed river miles from fully supporting a healthy aquatic community or human activities all year round. Twenty-two percent of the surveyed river miles have fair water quality that partially supports designated uses. Most of the time, these waters provide adequate habitat for aquatic organisms and support human activities, but periodic pollution interferes with these activities and/or stresses aquatic life. Fourteen percent of the surveyed river miles have poor water quality that consistently stresses aquatic life and/or prevents people from using the river for activities such as swimming and fishing.

What Is Polluting Our Rivers and Streams?

The States and Tribes report that bacteria pollute 76,397 river miles (which equals 34% of the impaired river miles) (Figure 4). Bacteria provide evidence of possible fecal contamination that may cause illness if the public ingests the water.

Siltation, composed of tiny soil particles, remains one of the most widespread pollutants impacting rivers and streams. The States and Tribes reported that siltation impairs 75,792 river miles (which equals 34% of the impaired river miles).

Bacteria and siltation are the most widespread pollutants in rivers and streams, affecting 34% of the impaired river miles.

Siltation alters aquatic habitat and suffocates fish eggs and bottom-dwelling organisms. Excessive siltation can also interfere with drinking water treatment processes and recreational use of a river.

In addition to siltation and bacteria, the States and Tribes also reported that nutrients, oxygen-depleting substances, metals, and habitat alterations impact more miles of rivers and streams than other pollutants and processes. Often, several pollutants and processes impact a single river segment. For example, a process, such as removal of shoreline vegetation, may accelerate erosion of sediment and nutrients into a stream.

Where Does This Pollution Come From?

The States and Tribes reported that agriculture is the most widespread source of pollution in the Nation's surveyed rivers (Figure 4). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 134,557 river miles (which equals 60% of the impaired river miles) in 49 States and Tribes.

Twenty-one States reported the size of rivers impacted by specific types of agricultural activities:

- Nonirrigated Crop Production – crop production that relies on rain as the sole source of water.
- Irrigated Crop Production – crop production that uses irrigation systems to supplement rainwater.
- Rangeland – land grazed by animals that is seldom enhanced by the application of fertilizers or pesticides, although managers sometimes modify plant species to a limited extent.
- Pastureland – land upon which a crop (such as alfalfa) is raised to feed animals, either by grazing the animals among the crops or harvesting the crops.
- Feedlots – facilities where animals are fattened and confined at high densities.
- Animal Holding Areas – facilities where animals are confined briefly before slaughter.

The States reported that nonirrigated crop production impaired the most river miles, followed by irrigated crop production, rangeland, feedlots, pastureland, and animal holding areas.

Many States reported declines in pollution from sewage treatment

Agriculture is the leading source of impairment in the Nation's rivers, affecting 60% of the impaired river miles.

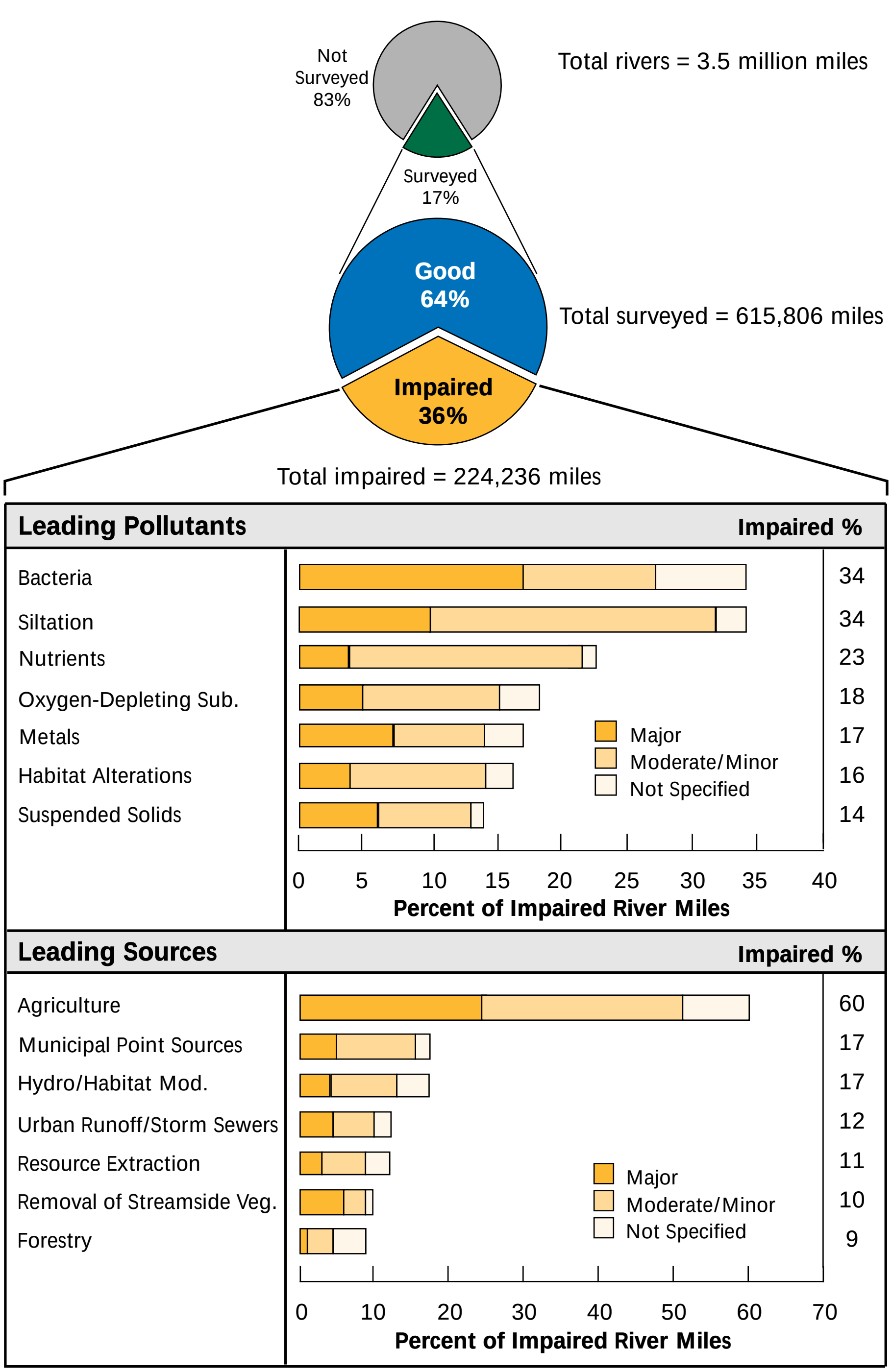
plants and industrial discharges as a result of sewage treatment plant construction and upgrades and permit controls on industrial discharges. Despite the improvements, municipal sewage treatment plants remain the second most common source of pollution in rivers (impairing 37,443 miles) because population growth increases the burden on our municipal facilities.

Hydrologic modifications and habitat alterations are a growing concern to the States. Hydrologic modifications include activities that alter the flow of water in a stream, such as channelization, dewatering, and damming of streams. Habitat alterations include removal of streamside vegetation that protects the stream from high temperatures, and scouring of stream bottoms. Additional gains in water quality conditions will be more subtle and require innovative management strategies that go beyond point source controls.

The States, Tribes, and other jurisdictions also reported that urban runoff and storm sewers impair 26,862 river miles (12% of the impaired rivers), resource extraction impairs 24,059 river miles (11% of the impaired rivers), and removal of streamside vegetation impairs 21,706 river miles (10% of the impaired rivers).

The States, Tribes, and other jurisdictions also report that “natural” sources impair significant stretches of rivers and streams. “Natural” sources, such as low flow and soils with arsenic deposits, can prevent waters from supporting uses in the absence of human activities.

Figure 4. Impaired River Miles: Pollutants and Sources



Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Lakes, Ponds, and Reservoirs

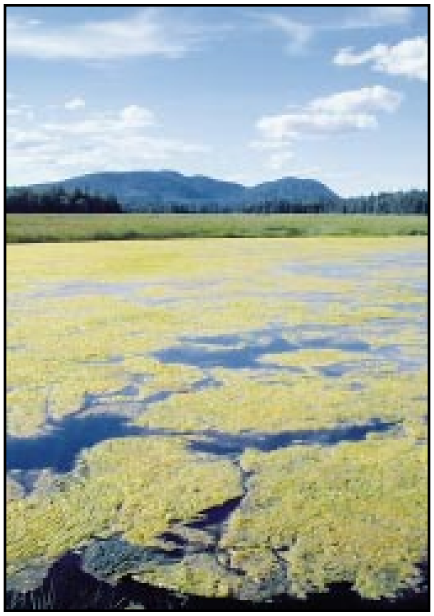
Lakes are sensitive to pollution inputs because lakes flush out their contents relatively slowly. Even under natural conditions, lakes undergo eutrophication, an aging process that slowly fills in the lake with sediment and organic matter (see sidebar). The eutrophication process alters basic lake characteristics such as depth, biological productivity, oxygen levels, and water clarity. The eutrophication process is commonly defined by a series of trophic states as described in the sidebar.

Overall Water Quality

Forty-eight States, Tribes, and other jurisdictions surveyed overall use support in more than 17.1 million lake acres representing 42% of the approximately 40.8 million total acres of lakes, ponds, and reservoirs in the Nation (Figure 5). For 1994, the States surveyed about 1 million fewer lake acres than in 1992.

The number of surveyed lake acres declined because several States separated fish tissue data from their survey of overall use support. Some of these States, such as Minnesota, have established massive databases of fish tissue contamination information (which is used to establish fish consumption advisories), but lack other types of water quality data for many of their lakes. In 1994, these States chose not to assess overall use support entirely with fish tissue data alone, which is a very narrow indicator of water quality.

The States and Tribes reported that 63% of their surveyed 17.1 million lake acres have good water quality. Waters with good quality include 50% of the surveyed lake acres fully supporting uses and 13% of the surveyed lake acres that are threatened and might deteriorate if we fail to manage potential sources of pollution (Figure 6).



John Theilgard, Bynum, NC

Some form of pollution or habitat degradation impairs the remaining 37% of the surveyed lake acres. Twenty-eight percent of the surveyed lake acres have fair water quality that partially supports designated uses. Most of the time, these waters provide adequate habitat for aquatic organisms and support human activities, but periodic pollution interferes with these activities and/or stresses aquatic life. Nine percent of the surveyed lake acres suffer from poor water quality that consistently stresses aquatic life and/or prevents people from using the lake for activities such as swimming and fishing.

Figure 5. Lake Acres Surveyed

Total lakes = 40.8 million acres
Total surveyed = 17.1 million acres

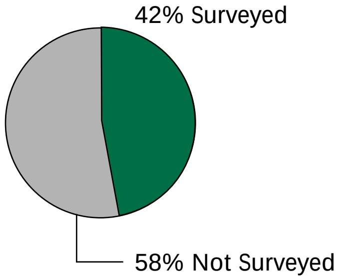
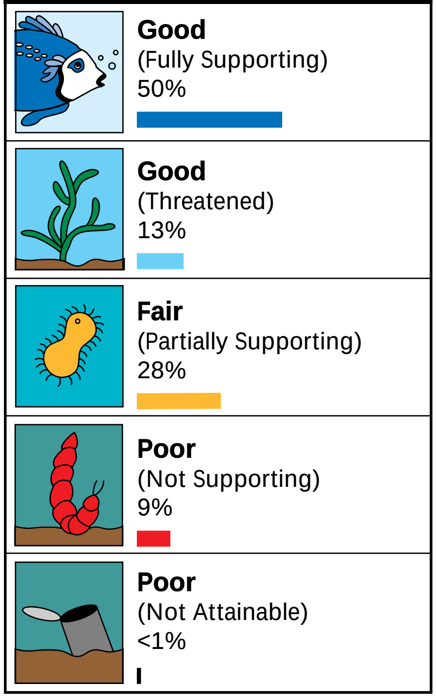


Figure 6. Levels of Overall Use Support – Lakes



Source: Based on 1994 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

What Is Polluting Our Lakes, Ponds, and Reservoirs?

Forty-one States, the District of Columbia, and Puerto Rico reported the number of lake acres impacted by individual pollutants and processes.

Thirty-seven States and Puerto Rico identified more lake acres polluted by nutrients than any other pollutant or process (Figure 7). The States and Puerto Rico reported that extra nutrients pollute 2.8 million lake acres (which equals 43% of the impaired lake acres). Healthy lake ecosystems contain nutrients in small quantities, but extra inputs of nutrients from human activities unbalance lake ecosystems.

In addition to nutrients, the States, Puerto Rico, and the District of Columbia report that siltation pollutes 1.8 million lake acres (which equals 28% of the impaired lake acres), enrichment by organic wastes that deplete oxygen impacts 1.6 million lake acres (which equals 24% of the impaired lake acres), and metals pollute 1.4 million acres (which equals 21% of the impaired lake acres).

Metals declined from the most widespread pollutant impairing lakes in the 1992 305(b) reporting

Trophic States

Oligotrophic	Clear waters with little organic matter or sediment and minimum biological activity.
Mesotrophic	Waters with more nutrients and, therefore, more biological productivity.
Eutrophic	Waters extremely rich in nutrients, with high biological productivity. Some species may be choked out.
Hypereutrophic	Murky, highly productive waters, closest to the wetlands status. Many clearwater species cannot survive.
Dystrophic	Low in nutrients, highly colored with dissolved humic organic matter. (Not necessarily a part of the natural trophic progression.)

The Eutrophication Process

Eutrophication is a natural process, but human activities can accelerate eutrophication by increasing the rate at which nutrients and organic substances enter lakes from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded streambanks, and similar sources can enhance the flow of nutrients and organic substances into lakes. These substances can overstimulate the growth of algae and aquatic plants, creating conditions that interfere with the recreational use of lakes and the health and diversity of native fish, plant, and animal populations. Enhanced eutrophication from nutrient enrichment due to human activities is one of the leading problems facing our Nation's lakes and reservoirs.

Acid Effects on Lakes

Increases in lake acidity can radically alter the community of fish and plant species in lakes and can increase the solubility of toxic substances and magnify their adverse effects. Twenty-eight States reported the results of lake acidification assessments. These States assessed pH (a measure of acidity) at more than 5,933 lakes and detected acidic conditions in 526 lakes and a threat of acidic conditions in 423 lakes. Most of the States that assessed acidic conditions are located in the Northeast, upper Midwest, and the South.

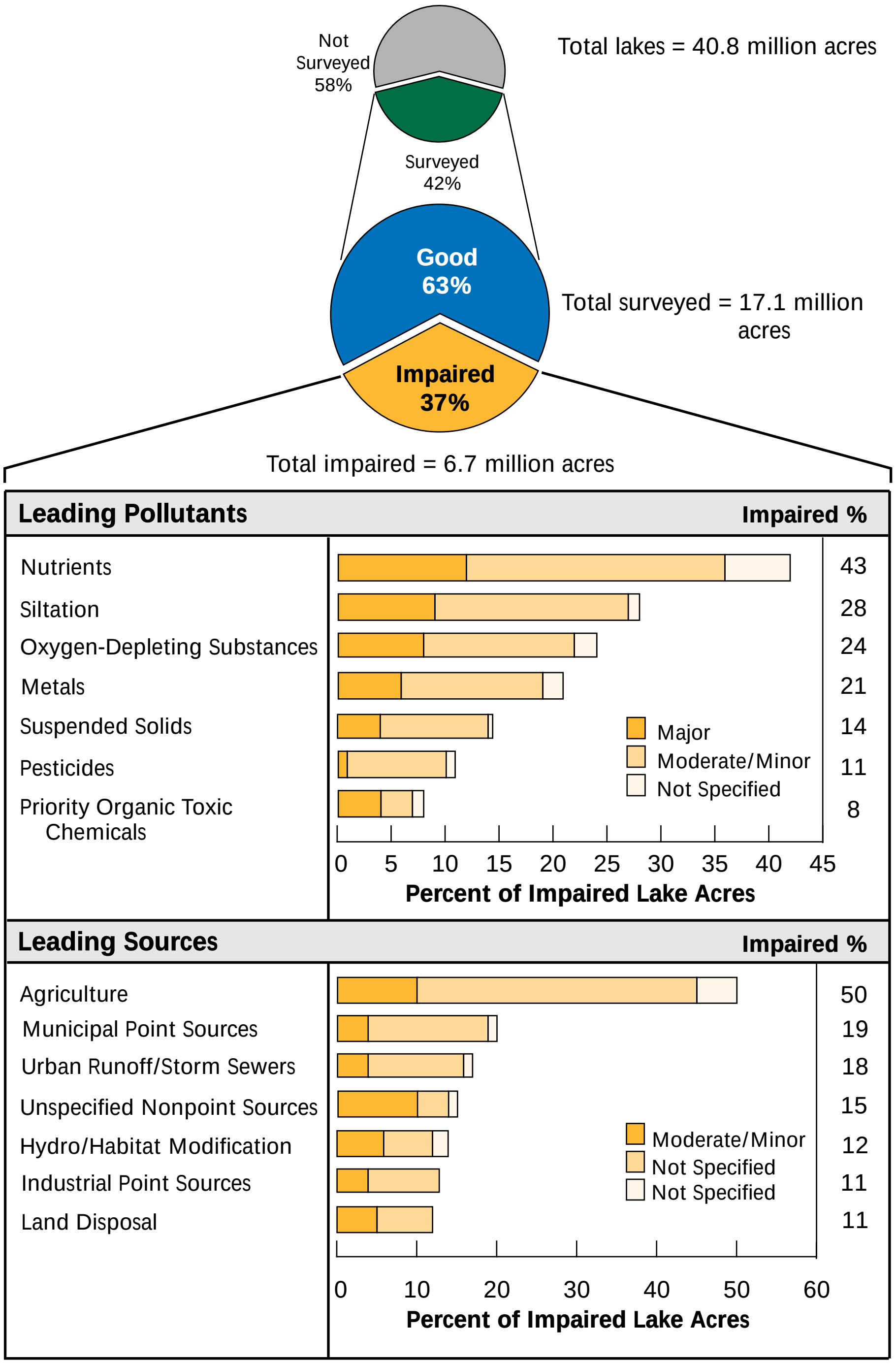
Only 11 States identified sources of acidic conditions. Maine and New Hampshire attributed most of their acid lake conditions to acid deposition from acidic rain, fog, or dry deposition in conjunction with natural conditions that limit a lake's capacity to neutralize acids. Alabama, Kansas, Maryland, Montana, Oklahoma, and Tennessee reported that acid mine drainage resulted in acidic lake conditions or threatened lakes with the potential to generate acidic conditions.

cycle to the fourth leading pollutant impairing lakes in 1994. The decline is due to changes in State reporting and assessment methods rather than a measured decrease in metals contamination. In 1994, several States chose to no longer assess overall use support with fish contamination data alone. Much of that data consisted of measurements of metals in fish tissue. As a result of excluding these fish tissue data, the national estimate of lake acres impaired by metals fell by over 2 million acres in 1994.

More States reported impairments due to nutrients than any other single pollutant.

Forty-one States also surveyed trophic status, which is associated with nutrient enrichment, in 9,735 of their lakes. Nutrient enrichment tends to increase the proportion of lakes in the eutrophic and hypereutrophic categories. These States reported that 18% of the lakes they surveyed for trophic status were oligotrophic, 32% were mesotrophic, 36% were eutrophic, 6% were hypereutrophic, and 3% were dystrophic. This information may not be representative of national lake conditions because States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes—which are probably less impaired—are underrepresented in these assessments.

Figure 7. Impaired Lake Acres: Pollutants and Sources



Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Where Does This Pollution Come From?

Forty-two States and Puerto Rico reported sources of pollution in some of their impacted lakes, ponds, and reservoirs. These States and Puerto Rico reported that agriculture is the most widespread source of pollution in the Nation's surveyed lakes (Figure 7). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 3.3 million lake acres (which equals 50% of the impaired lake acres).

Agriculture is the leading source of impairment in lakes, affecting 50% of impaired lake acres.

Chesapeake Bay Foundation, Richmond, VA

The States and Puerto Rico also reported that municipal sewage treatment plants pollute 1.3 million lake acres (19% of the impaired lake acres), urban runoff and storm sewers pollute 1.2 million lake acres (18% of the surveyed lake acres), unspecified nonpoint sources impair 989,000 lake acres (15% of the impaired lake acres), hydrologic modifications and habitat alterations degrade 832,000 lake acres (12% of the impaired lake acres), and industrial point sources pollute 759,000 lake acres (11% of the impaired lake acres). Many States prohibit new point source discharges into lakes, but existing municipal sewage treatment plants remain a leading source of pollution entering lakes.

The States and Puerto Rico listed numerous sources that impact several hundred thousand lake acres, including land disposal of wastes, construction, flow regulation, highway maintenance and runoff, contaminated sediments, atmospheric deposition of pollutants, and onsite wastewater systems (including septic tanks).

The Great Lakes

The Great Lakes contain one-fifth of the world's fresh surface water and are stressed by a wide range of pollution sources, including air pollution. Many of the pollutants that reach the Great Lakes remain in the system indefinitely because the Great Lakes are a relatively closed water system with few natural outlets. Despite dramatic declines in the occurrence of algal blooms, fish kills, and localized "dead" zones depleted of oxygen, less visible problems continue to degrade the Great Lakes.

Overall Water Quality

The States surveyed 94% of the Great Lakes shoreline miles for 1994 and reported that fish consumption advisories and aquatic life concerns are the dominant water quality problems, overall, in the Great Lakes (Figure 8). The States reported that most of the Great Lakes nearshore waters are safe for swimming and other recreational activities and can be used as a source of drinking water with normal treatment. However, only 2% of the surveyed nearshore waters fully support designated uses, overall, and 1% support uses but are threatened (Figure 9). About 97% of the surveyed waters do not fully support designated uses, overall, because fish consumption advisories are posted throughout the nearshore waters of the Great Lakes and water quality conditions are unfavorable for supporting aquatic life in many cases. Aquatic life impacts result from persistent toxic pollutant burdens in birds, habitat degradation and destruction, and

Paul Goetz, Cary, NC

Figure 8. Great Lakes Shore Miles Surveyed

Total Great Lakes = 5,559 miles
Total surveyed = 5,224 miles

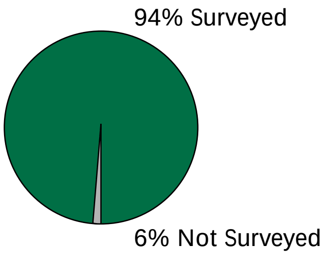
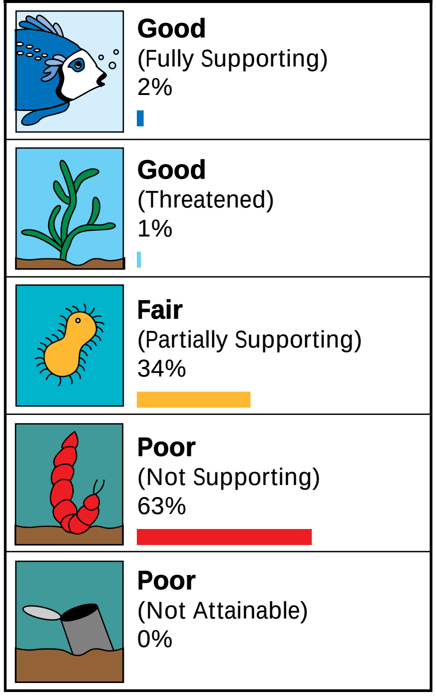


Figure 9. Levels of Overall Use Support – Great Lakes



Source: Based on 1994 State Section 305(b) reports.

competition and predation by nonnative species such as the zebra mussel and the sea lamprey.

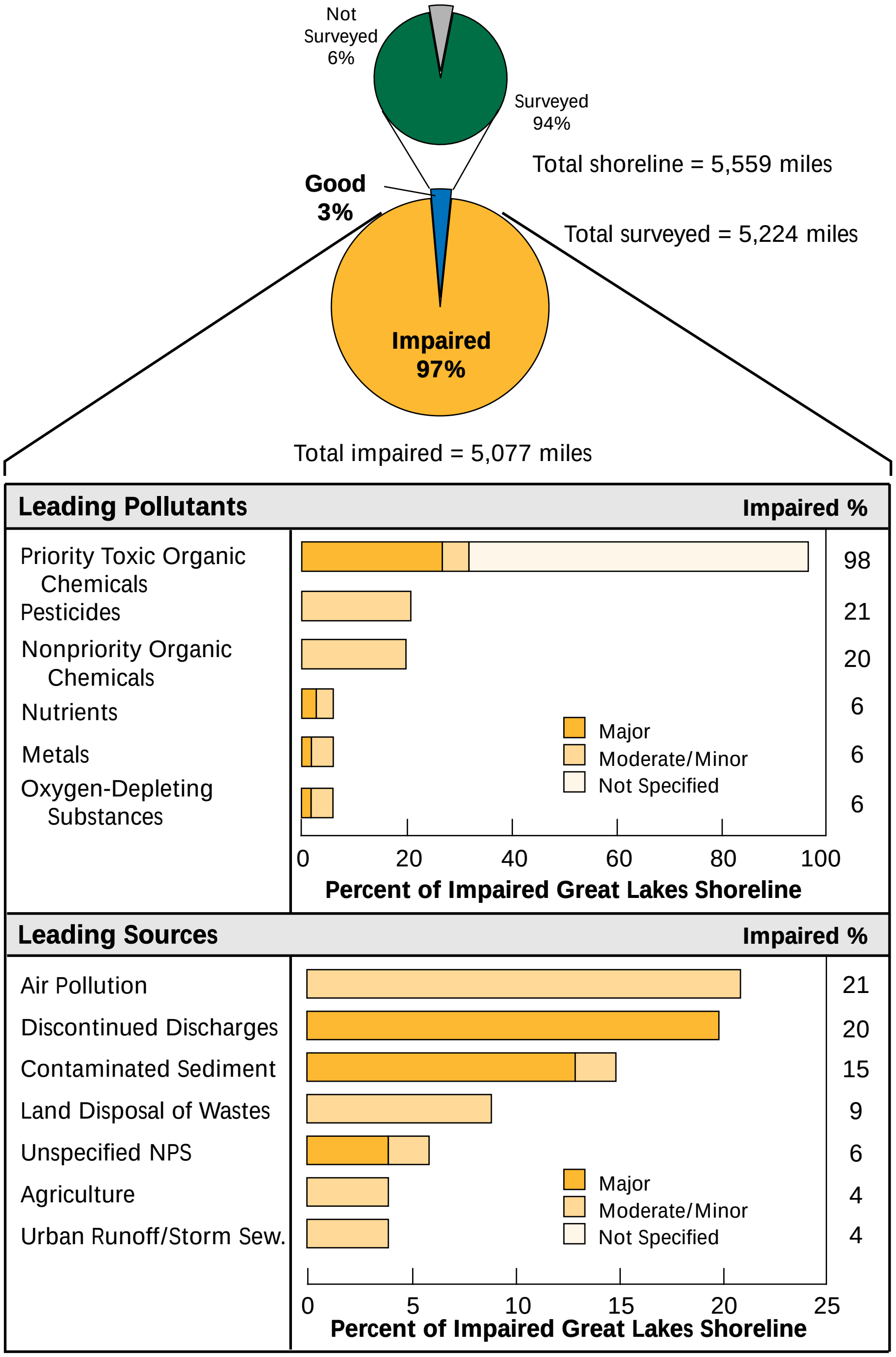
Considerable progress has been made in controlling conventional pollutants, but the Great Lakes are still subject to the effects of toxic pollutants.

These figures do not address water quality conditions in the deeper, cleaner, central waters of the Lakes.

What Is Polluting the Great Lakes?

The States reported that most of the Great Lakes shoreline is polluted by toxic organic chemicals–primarily PCBs–that are often found in fish tissue samples. The Great Lakes States reported that toxic organic chemicals impact 98% of the impaired Great Lakes shoreline miles. Other leading causes of impairment include pesticides, affecting 21%; nonpriority organic chemicals, affecting 20%; nutrients, affecting 6%; and metals, affecting 6% (Figure 10).

Figure 10. Impaired Great Lakes Shoreline: Pollutants and Sources



Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Where Does This Pollution Come From?

Only four of the eight Great Lakes States measured the size of their Great Lakes shoreline polluted by specific sources. These States have jurisdiction over one-third of the Great Lakes shoreline, so their findings do not necessarily reflect conditions throughout the Great Lakes Basin.

- Wisconsin identifies air pollution and discontinued discharges as a source of pollutants contaminating all 1,017 of their surveyed shoreline miles. Wisconsin also identified smaller areas impacted by contaminated sediments, nonpoint sources, industrial and municipal discharges, agriculture, urban runoff and storm sewers, combined sewer overflows, and land disposal of waste.

- Indiana attributes all of the pollution along its entire 43-mile shoreline to air pollution, urban runoff and storm sewers, industrial and municipal discharges, and agriculture.

- Ohio reports that nonpoint sources pollute 86 miles of its 236 miles of shoreline, in-place contaminants impact 33 miles, and land disposal of waste impacts 24 miles of shoreline.

- New York identifies many sources of pollutants in their Great Lakes waters, but the State attributes the most miles of degradation to contaminated sediments (439 miles) and land disposal of waste (374 miles).

Phil Johnson, U.S. EPA, Region 8

Estuaries

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity, complex water movements affected by ocean tides and river currents, and high turbidity levels. They are also highly productive ecosystems with a range of habitats for many different species of plants, shellfish, fish, and animals.

Many species permanently inhabit the estuarine ecosystem; others, such as shrimp, use the nutrient-rich estuarine waters as nurseries before traveling to the sea.

Estuaries are stressed by the particularly wide range of activities located within their watersheds. They receive pollutants carried by rivers from agricultural lands and cities; they often support marinas, harbors, and commercial fishing fleets; and their surrounding lands are highly prized for development. These stresses pose a continuing threat to the survival of these bountiful waters.

Overall Water Quality

Twenty-five coastal States and jurisdictions surveyed 78% of the Nation's total estuarine waters in 1994 (Figure 11). The States and other jurisdictions reported that 63% of the surveyed estuarine waters have good water quality that fully supports designated uses (Figure 12). Of these waters, 6% are threatened and might deteriorate if we fail to manage potential sources of pollution.

Brian Murphy, Walnut Creek, CA

Some form of pollution or habitat degradation impairs the remaining 37% of the surveyed estuarine waters. Twenty-seven percent of the surveyed estuarine waters have fair water quality that partially supports designated uses. Most of the time these waters provide adequate habitat for aquatic organisms and support human activities, but periodic pollution interferes with these activities and/or stresses aquatic life. Nine percent of the surveyed estuarine waters suffer from poor water quality that consistently stresses aquatic life and/or prevents people from using the estuarine waters for activities such as swimming and shellfishing.

Figure 11. Estuary Square Miles Surveyed

Total estuaries = 34,388 square miles
Total surveyed = 26,847 square miles

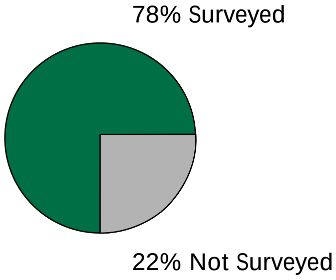
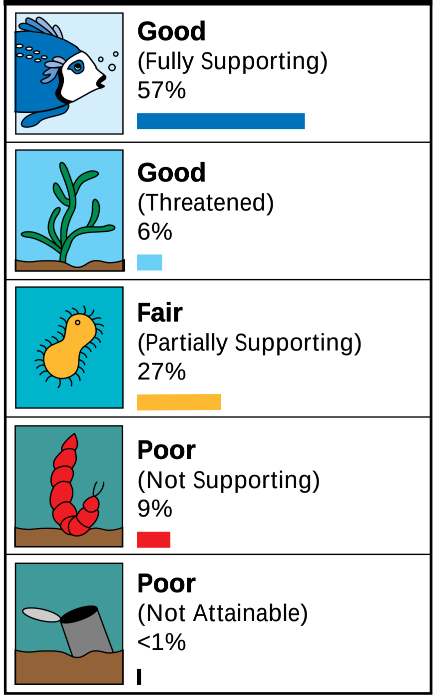


Figure 12. Levels of Overall Use Support – Estuaries



Source: Based on 1994 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

What Is Polluting Our Estuaries?

The States identified more square miles of estuarine waters polluted by nutrients and bacteria than any other pollutant or process (Figure 13). Fifteen States reported that extra nutrients pollute 4,548 square miles of estuarine waters (which equals 47% of the impaired estuarine waters). As in lakes, extra inputs of nutrients from human activities destabilize estuarine ecosystems.

Twenty-five States reported that bacteria pollute 4,479 square miles of estuarine waters (which equals 46% of the impaired estuarine waters). Bacteria provide evidence that an estuary is contaminated with sewage that may contain numerous viruses and bacteria that cause illness in people.

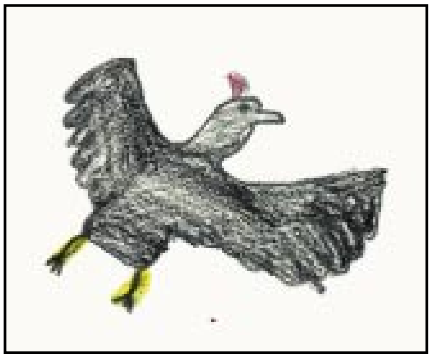
The States also report that oxygen depletion from organic wastes impacts 3,127 square miles (which equals 32% of the impaired estuarine waters), habitat alterations impact 1,564 square miles (which equals 16% of the impaired estuarine waters), and oil and grease pollute 1,344 square miles (which equals 14% of the impaired estuarine waters).

Chris Inghram, age 8, Bruner Elementary, North Las Vegas, NV

Where Does This Pollution Come From?

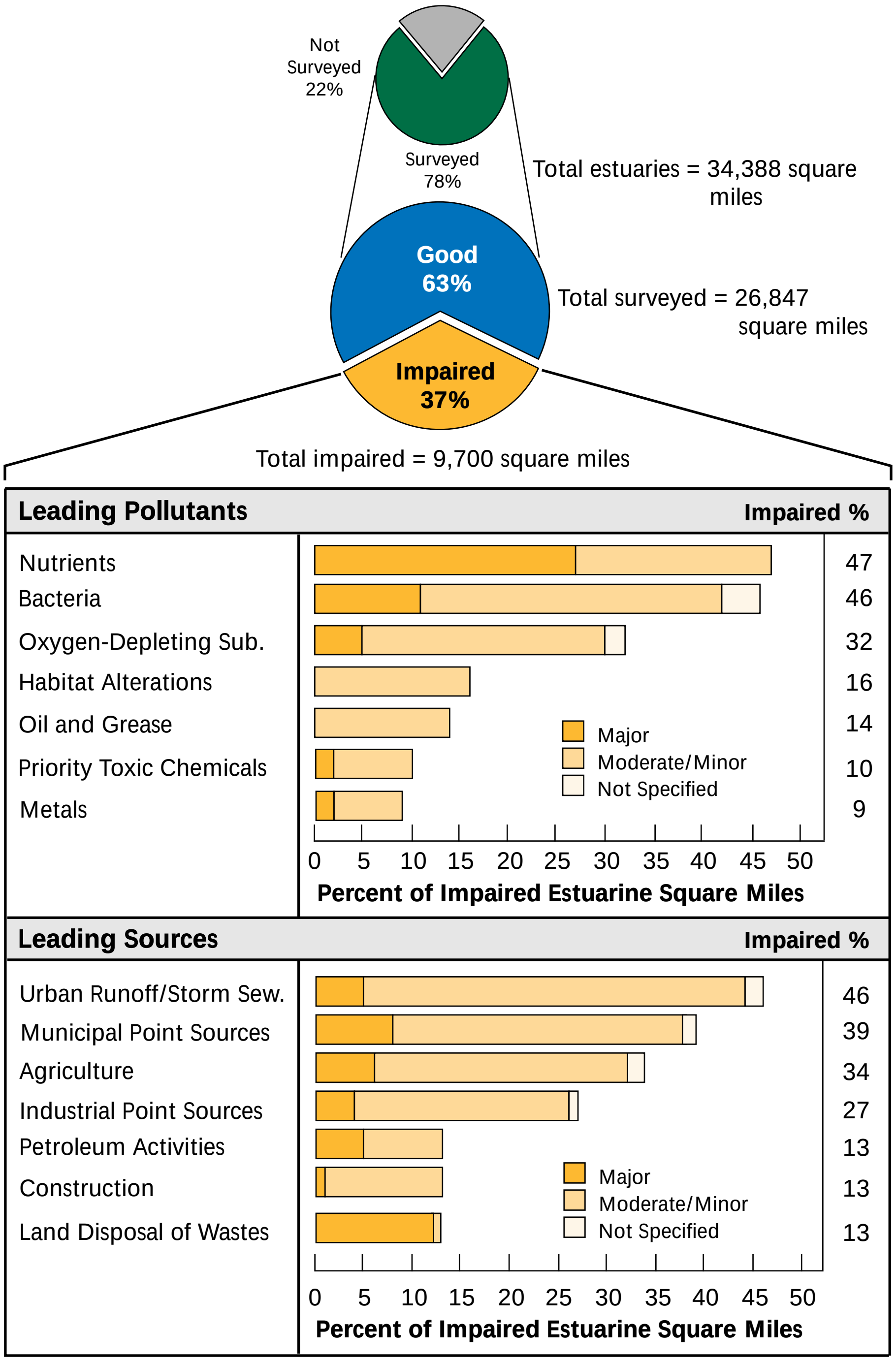
Twenty-three States reported that urban runoff and storm sewers are the most widespread source of pollution in the Nation's surveyed estuarine waters. Pollutants in urban runoff and storm sewer effluent degrade aquatic life or interfere with public use of 4,508 square miles of estuarine waters (which equals 46% of the impaired estuarine waters) (Figure 13).

The States also reported that municipal sewage treatment plants pollute 3,827 square miles of estuarine waters (39% of the impaired estuarine waters), agriculture pollutes 3,321 square miles of estuarine waters (34% of the impaired estuarine waters), and industrial discharges pollute 2,609 square miles (27% of the impaired estuarine waters). Urban sources contribute more to the degradation of estuarine waters than agriculture because urban centers are located adjacent to most major estuaries.



Krista Rose, age 8, Bruner Elementary, North Las Vegas, NV

Figure 13. Impaired Estuaries: Pollutants and Sources



Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Ocean Shoreline Waters

Although the oceans are expansive, they are vulnerable to pollution from numerous sources, including city storm sewers, ocean outfalls from sewage treatment plants, overboard disposal of debris and sewage, oil spills, and bilge discharges that contain oil and grease. Nearshore ocean waters, in particular, suffer from the same pollution problems that degrade our inland waters.

Overall Water Quality

Thirteen of the 27 coastal States and Territories surveyed only 9% of the Nation's estimated 58,421 miles of ocean coastline (Figure 14). Most of the surveyed waters (4,834 miles, or 93%) have good quality that supports a healthy aquatic community and public activities (Figure 15). Of these waters, 225 miles (4% of the surveyed shoreline) are threatened and may deteriorate in the future.

Some form of pollution or habitat degradation impairs the remaining 7% of the surveyed shoreline (374 miles). Five percent of the surveyed estuarine waters have fair water quality that partially supports designated uses. Most of the time, these waters provide adequate habitat for aquatic organisms and support human activities, but periodic pollution interferes with these activities and/or stresses aquatic life. Only 2% of the surveyed shoreline suffers from poor water quality that consistently stresses aquatic life and/or prevents people from using the shoreline for activities such as swimming and shellfishing.

Paul Goetz, Cary, NC

Only six of the 27 coastal States identified pollutants and sources of pollutants degrading ocean shoreline waters. General conclusions cannot be drawn from the information supplied by these States because these States border less than 1% of the shoreline along the contiguous States. The six States identified impacts in their ocean shoreline waters from bacteria, metals, nutrients, turbidity, siltation, and pesticides. The six States reported that urban runoff and storm sewers, industrial discharges, land disposal of wastes, septic systems, agriculture, unspecified nonpoint sources, and combined sewer overflows (CSOs) pollute their coastal shoreline waters.

Figure 14. Ocean Shoreline Waters Surveyed

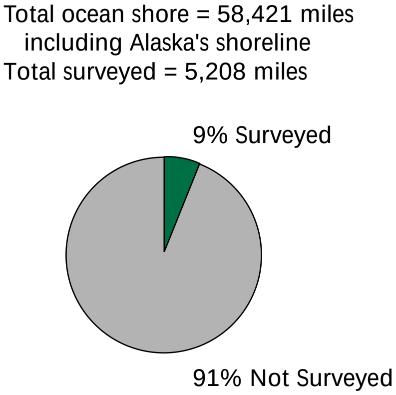
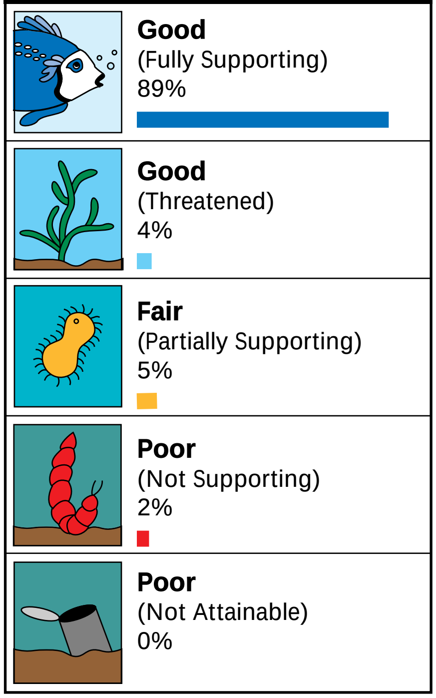


Figure 15. Levels of Overall Use Support – Ocean Shoreline Waters



Source: Based on 1994 State Section 305(b) reports submitted by States and Territories.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support (and that under normal circumstances does support) a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands, which are found throughout the United States, generally include swamps, marshes, bogs, and similar areas.

Wetlands are now recognized as some of the most unique and important natural areas on earth. They vary in type according to differences in local and regional hydrology, vegetation, water chemistry, soils, topography, and climate. Coastal wetlands include estuarine marshes; mangrove swamps found in Puerto Rico, Hawaii, Louisiana, and Florida; and Great Lakes coastal wetlands. Inland wetlands, which may be adjacent to a waterbody or isolated, include marshes and wet meadows, bottomland hardwood forests, Great Plains prairie potholes, cypress-gum swamps, and southwestern playa lakes.

In their natural condition, wetlands provide many benefits, including food and habitat for fish and wildlife, water quality improvement, flood protection, shoreline erosion control, ground water exchange, as well as natural products for human use and opportunities for recreation, education, and research.

Wetlands help maintain and improve water quality by intercepting surface water runoff before it reaches open water, removing or retaining nutrients, processing chemical and organic wastes, and reducing sediment loads to receiving waters. As water moves through a wetland, plants slow the water, allowing sediment and pollutants to settle out. Plant roots trap sediment and are then able to metabolize and detoxify pollutants and remove nutrients such as nitrogen and phosphorus.

Audrey Moore, U.S. EPA, Region 2

Wetlands function like natural basins, storing either floodwater that overflows riverbanks or surface water that collects in isolated depressions. By doing so, wetlands help protect adjacent and downstream property from flood damage. Trees and other wetlands vegetation help slow the speed of flood waters. This action, combined with water storage, can lower flood heights and reduce the water's erosive potential. In agricultural areas, wetlands can help reduce the likelihood of flood damage to crops. Wetlands within and upstream of urban areas are especially valuable for flood protection because urban development increases the rate and volume of surface water runoff, thereby increasing the risk of flood damage.

Wetlands produce a wealth of natural products, including fish and shellfish, timber, wildlife, and wild rice. Much of the Nation's fishing and shellfishing industry harvests wetlands-dependent species. A national survey conducted by the Fish and Wildlife Service (FWS) in 1991 illustrates the economic value of some of the wetlands-dependent products. Over 9 billion pounds of fish and shellfish landed in the United States in 1991 had a direct, dockside value of $3.3 billion. This served as the basis of a seafood processing and sales industry that generated total expenditures of $26.8 billion. In addition, 35.6 million anglers spent $24 billion on freshwater and saltwater fishing. It is estimated that 71% of commercially valuable fish and shellfish depend directly or indirectly on coastal wetlands.

Overall Water Quality

The States, Tribes, and other jurisdictions are making progress in developing specific designated uses and water quality standards for wetlands, but many States and Tribes still lack specific water quality criteria and monitoring programs for wetlands. Without criteria and monitoring data, most States and Tribes cannot evaluate use support. To date, only nine States and Tribes reported the designated use support status for some of their wetlands. Only one State used quantitative data as a basis for the use support decisions.

EPA cannot derive national conclusions about water quality conditions in all wetlands because the States used different methodologies to survey only 3% of the total wetlands in the Nation. Summarizing State wetlands data would also produce misleading results because two States (North Carolina and Louisiana) contain 91% of the surveyed wetlands acreage.

What Is Polluting Our Wetlands and Where Does This Pollution Come From?

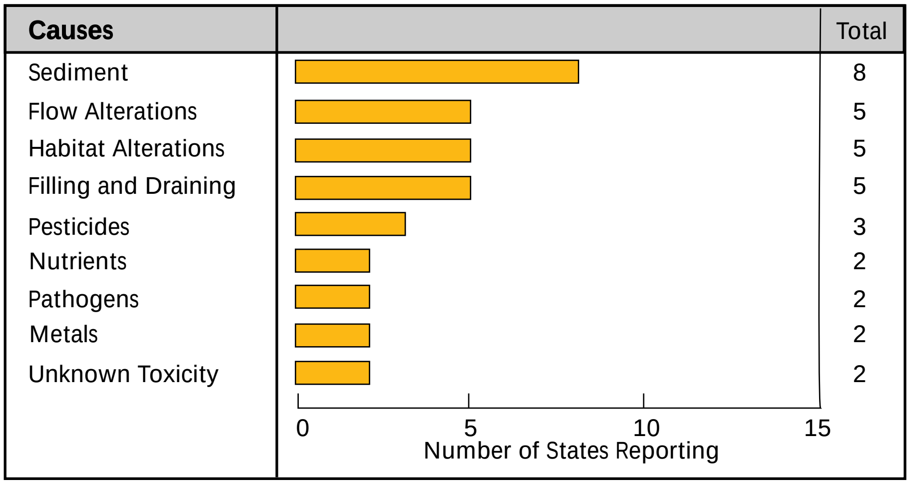
The States have even fewer data to quantify the extent of pollutants degrading wetlands and the sources of these pollutants. Although most States cannot quantify wetlands area impacted by individual causes and sources of degradation, 12 States identified causes and 13 States identified sources known to degrade wetlands integrity to some extent. These States listed sediment as the most widespread cause of degradation impacting wetlands, followed by flow alterations, habitat modifications, and draining (Figure 16). Agriculture topped the list of sources degrading wetlands, followed by urban runoff, hydrologic modification, and municipal point sources (Figure 17).

Wetlands Loss: A Continuing Problem

It is estimated that over 200 million acres of wetlands existed in the lower 48 States at the time of European settlement. Since then, extensive wetlands acreage has been lost, with many of the original wetlands drained and converted to farmland and urban development. Today, less than half of our original wetlands remain. The losses amount to an area equal to the size of California. According to the U.S. Fish and Wildlife Service's *Wetlands Losses in the United States 1780's to 1980's*, the three States that have sustained the greatest percentage of wetlands loss are California (91%), Ohio (90%), and Iowa (89%).

According to FWS status and trends reports, the average annual loss of wetlands has decreased over the past 40 years. The average annual loss from the mid-1950s to the mid-1970s was 458,000 acres, and from the mid-1970s to the mid-1980s it was 290,000 acres. Agriculture was responsible for 87% of the loss from the mid-1950s to the mid-1970s and 54% of the loss from the mid-1970s to the mid-1980s.

Figure 16. Causes Degrading Wetlands Integrity (12 States Reporting)



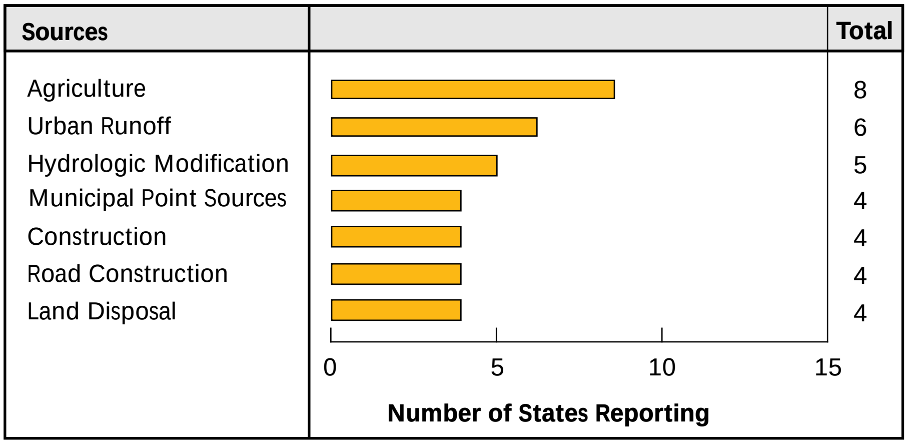
Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

A more recent estimate of wetlands losses from the National Resources Inventory (NRI), conducted by the Natural Resources Conservation Service (NRCS), indicates that 792,000 acres of wetlands were lost on non-Federal lands between 1982 and 1992 for a yearly loss estimate of 70,000 to 90,000 acres. This net loss is the result of gross losses of 1,561,300 acres of wetlands and gross gains of 768,700 acres of wetlands over the 10-year period. The NRI estimates are consistent with the trend of declining wetlands losses reported by FWS. Although losses have decreased, we still have to make progress toward our interim goal of no overall net loss of the Nation's remaining wetlands and the long-term goal of increasing the quantity and quality of the Nation's wetlands resource base.

The decline in wetlands losses is a result of the combined effect of several trends: (1) the decline in profitability in converting wetlands for agricultural production; (2) passage of Swampbuster provisions in the 1985 and 1990 Farm Bills that denied crop subsidy benefits to farm operators who converted wetlands to cropland after 1985; (3) presence of the CWA Section 404 permit programs as well as development of State management programs; (4) greater public interest and support for wetlands protection; and (5) implementation of wetlands restoration programs at the Federal, State, and local level.

Nineteen States listed sources of recent wetlands losses in their 1994 305(b) reports. Residential development and urban growth were cited as the leading sources of current losses. Other losses were due to commercial development; construction of roads, highways, and bridges; agriculture; and industrial development. In addition to human activities, a few States also reported that natural sources, such as rising lake levels, resulted in wetlands losses and degradation.

Figure 17. Sources Degrading Wetlands Integrity (12 States Reporting)



Source: Based on 1994 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Kings Park Elementary, 3rd Grade, Springfield, VA

More information on wetlands can be obtained from the EPA Wetlands Hotline at 1-800-832-7828.

Ground Water

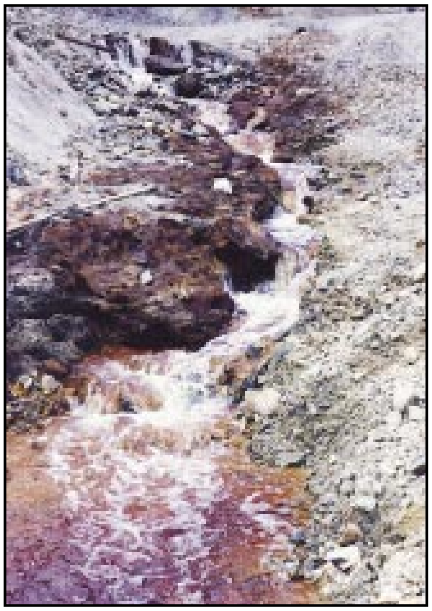
Ninety-five percent of all fresh water available on earth (exclusive of icecaps) is ground water. Ground water–water found in natural underground rock formations called aquifers–is a vital natural resource with many uses. The extent of the Nation's ground water resources is enormous. At least 60% of the land area in the conterminous United States overlies aquifers that may be susceptible to contamination. Usable ground water exists in every State.

Aquifers can range in size from thin surficial formations that yield small quantities of ground water to large systems such as the High Plains aquifer that underlies eight western States and provides water to millions. Although the Nation's ground water is of good quality, it is recognized that ground water is more vulnerable to contamination than previously reported and that an increasing number of pollution events and contamination sources are threatening the integrity of the resource.

Ground Water Use

Nationally, 51% of the population relies to some extent on ground water as a source of drinking water. This percentage is even higher in rural areas where most residents rely on potable or treatable ground water as an economical source of drinking water. Eighty-one percent of community water systems are dependent on ground water. Seventy-four percent of community water systems are small ground water systems serving 3,300 people or less. Ninety-five percent of the approximately 200,000 noncommunity water systems (serving schools, parks, and other small facilities) are ground water systems.

Ground water provides drinking water for 51% of the population.



Jeff Reynolds, Raleigh, NC

Irrigation accounts for approximately 63% of national ground water withdrawals. Public drinking water supplies account for approximately 19% of the Nation's total ground water withdrawals. Domestic, commercial, livestock, industrial, mining, and thermoelectric withdrawals together account for approximately 18% of national ground water withdrawals.

Ground Water Quality

Although the 1994 Section 305(b) State Water Quality Reports indicate that, overall, the Nation's ground water is of good quality, many local areas have experienced significant ground water contamination. The sources and types of ground water contamination vary depending upon the region of the country. Those most frequently reported by States include:

- **Leaking underground storage tanks**. Approximately 1.2 million federally regulated underground storage tanks are buried at over 500,000 sites nationwide. An estimated 139,000 tanks have leaked and impacted ground water quality.

- **Agricultural activities**. Seventy-seven percent of the 1.1 billion pounds of pesticides produced annually in the United States is applied to land in agricultural production, which usually overlies aquifers.

- **Superfund sites**. More than 85% of all Superfund sites have some degree of ground water contamination. Most of these sites impact aquifers that are currently used, or potentially may be used, for drinking water purposes.

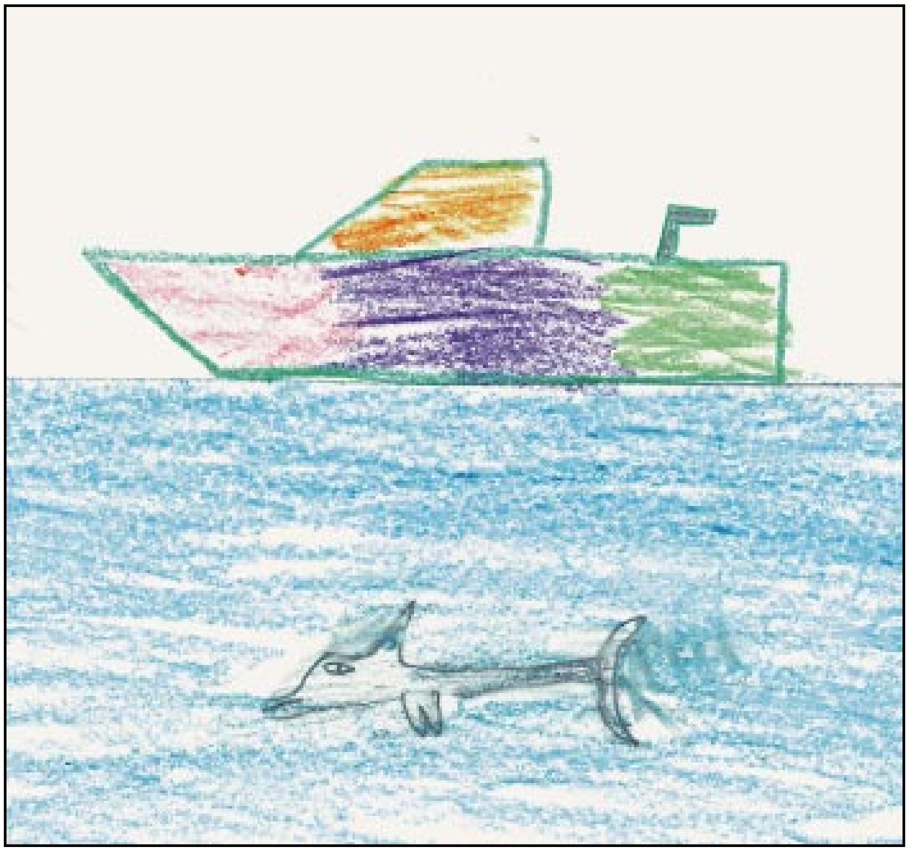
- **Septic tanks**. Approximately 23 million domestic septic tanks are in operation in the United States. These tanks impact ground water quality through the discharge of fluids into or above aquifers.

The most common contaminants associated with these sources include petroleum compounds, nitrates, metals, volatile organic compounds (VOCs), and pesticides.

States are reporting that ground water quality is most likely to be adversely affected by contamination in areas of high demand or stress. To combat these problems, States are developing programs designed to evaluate the overall quality and vulnerability of their ground water resources, to identify potential threats to ground water quality, and to identify methods to protect their ground water resources. Thirty-three States indicate that they have implemented statewide ground water monitoring programs.

Ground water monitoring programs vary widely among the States, depending upon the special needs of each of the States. For example, some States choose to monitor ground water quality in specific areas that are especially vulnerable to contamination, whereas other States may choose to monitor ground water quality on a statewide basis. When it comes to selecting chemicals to test for in the ground water, some States monitor for a large suite of chemicals, whereas other States limit monitoring to one or two specific chemicals that are a definite threat to ground water quality.

Ground water monitoring provides a great deal of information about the nature and quality of our Nation's ground water resources. Still, there is much we do not know about how human activities influence ground water quality. Our continued quest for information about the status of our ground water will help protect and preserve this vast and vulnerable resource. Through a greater understanding of how human activities influence ground water quality, we can better ensure the long-term availability of high-quality water for future generations.



Alisha Batten, age 8, Bruner Elementary, North Las Vegas, NV

Kings Park Elementary, 3rd Grade, Springfield, VA

Water Quality Protection Programs

Although significant strides have been made in reducing the impacts of discrete pollutant sources, our aquatic resources remain at risk from a combination of point sources and complex nonpoint sources, including air pollution. Since 1991, EPA has promoted the watershed protection approach as a holistic framework for addressing complex pollution problems.

The watershed protection approach is a place-based strategy that integrates water quality management activities within hydrologically defined drainage basins–watersheds–rather than areas defined by political boundaries. Thus, for a given watershed, the approach encompasses not only the water resource (such as a stream, lake, estuary, or ground water aquifer), but all the land from which water drains to the resource. To protect water resources, it is increasingly important to address the condition of land areas within the watershed because water carries the effects of human activities throughout the watershed as it drains off the land into surface waters or leaches into the ground water.

Under the Watershed Protection Approach (WPA), a "watershed" is a hydrogeologic area defined for addressing water quality problems. For example, a WPA watershed may be a river basin, a county-sized watershed, or a small drinking water supply watershed.

Mike Steuart, Minnesota Pollution Control Agency

EPA's Office of Water envisions the watershed protection approach as the primary mechanism for achieving clean water and healthy, sustainable ecosystems throughout the Nation. The watershed protection approach enables stakeholders to take a comprehensive look at ecosystem issues and tailor corrective actions to local concerns within the coordinated framework of a national water program. The emphasis on public participation also provides an opportunity to incorporate environmental justice issues into watershed restoration and protection solutions.

In May of 1994, the EPA Assistant Administrator for Water, Robert Perciasepe, created the Watershed Management Policy Committee to coordinate the EPA water program's support of the watershed protection approach. During 1995, EPA's water program managers, under the direction of the Watershed Management Policy Committee, evaluated their programs and identified additional activities needed to support the watershed protection approach in an action plan.

EPA's Office of Water will continue to promote and support the watershed protection approach at local, State, Tribal, Territorial, and Federal levels. The Office of Water recognizes that the watershed protection approach relies on active participation by local governments and citizens who have the most direct knowledge of local problems and opportunities in their watersheds. However, the Office of Water will look to the States, Tribes, and

Territories to create the framework for supporting local efforts because most EPA programs are implemented by the States, Tribes, and Territories.

The Clean Water Act

A number of laws provide the authority to develop and implement pollution control programs. The primary statute providing for water quality protection in the Nation's rivers, lakes, wetlands, estuaries, and coastal waters is the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act.

The CWA and its amendments are the driving force behind many of the water quality improvements we have witnessed in recent years. Key provisions of the CWA provide the following pollution control programs.

Water quality standards and criteria – States, Tribes, and other jurisdictions adopt EPA-approved standards for their waters that define water quality goals for individual waterbodies. Standards consist of designated beneficial uses to be made of the water, criteria to protect those uses, and antidegradation provisions to protect existing water quality.

Effluent guidelines – The EPA develops nationally consistent guidelines limiting pollutants in discharges from industrial facilities and municipal sewage treatment plants. These guidelines are then used in permits issued to dischargers under the

The Watershed Protection Approach (WPA)

Several key principles guide the watershed protection approach:

- **Place-based focus** – Resource management activities are directed within specific geographical areas, usually defined by watershed boundaries, areas overlying or recharging ground water, or a combination of both.
- **Stakeholder involvement and partnerships** – Watershed initiatives involve the people most likely to be affected by management decisions in the decision making process. Stakeholder participation ensures that the objectives of the watershed initiative will include economic stability and that the people who depend on the water resources in the watershed will participate in planning and implementation activities. Watershed initiatives also establish partnerships between Federal, State, and local agencies and nongovernmental organizations with interests in the watershed.
- **Environmental objectives** – The stakeholders and partners identify environmental objectives (such as "populations of striped bass will stabilize or increase") rather than programmatic objectives (such as "the State will eliminate the backlog of discharge permit renewals") to measure the success of the watershed initiative. The environmental objectives are based on the condition of the ecological resource and the needs of people in the watershed.
- **Problem identification and prioritization** – The stakeholders and partners use sound scientific data and methods to identify and prioritize the primary threats to human and ecosystem health within the watershed. Consistent with the Agency's mission, EPA views ecosystems as the interactions of complex communities that include people; thus, healthy ecosystems provide for the health and welfare of humans as well as other living things.
- **Integrated actions** – The stakeholders and partners take corrective actions in a comprehensive and integrated manner, evaluate success, and refine actions if necessary. The watershed protection approach coordinates activities conducted by numerous government agencies and nongovernmental organizations to maximize efficient use of limited resources.

National Pollutant Discharge Elimination System (NPDES) program. Additional controls may be required if receiving waters are still affected by water quality problems after permit limits are met.

Total Maximum Daily Loads– The development of Total Maximum Daily Loads, or TMDLs, establishes the link between water quality standards and point/nonpoint source pollution control actions such as permits or Best Management Practices (BMPs). A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides the quantitative basis for pollution reduction necessary to meet water quality standards. States, Tribes, and other jurisdictions develop and implement TMDLs for high-priority impaired or threatened waterbodies.

Permits and enforcement – All industrial and municipal facilities that discharge wastewater must have an NPDES permit and are responsible for monitoring and reporting levels of pollutants in their discharges. EPA issues these permits or can delegate that permitting authority to qualifying States or other jurisdictions. The States, other qualified jurisdictions, and EPA inspect facilities to determine if their discharges comply with permit limits. If dischargers are not in compliance, enforcement action is taken.

Grants – The EPA provides States with financial assistance to help support many of their pollution control programs. These programs include the State Revolving Fund program for construction and upgrading of municipal sewage treatment plants; water quality monitoring, permitting, and enforcement; and developing and implementing nonpoint source pollution controls, combined sewer and stormwater controls, ground water strategies, lake assessment, protection, and restoration activities, estuary and near coastal management programs, and wetlands protection activities.

Nonpoint source control – The EPA provides program guidance, technical support, and funding to help the States, Tribes, and other jurisdictions control nonpoint source pollution. The States, Tribes, and other jurisdictions are responsible for analyzing the extent and severity of their nonpoint source pollution problems and developing and implementing needed water quality management actions.

The CWA also established pollution control and prevention programs for specific waterbody categories, such as the Clean Lakes Program. Other statutes that also guide the development of water quality protection programs include:

- **The Safe Drinking Water Act**, under which States establish standards for drinking water quality, monitor wells and local water supply systems, implement drinking water protection programs, and implement Underground Injection Control (UIC) programs.

- **The Resource Conservation and Recovery Act**, which establishes State and EPA programs for ground water and surface water protection and cleanup and emphasizes prevention of releases through management standards in addition to other waste management activities.

- **The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Program)**, which provides EPA with the authority to clean up contaminated waters during remediation at contaminated sites.

- **The Pollution Prevention Act of 1990**, which requires EPA to promote pollutant source reduction rather than focus on controlling pollutants after they enter the environment.

Protecting Lakes

Managing lake quality often requires a combination of in-lake restoration measures and pollution controls, including watershed management measures:

Restoration measures are implemented to reduce existing pollution problems. Examples of in-lake restoration measures include harvesting aquatic weeds, dredging sediment, and adding chemicals to precipitate nutrients out of the water column. Restoration measures focus on restoring uses of a lake and may not address the source of the pollution.

Pollution control measures deal with the sources of pollutants degrading lake water qual34ity or threatening to impair lake water quality. Control measures include planning activities, regulatory actions, and implementation of BMPs to reduce nonpoint sources of pollutants.

During the 1980s, most States implemented chemical and mechanical in-lake restoration measures to control aquatic weeds and algae. In their 1994 Section 305(b) reports, the States and Tribes report a shift toward nonpoint source controls to reduce pollutant loads responsible for aquatic weed growth and algal blooms (Figure 18). Twenty-two States reported that they implemented best management practices to control nonpoint source pollution entering more than 171 lakes. The States reported that they implemented agricultural practices to control soil erosion, constructed retention and detention basins to control urban runoff, managed animal waste, revegetated shorelines, and constructed or restored wetlands to remove pollutants from runoff. Although the States reported that they still use in-lake treatments, the States recognize that source controls are needed in addition to in-lake treatments to restore lake water quality.

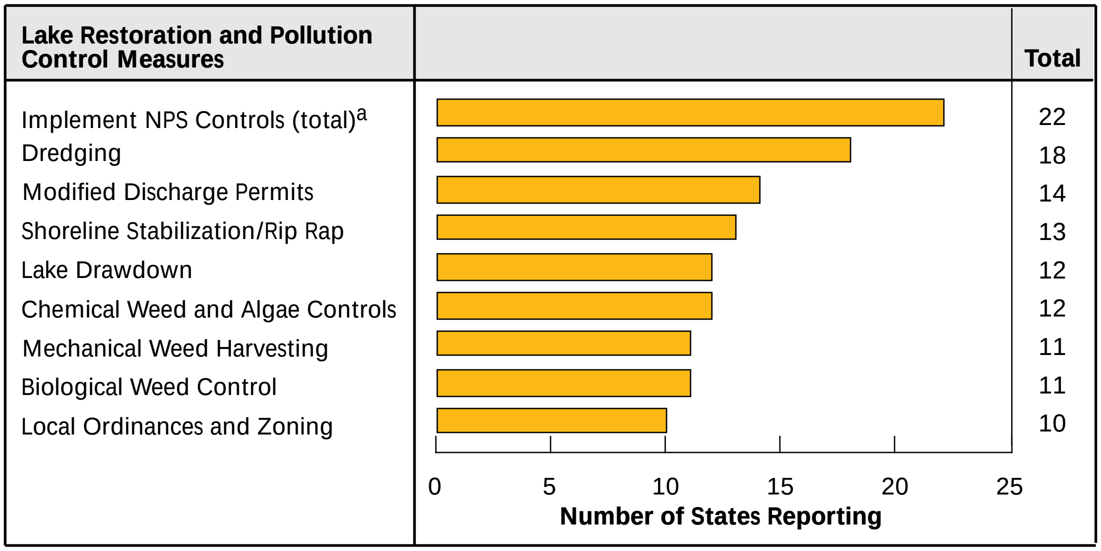
Successful lake programs require strong commitment from local citizens and cooperation from natural resource agencies at the local, State, and Federal levels.

The National Estuary Program

Section 320 of the Clean Water Act (as amended by the Water Quality Act of 1987) established the National Estuary Program (NEP) to protect and restore water quality and living resources in estuaries. The NEP adopts a geographic or watershed approach by planning and implementing pollution abatement activities for the estuary and its surrounding land area as a whole.

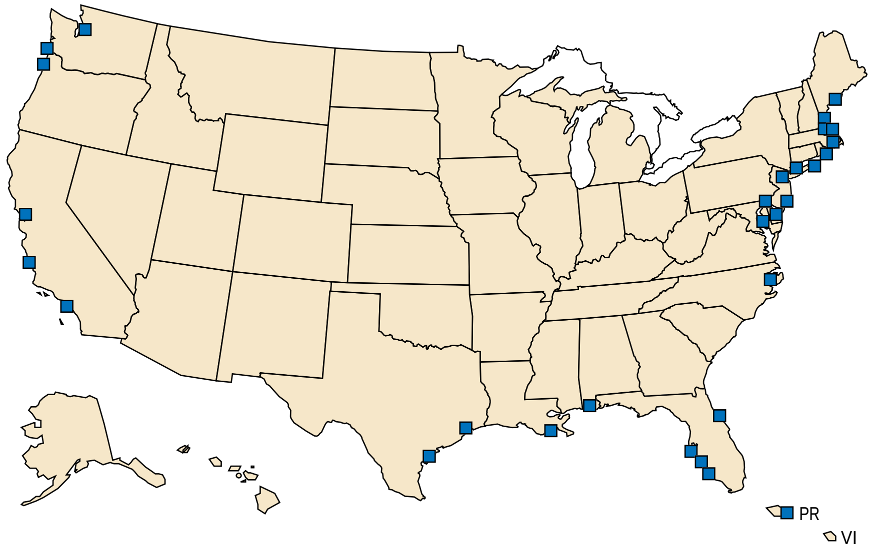
The NEP embodies the ecosystem approach by building coalitions, addressing multiple sources of contamination, pursuing habitat protection as a pollution control mechanism, and investigating cross-media transfer of pollutants from air and soil into specific estuarine waters. Under the NEP, a State governor nominates an estuary in his or her State for participation in the program. The State must demonstrate a likelihood of success in protecting candidate estuaries and provide evidence of institutional, financial, and political commitment to solving estuarine problems.

Figure 18



[a] Includes best management practices, such as conservation tillage, sediment detention basins, vegetated buffers, and animal waste management.

Figure 19. Locations of National Estuary Program Sites



If an estuary meets the NEP guidelines, the EPA Administrator convenes a management conference of representatives from interested Federal, Regional, State, and local governments; affected industries; scientific and academic institutions; and citizen organizations. The management conference defines program goals and objectives, identifies problems, and designs strategies to control pollution and manage natural resources in the estuarine basin. Each management conference develops and initiates implementation of a Comprehensive Conservation and Management Plan (CCMP) to restore and protect the estuary.

The NEP currently supports 28 estuary projects.

The NEP integrates science and policy by bringing water quality managers, elected officials, and stakeholders together with scientists from government agencies, academic institutions, and the private sector. Because the NEP is not a research program, it relies heavily on past and ongoing research of other agencies and institutions to support development of CCMPs.

With the addition of seven estuary sites in July of 1995, the NEP currently supports 28 estuary projects (see Figure 19). These 28 estuaries are nationally significant in their economic value as well as in their ability to support living resources. The project sites also represent a broad range of environmental conditions in estuaries throughout the United States and its Territories so that the lessons learned through the NEP can be applied to other estuaries.

Protecting Wetlands

A variety of public and private programs protect wetlands. Section 404 of the CWA continues to provide the primary Federal vehicle for regulating certain activities in wetlands. Section 404 establishes a permit program for discharges of dredged or fill material into waters of the United States, including wetlands.

The U.S. Army Corps of Engineers (COE) and EPA jointly implement the Section 404 program. The COE is responsible for reviewing permit applications and making permit decisions. EPA establishes the environmental criteria for making permit decisions and has the authority to review and veto Section 404 permits proposed for issuance by the COE. EPA is also responsible for determining geographic jurisdiction of the Section 404 permit program, interpreting statutory exemptions, and

Shortly after coming into office, the Clinton Administration convened an interagency working group to address concerns with Federal wetlands policy. After hearing from States, developers, farmers, environmental interests, members of Congress, and scientists, the working group developed a comprehensive 40-point plan for wetlands protection to make wetlands programs more fair, flexible, and effective. This plan was issued on August 24, 1993.

The Administration's Wetlands Plan emphasizes improving Federal wetlands policy by

- Streamlining wetlands permitting programs
- Increasing cooperation with private landowners to protect and restore wetlands
- Basing wetlands protection on good science and sound judgment
- Increasing participation by States, Tribes, local governments, and the public in wetlands protection.

overseeing Section 404 permit programs assumed by individual States. To date, only two States (Michigan and New Jersey) have assumed the Section 404 permit program from the COE. The COE and EPA share responsibility for enforcing Section 404 requirements.

The COE issues individual Section 404 permits for specific projects or general permits (Table 5). Applications for individual permits go through a review process that includes opportunities for EPA, other Federal agencies (such as the U.S. Fish and Wildlife Service and the National Marine Fisheries Service), State agencies, and the public to comment. However, the vast majority of activities proposed in wetlands are covered by Section 404 general permits. For example, in FY94, over 48,000 people applied to the COE for a Section 404 permit. Eighty-two percent of these applications were covered by general permits and were processed in an average of 16 days. It is estimated that another 50,000 activities are covered by general permits that do not require notification of the COE at all.

General permits allow the COE to permit certain activities without performing a separate individual permit review. Some general permits require notification of the COE before an activity begins. There are three types of general permits:

- Nationwide permits (NWPs) authorize specific activities across the entire Nation that the COE determines will have only minimal individual and cumulative impacts on the environment, including construction of minor road crossings and farm buildings, bank stabilization activities, and the filling of up to 10 acres of isolated or headwater wetlands.

- Regional permits authorize types of activities within a geographic area defined by a COE District Office.

- Programmatic general permits are issued to an entity that the COE determines may regulate activities within its jurisdictional wetlands.

Table 5. Federal Section 404 Permits

General Permits (streamlined permit review procedures)				Individual Permits
Nationwide Permits	**Regional Permits**	**Programmatic Permits**		• Required for major projects that have the potential to cause significant adverse impacts • Project must undergo interagency review • Opportunity for public comment • Opportunity for 401 certification review
• Cover 36 types of activities that the COE determines to have minimal adverse impacts on the environment	• Developed by COE District Offices to cover activities in a specified region	**State Programmatic Permits**	**Others**	
		• COE defers permit decisions to State agency while reserving authority to require an individual permit	• Special Management Agencies • Watershed Planning Commissions	

Under a programmatic general permit, the COE defers its permit decision to the regulating entity but reserves its authority to require an individual permit.

Currently, the COE and EPA are promoting the development of State programmatic general permits (SPGPs) to increase State involvement in wetlands protection and minimize duplicative State and Federal review of activities proposed in wetlands. Each SPGP is a unique arrangement developed by a State and the COE to take advantage of the strengths of the individual State wetlands program. Several States have adopted comprehensive SPGPs that replace many or all COE-issued nationwide general permits. SPGPs simplify the regulatory process and increase State control over their wetlands resources. Carefully developed SPGPs can improve wetlands protection while reducing regulatory demands on landowners.

Water quality standards for wetlands ensure that the provisions of CWA Section 303 that apply to other surface waters are also applied to wetlands. In July 1990, EPA issued guidance to States for the development of wetlands water quality standards. Water quality standards consist of designated beneficial uses, numeric criteria, narrative criteria, and antidegradation statements. Figure 20 indicates the State's progress in developing these standards.

Standards provide the foundation for a broad range of water quality management activities under the CWA including, but not limited to, monitoring for the Section 305(b) report, permitting under Section 402 and 404, water quality certification under Section 401, and the control of nonpoint source pollution under Section 319.

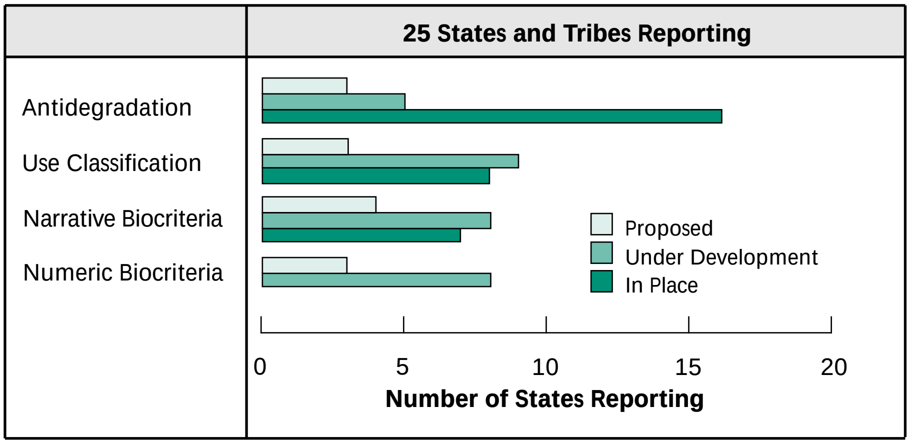
States, Territories, and Tribes are well positioned between Federal and local government to take the lead in integrating and expanding wetlands protection and management programs. They are experienced in managing federally mandated environmental programs, and they are uniquely equipped to help resolve local and regional conflicts and identify the local economic and geographic factors that may influence wetlands protection.

Section 401 of the CWA gives States and eligible American Indian Tribes the authority to grant, condition, or deny certification of federally permitted or licensed activities that may result in a discharge to U.S. waters, including wetlands. Such activities include discharge of dredged or fill material permitted under CWA Section 404, point source discharges permitted under CWA Section 402, and Federal Energy Regulatory Commission's hydropower licenses. States review these permits to ensure that they meet State water quality standards.

Section 401 certification can be a powerful tool for protecting wetlands from unacceptable degradation or destruction especially when implemented in conjunction with wetlands-specific water quality standards. If a State or an eligible Tribe denies Section 401 certification, the Federal permitting or licensing agency cannot issue the permit or license.

Until recently, many States waived their right to review and certify Section 404 permits because these States had not defined water

Figure 20. Development of State Water Quality Standards for Wetlands



quality standards for wetlands or codified regulations for implementing their 401 certification program into State law. Now, most States report that they use the Section 401 certification process to review Section 404 projects and to require mitigation if there is no alternative to degradation of wetlands. Ideally, 401 certification should be used to augment State programs because activities that do not require Federal permits or licenses, such as some ground water withdrawals, are not covered.

State Wetlands Conservation Plans (SWCPs) are strategies that integrate regulatory and cooperative approaches to achieve State wetlands management goals, such as no overall net loss of wetlands. SWCPs are not meant to create a new level of bureaucracy. Instead, SWCPs improve government and private-sector effectiveness and efficiency by identifying gaps in wetlands protection programs and identifying opportunities to improve wetlands programs.

States, Tribes, and other jurisdictions protect their wetlands with a variety of other approaches, including permitting programs, coastal management programs, wetlands acquisition programs, natural heritage programs, and integration with other programs. The following trends emerged from individual State and Tribal reporting:

- Most States have defined wetlands as waters of the State, which offers general protection through antidegradation clauses and designated uses that apply to all waters of a State. However, most States have not developed specific wetlands water quality standards and designated uses that protect wetlands' unique functions, such as flood attenuation and filtration.

- Without specific wetlands uses and standards, the Section 401 certification process relies heavily on antidegradation clauses to prevent significant degradation of wetlands.

- In many cases, the States use the Section 401 certification process to add conditions to Section 404 permits that minimize the size of wetlands destroyed or degraded by proposed activities to the extent practicable. States often add conditions that require compensatory mitigation for destroyed wetlands, but the States do not have the resources to perform enforcement inspections or followup monitoring to ensure that the wetlands are constructed and functioning properly.

- More States are monitoring selected, largely unimpacted wetlands to establish baseline conditions in healthy wetlands. The States will use this information to monitor the relative performance of constructed wetlands and to help establish biocriteria and water quality standards for wetlands.

Although the States, Tribes, and other jurisdictions report that they are making progress in protecting wetlands, they also report that the pressure to develop or destroy wetlands remains high. EPA and the States, Tribes, and other jurisdictions will continue to pursue new mechanisms for protecting wetlands that rely less on regulatory tools.

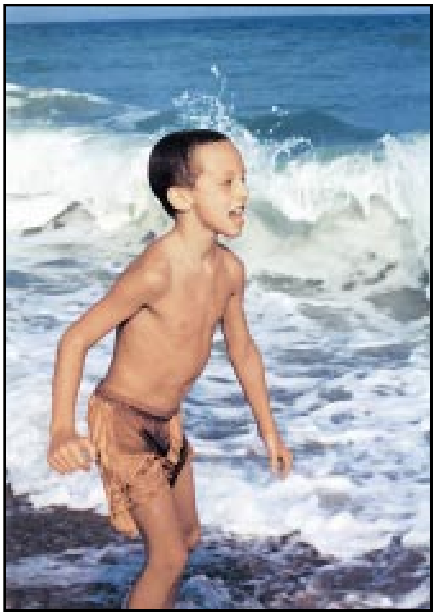
Protecting the Great Lakes

Restoring and protecting the Great Lakes requires cooperation from numerous organizations because the pollutants that enter the Great Lakes originate in both the United States and Canada, as well as in other countries. The International Joint Commission (IJC), established by the 1909 Boundary Waters Treaty, provides a framework for the cooperative management of the Great Lakes. Representatives from the United States and Canada, the Province of Ontario, and the eight States bordering the Lakes sit on the IJC's Water Quality Board. The Water Quality Board recommends actions for protecting and restoring the Great Lakes and evaluates the environmental policies and actions implemented by the United States and Canada.

The EPA Great Lakes National Program Office (GLNPO) coordinates Great Lakes management activities conducted by all levels of government within the United States. The GLNPO also works with nongovernmental organizations to protect and restore the Lakes. The GLNPO provides leadership through its annual Great Lakes Program Priorities and Funding Guidance. The GLNPO also serves as a liaison to the Canadian members of the IJC and the Canadian environmental agencies.

The 1978 Great Lakes Water Quality Agreement (as amended in 1987) lay the foundation for ongoing efforts to restore and protect the Great Lakes. The Agreement committed the United States and Canada to developing Remedial Action Plans (RAPs) for Areas of Concern and Lakewide Management Plans (LaMPs) for each Lake. Areas of Concern are specially designated waterbodies around the Great Lakes that show symptoms of serious water quality degradation. Most of the 42 Areas of Concern are located in harbors, bays, or river mouths entering the Great Lakes. RAPs identify impaired uses and examine management options for addressing degradation in an Area of Concern. LaMPs use an ecosystem approach to examine water quality issues that have more widespread impacts within each Great Lake. Public involvement is a critical component of both LaMP development and RAP development.

EPA advocates pollution prevention as the most effective approach for achieving the virtual elimination of persistent toxic discharges into the Great Lakes. The GLNPO has funded numerous pollution prevention grants throughout the Great Lakes Basin during the past 3 years. EPA and the States also implemented the 38/50 Program in the Great Lakes Basin, under which EPA received voluntary commitments from industry to reduce the emission of 17 priority pollutants by 50% by the end of 1995. In addition, EPA, the States, and Canada are implementing a virtual elimination initiative for Lake Superior. The first phase of the initiative seeks to eliminate new contributions of mercury.



Julie Fountain, Youngsville, NC

The Great Lakes Water Quality Initiative is a key element of the environmental protection efforts undertaken by the United States in the Great Lakes Basin. The purpose of the Initiative is to provide a consistent level of protection in the Basin from the effects of toxic pollutants. In 1989, the Initiative was organized by EPA at the request of the Great Lakes States to promote consistency in their environmental programs in the Great Lakes Basin with minimum requirements.

Initiative efforts were well under way when Congress enacted the Great Lakes Critical Programs Act of 1990. The Act requires EPA to publish proposed and final water quality guidance that specifies minimum water quality criteria for the Great Lakes System. The Act also requires the Great Lakes States to adopt provisions that are consistent with the EPA final guidance within 2 years of EPA's publication. In addition, Indian Tribes authorized to administer an NPDES program in the Great Lakes Basin must also adopt provisions consistent with EPA's final guidance.

To carry out the Act, EPA proposed regulations for implementing the guidance on April 16, 1993, and invited the public to comment. The States and EPA conducted public meetings in all of the Great Lakes States during the comment period. As a result, EPA received over 26,500 pages of comments from over 6,000 commenters. EPA reviewed all of the comments and published the final guidance in March of 1995.

The final guidance prioritizes control of long-lasting pollutants that accumulate in the food web—bioaccumulative chemicals of concern (BCCs). The final guidance includes provisions to phase out mixing zones for BCCs (except in limited circumstances), more extensive data requirements to ensure that BCCs are not underregulated due to a lack of data, and water quality criteria to protect wildlife that feed on aquatic prey. Publication of the final guidance is a milestone in EPA's move toward increasing stakeholder participation in the development of innovative and comprehensive programs for protecting and restoring our natural resources.

The Chesapeake Bay Program

In many areas of the Chesapeake Bay, the quality is not sufficient to support living resources year round. In the warmer months, large portions of the Bay contain little or no dissolved oxygen. Low oxygen conditions may cause fish eggs and larvae to die. The growth and reproduction of oysters, clams, and other bottom-dwelling animals are impaired. Adult fish find their habitat reduced and their feeding inhibited.

Many areas of the Bay also have cloudy water from excess sediment in the water or an overgrowth of algae (stimulated by excessive nutrients in the water). Turbid waters block the sunlight needed to support the growth and survival of Bay grasses, also known as submerged aquatic vegetation (SAV). Without SAV, critical habitat for fish and crabs is lost. Although there has been a recent resurgence of SAV in some areas of the Bay, most areas still do not support abundant populations as they once did.

The main causes of the Bay's poor water quality and aquatic habitat loss are elevated levels of the nutrients nitrogen and phosphorus. Both are natural fertilizers found in animal wastes, soil, and the atmosphere. These nutrients have always existed in the Bay, but not at the present elevated concentrations. When the Bay was surrounded primarily by forests and wetlands, very little nitrogen and phosphorus ran off the land into the water. Most of it was absorbed or held in place by the natural vegetation. As the use of the land has changed and the watershed's population has grown, the amount of nutrients entering the Bay has increased tremendously.

Now in its twelfth year, the Chesapeake Bay Program is a regional partnership of Federal, State, and local participants that has directed and coordinated restoration of the Bay since the signing of the historic 1983 Chesapeake Bay Agreement. Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, EPA, and advisory groups form the partnership. The Chesapeake Executive Council provides leadership for the Bay Program and establishes program policies to restore and protect the Bay and its living resources. The Council consists of the governors of Maryland, Virginia, and Pennsylvania, the mayor of the District of Columbia, the administrator of EPA, and the chairperson of the Chesapeake Bay Commission.

Considered a national and international model for estuarine restoration and protection programs, the Chesapeake Bay Program is still a "work in progress." Since 1983, milestones in the evolution of the program include the 1987 Chesapeake Bay Agreement and the 1992 amendments to the Agreement. The 1987 Agreement set a goal to reduce the quantity of nutrients entering the Bay by 40% by the year 2000. In the 1992 amendments to the Agreement, the partners reaffirmed the 40% nutrient reduction goal, agreed to cap nutrient loadings beyond the year 2000, and agreed to attack nutrients at their source by applying the 40% reduction goal to the 10 major tributaries of the Bay. The amendments also stressed managing the Bay as a whole ecosystem. The amendments also spell out the importance of reducing atmospheric sources of nutrients and broadening regional interstate cooperation.

Protection and restoration of forests is a critical component of the Chesapeake Bay Program because scientific data clearly show that forests are the most beneficial land cover for maintaining clean water, especially forests alongside waterbodies in the riparian zone. Through the Chesapeake Bay Program, unique partnerships have been formed among the Bay region's forestry agencies, forest managers, and interested citizen groups. Since 1990, the U.S. Forest Service has assigned a Forestry Program Coordinator to the Chesapeake Bay Program to assist both the EPA and Bay Program committees in developing strategies and projects that will contribute to the Bay restoration goals. A Forestry Work Group, formed under the Nonpoint Source Subcommittee, raises and addresses issues related to forests and the practice of forestry in the watershed.

In addition, State foresters and local governments have developed and implemented numerous programs and projects aimed at the protection and restoration of forests. Forestry incentive programs in all of the Bay States have resulted in the planting of millions of trees, the restoration of nearly 50 miles of riparian forest, the development of stewardship plans, and forest enhancement projects on thousands of acres within the Bay watershed.

On the positive side, the extent of Bay grasses has increased by 75% since 1978. The current extent of SAV attains 64% of the goal established by the Chesapeake Bay Program. Striped bass, or rockfish, have made a remarkable recovery over the past decade due to improved reproduction and better control of the harvest. There has been a modest increase in the number of American shad returning to the Bay to spawn. Controls on the harvest of American shad, creation of fish passages at blockages, stocking programs, and habitat restoration are expected to yield increases in the American shad population and similar fish species that inhabit the Bay during part of their life cycle.

Phosphorus levels continue to decline and, after many years of increasing nitrogen concentrations, most of the Bay's tributaries are showing a leveling off of this trend. Some tributaries are showing declining trends in nitrogen concentrations. These trends indicate that both point and nonpoint source pollution abatement programs are working.

Despite the promising trends in nutrient concentrations, oxygen concentrations are still low enough to cause severe impacts or stressful conditions in the mainstem of the Bay and several larger tributaries. Prospects for the Bay's oyster populations remain poor. Overharvesting, habitat loss, and disease have severely depleted oyster stocks. New management efforts have been developed to improve this situation.

Chesapeake Bay Foundation, Richmond, VA

The blue crab is currently the most important commercial and recreational fishery in the Bay. There is growing concern about the health of the blue crab population due to increasing harvesting pressures and relatively low harvests in recent years. Both Maryland and Virginia have recently implemented new regulations on commercial and recreational crabbers to protect this important resource.

Overall, the Chesapeake Bay still shows symptoms of stress from an expanding population and changes in land use. However, conditions in the Chesapeake Bay have improved since the Chesapeake Bay Program was launched, and continuation of the Program promises an even brighter future for the Bay.

The Gulf of Mexico Program

The Gulf of Mexico Program (GMP) was established in 1988 with EPA as the lead Federal agency in response to signs of long-term environmental damage throughout the Gulf's coastal and marine ecosystem. The main purpose of the GMP is to develop and help implement a strategy to protect, restore, and maintain the health and productivity of the Gulf. The GMP is a grass roots program that serves as a catalyst to promote sharing of information, pooling of resources, and coordination of efforts to restore and reclaim wetlands and wildlife habitat, clean up existing pollution, and prevent future contamination and destruction of the Gulf. The GMP mobilizes State, Federal, and local government; business and industry;

academia; and the community at large through public awareness and information dissemination programs, forum discussions, citizen committees, and technology applications.

A Policy Review Board and the Management Committee determine the scope and focus of GMP activities. The program also receives input from a Technical Advisory Committee and a Citizen's Advisory Committee. The GMP Office, eight technical issue committees, and the operations and support committees coordinate the collection, integration, and reporting of pertinent data and information. The issue committees are composed of individuals from Federal, State, and local agencies and from industry, science, education, business, citizen groups, and private organizations.

The issue committees are responsible for documenting environmental problems and management goals, available resources, and potential solutions for a broad range of issues, including habitat degradation, public health, freshwater inflow, marine debris, shoreline erosion, nutrient enrichment, toxic pollutants, and living aquatic resources. The issue committees publish their findings in Action Agendas.

On December 10, 1992, the Governors of Alabama, Florida, Louisiana, Mississippi, and Texas; EPA; the Chair of the Citizen's Advisory Committee; and representatives of 10 other Federal agencies signed the Gulf of Mexico Program Partnership for Action agreement for protecting, restoring, and enhancing the Gulf of Mexico and adjacent lands. The agreement committed the signatory agencies to pledge their efforts, over 5 years, to obtain the knowledge and resources to:

- Significantly reduce the rate of loss of coastal wetlands
- Achieve an increase in Gulf Coast seagrass beds
- Enhance the sustainability of Gulf commercial and recreational fisheries
- Protect human health and food supply by reducing input of nutrients, toxic substances, and pathogens to the Gulf
- Increase Gulf shellfish beds available for safe harvesting by 10%
- Ensure that all Gulf beaches are safe for swimming and recreational uses
- Reduce by at least 10% the amount of trash on beaches
- Improve and expand coastal habitats that support migratory birds, fish, and other living resources
- Expand public education/outreach tailored for each Gulf Coast county or parish
- Reduce critical coastal and shoreline erosion.

Beginning in 1992, the GMP also launched Take-Action Projects in each of the five Gulf States to demonstrate that program strategies and methods could achieve rapid results. The Take-Action Projects primarily address inadequate sewage treatment, pollution prevention, and habitat protection and restoration. Several projects aim to demonstrate the effectiveness of innovative sewage treatment technologies to control pathogenic contamination of shellfish harvesting areas. Other projects aim to restore wetlands, sea grass beds, and oyster reefs. The Take-Action Projects are designed to have Gulf-wide application.

Take-Action Projects in the five Gulf States primarily address sewage treatment, pollution prevention, and habitat protection and restoration.

Since 1992, EPA has streamlined and restructured its management scheme for the GMP to increase Regional involvement and better meet the needs of the 5-year environmental challenges. The GMP has also expanded efforts to integrate Mexico and the Caribbean Islands into management of the Gulf. These activities include technology transfer and development of international agreements that prohibit the discharge of ship-generated wastes and plastics into waters of the Gulf and Caribbean Sea.

Jeff Reynolds, Raleigh, NC

Ground Water Protection Programs

The sage adage that "An ounce of prevention is worth a pound of cure" is being borne out in the field of ground water protection. Studies evaluating the cost of prevention versus the cost of cleaning up contaminated ground water have found that there are real cost advantages to promoting protection of our Nation's ground water resources.

Numerous laws, regulations, and programs play a vital role in protecting ground water. The following Federal laws and programs enable, or provide incentives for, EPA and/or States to regulate or voluntarily manage and monitor sources of ground water pollution:

- The Resource Conservation and Recovery Act (RCRA) addresses the problem of safe disposal of the huge volumes of solid and hazardous waste generated nationwide each year. RCRA is part of EPA's comprehensive program to protect ground water resources through the development of regulations and methods for handling, storing, and disposing of hazardous material and through the regulation of underground storage tanks—the most frequently cited source of ground water contamination.

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulates the restoration of contaminated ground water at abandoned hazardous waste sites.

- The Safe Drinking Water Act (SDWA) regulates subsurface injection of fluids that can contaminate ground water.

- The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) controls the use and disposal of pesticides, some of which have been detected in ground water wells in rural communities.

- The Toxic Substances Control Act (TSCA) controls the use and disposal of additional toxic substances, thereby minimizing their entry into ground water. Other Federal laws establish State grants that may be used to protect ground water.

- Clean Water Act Sections 319(h) and (i) and 518 provide funds to State agencies to implement EPA-approved nonpoint source management programs that include ground water protection activities. Several States have developed programs that focus on ground water contamination resulting from agriculture and septic tanks.

Comprehensive State Ground Water Protection Programs

A Comprehensive State Ground Water Protection Program (CSGWPP) is composed of six "strategic activities." They are:

- Establishing a prevention-oriented goal
- Establishing priorities, based on the characterization of the resource and identification of sources of contamination
- Defining roles, responsibilities, resources, and coordinating mechanisms
- Implementing all necessary efforts to accomplish the State's ground water protection goal
- Coordinating information collection and management to measure progress and reevaluate priorities
- Improving public education and participation.

■ The Pollution Prevention Act of 1990 allows grants for research projects to demonstrate agricultural practices that emphasize ground water protection and reduce the excessive use of fertilizers and pesticides.

Comprehensive State Ground Water Protection Programs (CSGWPPs) attempt to combine all of the above efforts and emphasize contamination prevention.

Comprehensive State ground water protection programs support State-directed priorities in resource protection.

John Theilgard, Bynum, NC

CSGWPPs improve coordination of Federal, State, Tribal, and local ground water programs and enable distribution of resources to established priorities.

Another means of protecting our Nation's ground water resources is through the implementation of Wellhead Protection Plans. EPA's Office of Ground Water and Drinking Water is supporting the development and implementation of Wellhead Protection Plans at the local level through many efforts. For example, EPA-funded support is provided through the National Rural Water Association Ground Water/Wellhead Protection programs. At the conclusion of the first 4 years of this program, over 2,000 communities in 26 States were actively involved in protecting their water supplies by implementing wellhead protection programs. These 2,000 communities represent almost 4 million people in the rural areas of the United States who will have better-protected water supplies.

Recognizing the importance and cost-effectiveness of protecting our Nation's ground water resources, States are participating in numerous activities to prevent future impairments of the resource. These activities include enacting legislation aimed at the development of comprehensive State ground water protection programs and promulgating protection regulations. More than 80% of the States indicate that they have current or pending legislation geared specifically to ground water protection. Generally, State legislation focuses on the need for program development, increased data collection, and public education programs. In addition, States also may mandate strict technical controls such as discharge permits, underground storage tank registrations, and protection standards.

All of these programs are intended to provide protection to a valuable, and often vulnerable, resource. Through the promotion of ground water protection on both State and Federal levels, our Nation's ground water resources will be safeguarded against contamination, thereby protecting human health and the environment.

What You Can Do

Federal and State programs have helped clean up many waters and slow the degradation of others. But government alone cannot solve the entire problem, and water quality concerns persist. Nonpoint source pollution, in particular, is everybody's problem, and everybody needs to solve it.

Examine your everyday activities and think about how you are contributing to the pollution problem. Here are some suggestions on how you can make a difference.

Be Informed

You should learn about water quality issues that affect the communities in which you live and work. Become familiar with your local water resources. Where does your drinking water come from? What activities in your area might affect the water you drink or the rivers, lakes, beaches, or wetlands you use for recreation?

Learn about procedures for disposing of harmful household wastes so they do not end up in sewage treatment plants that cannot handle them or in landfills not designed to receive hazardous materials.

Be Responsible

In your yard, determine whether additional nutrients are needed before you apply fertilizers, and look for alternatives where fertilizers might run off into surface waters. Consider selecting plants and grasses that have low maintenance requirements. Water your lawn conservatively. Preserve existing trees and plant new trees and shrubs to help prevent erosion and promote infiltration of water into the soil. Restore bare patches in your lawn to prevent erosion. If you own or manage land through which a stream flows, you may wish to consult your local county extension office about methods of restoring stream banks in your area by planting buffer strips of native vegetation.


John Theilgard, Bynum, NC

Around your house, keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Use the minimum amount of water needed when you wash your car. Never dispose of any household, automotive, or gardening wastes in a storm drain. Keep your septic tank in good working order.

Within your home, fix any dripping faucets or leaky pipes and install water-saving devices in shower heads and toilets. Always follow directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal sites such as approved service stations or designated landfills.

Be Involved

As a citizen and a voter there is much you can do at the community level to help preserve and protect our Nation's water resources. Look around. Is soil erosion being controlled at construction sites? Is the community sewage plant being operated efficiently and correctly? Is the community trash dump in or along a stream? Is road deicing salt being stored properly?

Become involved in your community election processes. Listen and respond to candidates' views on water quality and environmental issues. Many communities have recycling programs; find out about them, learn how to recycle, and volunteer to help out if you can. One of the most important things you can do is find out how your community protects water quality, and speak out if you see problems.

Volunteer Monitoring: You Can Become Part of the Solution

In many areas of the country, citizens are becoming personally involved in monitoring the quality of our Nation's water. As a volunteer monitor, you might be involved in taking ongoing water quality measurements, tracking the progress of protection and restoration projects, or reporting special events, such as fish kills and storm damage.

Volunteer monitoring can be of great benefit to State and local governments. Some States stretch their monitoring budgets by using data collected by volunteers, particularly in remote areas that otherwise might not be monitored at all. Because you are familiar with the water resources in your own neighborhood, you are also more likely to spot unusual occurrences such as fish kills.

The benefits to you of becoming a volunteer are also great. You will learn about your local water resources and have the opportunity to become personally involved in a nationwide campaign to protect a vital, and mutually shared, resource. If you would like to find out more about organizing or joining volunteer monitoring programs in your State, contact your State department of environmental quality, or write to:

Alice Mayio
Volunteer Monitoring
  Coordinator
U.S. EPA (4503F)
401 M St. SW
Washington, DC 20460
(202) 260-7018

For further information on water quality in your State or other jurisdiction, contact your Section 305(b) coordinator listed in Section III. Additional water quality information may be obtained from the Regional offices of the U.S. Environmental Protection Agency (see inside back cover).

Jimmy Crawford, Raleigh, NC

For Further Reading

Volunteer Monitoring. EPA-800-F-93-008. September 1993. A brief fact sheet about volunteer monitoring, including examples of how volunteers have improved the environment.

Starting Out in Volunteer Water Monitoring. EPA-841-B-92-002. August 1992. A brief fact sheet about how to become involved in volunteer monitoring.

National Directory of Citizen Volunteer Environmental Monitoring Programs, Fourth Edition. EPA-841-B-94-001. January 1994. Contains information about 519 volunteer monitoring programs across the Nation.

Volunteer Stream Monitoring: A Methods Manual. EPA-841-D-95-001. 1995. Presents information and methods for volunteer monitoring of streams.

Volunteer Estuary Monitoring: A Methods Manual. EPA-842-B-93-004. December 1993. Presents information and methods for volunteer monitoring of estuarine waters.

Volunteer Lake Monitoring: A Methods Manual. EPA-440/4-91-002. December 1991. Discusses lake water quality issues and methods for volunteer monitoring of lakes.

Many of these publications can also be accessed through EPA's Water Channel on the Internet. From the World Wide Web or Gopher, enter **http://www.epa.gov/OWOW** to enter WIN and locate documents.

Fish Consumption Advisories

States issue fish consumption advisories to protect the public from ingesting harmful quantities of toxic pollutants in contaminated fish and shellfish. Fish may accumulate dangerous quantities of pollutants in their tissues by ingesting many smaller organisms, each contaminated with a small quantity of pollutant. This process is called bioaccumulation or biomagnification. Pollutants also enter fish and shellfish tissues through the gills or skin.

Fish consumption advisories recommend that the public limit the quantity and frequency of consumption of fish caught in specific waterbodies. The States tailor individual advisories to minimize health risks based on contaminant data collected in their fish tissue sampling programs. Advisories may completely ban fish consumption in severely polluted waters, or limit fish consumption to several meals per month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, and nursing mothers), specific fish species, or larger fish that may have accumulated high concentrations of a pollutant over a longer lifetime than a smaller, younger fish.

The EPA fish consumption advisory database tracks advisories issued by each State. For 1994, the database listed 1,531 fish consumption advisories in effect in 49 States. Fish consumption advisories are unevenly distributed among the States because the States use their own criteria to determine if fish tissue concentrations of toxics pose a health risk that justifies an advisory. States also vary the amount of fish tissue monitoring they conduct and the number of pollutants analyzed. States that conduct more monitoring and use strict criteria will issue more advisories than States that conduct less monitoring and use weaker criteria. For example, 62% of the advisories active in 1994 were issued by the States surrounding the Great Lakes, which support extensive fish sampling programs and follow strict criteria for issuing advisories.

Chesapeake Bay Foundation, Richmond, VA

Most of the fish consumption advisories (73%) are due to mercury. The other pollutants most commonly detected in elevated concentrations in fish tissue samples are polychlorinated biphenyls (PCBs), chlordane, dioxins, and DDT (with its byproducts).

Many coastal States report restrictions on shellfish harvesting in estuarine waters. Shellfish–particularly oysters, clams, and mussels–are filter-feeders that extract their food from water. Waterborne bacteria and viruses may also accumulate on their gills and mantles and in their digestive systems. Shellfish contaminated by these microorganisms are a serious human health concern, particularly if consumed raw.

States currently sample water from shellfish harvesting areas to measure indicator bacteria, such as total coliform and fecal coliform bacteria. These bacteria serve as indicators of the presence of potentially pathogenic microorganisms associated with untreated or undertreated sewage. States restrict shellfish harvesting to areas that maintain these bacteria at concentrations in sea water below established health limits.

In 1994, 15 States reported that shellfish harvesting restrictions were in effect for more than 6,052 square miles of estuarine and coastal waters during the 1992-1994 reporting period. Six States reported that urban runoff and storm sewers, municipal wastewater treatment facilities, nonpoint sources, marinas, industrial discharges, CSOs, and septic tanks restricted shellfish harvesting.

Section I

National Summary of Water Quality Conditions

The Quality of Our Nation's Water

Introduction

The National Water Quality Inventory Report to Congress is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters.

The *National Water Quality Inventory Report to Congress* summarizes the water quality information submitted by 58 States, American Indian Tribes, Territories, Interstate Water Commissions, and the District of Columbia (hereafter referred to as States, Tribes, and other jurisdictions) in their 1996 water quality assessment reports. As such, the report identifies water quality issues of concern to the States, Tribes, and other jurisdictions, not just the issues of concern to the U.S. Environmental Protection Agency (EPA). Section 305(b) of the Clean Water Act (CWA) requires that the States and other participating jurisdictions submit water quality assessment reports every 2 years. Most of the survey information in the 1996 Section 305(b) reports is based on water quality information collected and evaluated by the States, Tribes, and other jurisdictions during 1994 and 1995.

Cliff Haac, Chapel Hill, NC

It is important to note that this report is based on information submitted by States, Tribes, and other jurisdictions that do not use identical survey methods and criteria to rate their water quality. The States, Tribes, and other jurisdictions favor flexibility in the 305(b) process to accommodate natural variability in their waters, but there is a trade-off between flexibility and consistency. Without known and consistent survey methods in place, EPA must use caution in comparing data or determining the accuracy of data submitted by different States and jurisdictions. Also, EPA must use caution when comparing water quality information submitted during different 305(b) reporting periods because States and other jurisdictions may modify their criteria or survey different waterbodies every 2 years.

For over 10 years, EPA has pursued a balance between flexibility and consistency in the Section 305(b) process. Recent actions by EPA, the States, Tribes, and other jurisdictions include implementing the recommendations of the National 305(b) Consistency Workgroup and the National Water Quality Monitoring Council. These actions will enable States and other jurisdictions to share data across political boundaries as they develop watershed protection strategies.

EPA recognizes that national initiatives alone cannot clean up our waters; water quality protection and restoration must happen at the local watershed level, in conjunction with State, Tribal, and Federal activities. Similarly, this document alone cannot provide the detailed information needed to manage water quality at all levels. This document should be used together with the individual Section 305(b) reports (see the inside back cover for information on obtaining the State and Tribal Section 305(b) reports), watershed management plans, and other local documents to develop integrated water quality management options.

Index of Watershed Indicators

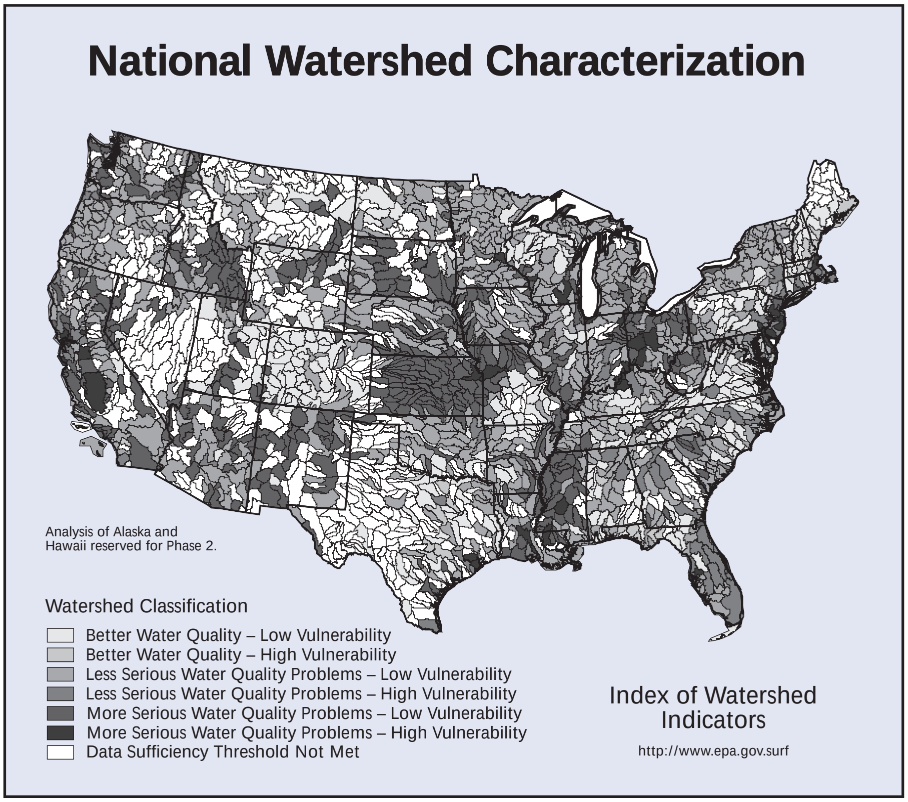
The Index of Watershed Indicators (IWI) is a compilation of information on the condition of aquatic resources in the United States. Using data from many sources, IWI maps 15 indicators on a watershed basis. Together these indicators point to whether these watersheds are "healthy" and whether activities on the surrounding lands are making these waters more vulnerable to pollution (see map).

While this new assessment tool is broader and more inclusive than the National Water Quality Inventory, State 305(b) assessment information is the most important data source in the IWI.

State 305(b) information is included as one of the 15 indicator maps in IWI as: Assessed Rivers Meeting All Designated Uses Set in State/Tribal Water Quality Standards. The IWI uses data compiled on a watershed basis from a number of national assessment programs from several EPA programs, from U.S. Department of Agriculture (USDA), National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), the Corps of Engineers, and the Nature Conservancy, and from the States, Tribes and other jurisdictions. Six other indicator maps show EPA's rating of the condition of watersheds; eight additional indicator maps show EPA's rating of the vulnerability of watersheds. Vulnerability factors include, for example, the rate of population growth, the potential of various forms of nonpoint source pollution, and compliance facility permits. Using this approach, the IWI characterizes nearly three-quarters of the 2,111 watersheds in the 48 contiguous States.

The IWI was released in October 1997 and is updated periodically. In October 1997, 16% of the watersheds had good water quality problems, 36% had moderate water quality problems, 21% had more serious problems, and sufficient data were lacking to fully characterize the remaining 27%. In addition, 1 in 14 watersheds in all areas was vulnerable to further degradation from pollution, primarily from urban and rural runoff.

The IWI enables managers and community residents to understand and help protect the watershed where they live. The information is easily available on the Internet at **http://www.epa.gov/surf/iwi**.



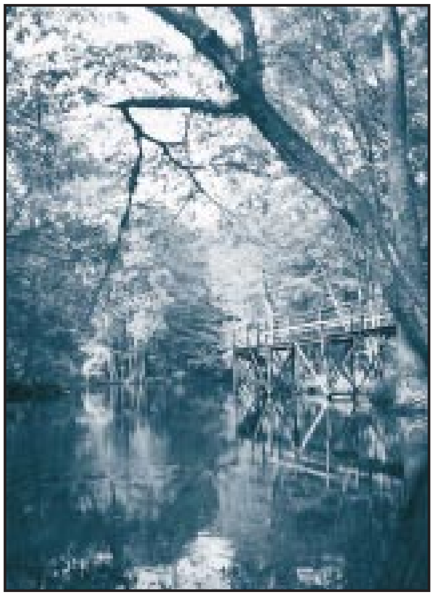
Key Concepts

Measuring Water Quality

The States, participating Tribes, and other jurisdictions survey the quality of their waters by determining if their waters attain the water quality standards they established. Water quality standards consist of beneficial uses, numeric and narrative criteria for supporting each use, and an antidegradation statement:

- **Designated beneficial uses** are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States, Tribes, and other jurisdictions may designate an individual waterbody for multiple beneficial uses.

- **Numeric water quality criteria** establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters such as flow, and minimum concentrations of desirable parameters such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.



Georgia Minnich, Durham, NC

- **Narrative water quality criteria** define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody. For example, "Aquatic life shall be as it naturally occurs," or "Ambient water quality shall be sufficient to support life stages of all indigenous aquatic species." Narrative criteria may also describe conditions that are desired in a waterbody, such as, "Waters must be free of substances that are toxic to humans, aquatic life, and wildlife."

- **Antidegradation statements**, where possible, protect existing uses and prevent waterbodies from deteriorating even if their water quality is better than the fishable and swimmable goals of the Act.

The CWA allows States, Tribes, and other jurisdictions to set their own standards but requires that all beneficial uses and their criteria comply with the goals of the Act. At a minimum, beneficial uses must provide for "the protection and propagation of fish, shellfish, and wildlife" and provide for "recreation in and on the water" (i.e., the fishable and swimmable goals of the Act), where attainable. The Act prohibits States and other jurisdictions from designating waste transport or waste assimilation as a beneficial use, as some States did prior to 1972.

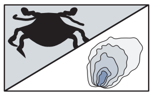
Section 305(b) of the CWA requires that the States biennially survey their water quality for attainment of the fishable and swimmable goals of the Act and report the results to EPA. The States, participating Tribes, and other jurisdictions measure attainment of the CWA goals by determining how well their waters support their designated beneficial uses. EPA encourages States, Tribes, and other jurisdictions to survey waterbodies for support of the following individual beneficial uses:

Aquatic Life Support

The waterbody provides suitable habitat for protection and propagation of desirable fish, shellfish, and other aquatic organisms.

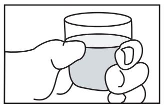
Fish Consumption

The waterbody supports fish free from contamination that could pose a human health risk to consumers.



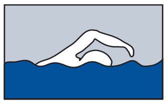
Shellfish Harvesting

The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.



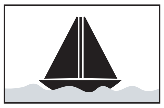
Drinking Water Supply

The waterbody can supply safe drinking water with conventional treatment.



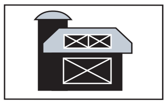
Primary Contact Recreation – Swimming

People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).



Secondary Contact Recreation

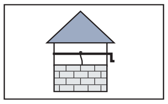
People can perform activities on the water (such as boating) without risk of adverse human health effects from ingestion or contact with the water.



Agriculture

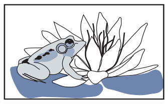
The water quality is suitable for irrigating fields or watering livestock.

States, Tribes, and other jurisdictions may also define their own individual uses to address special concerns. For example, many Tribes and States designate their waters for the following beneficial uses:



Ground Water Recharge

The surface waterbody plays a significant role in replenishing ground water, and surface water supply and quality are adequate to protect existing or potential uses of ground water.



Wildlife Habitat

Water quality supports the waterbody's role in providing habitat and resources for land-based wildlife as well as aquatic life.

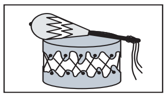
Tribes may designate their waters for special cultural and ceremonial uses:

Water Quality Monitoring

Water quality monitoring consists of data collection and sample analysis performed using accepted protocols and quality control procedures. Monitoring also includes subsequent analysis of the body of data to support decisionmaking. Federal, Interstate, State, Territorial, Tribal, Regional, and local agencies, industry, and volunteer groups with approved quality assurance programs monitor a combination of chemical, physical, and biological water quality parameters throughout the country.

- Chemical data often measure concentrations of pollutants and other chemical conditions that influence aquatic life, such as pH (i.e., acidity) and dissolved oxygen concentrations. The chemical data may be analyzed in water samples, fish tissue samples, or sediment samples.
- Physical data include measurements of temperature, turbidity (i.e., light penetration through the water column), and solids in the water column.
- Biological data measure the health of aquatic communities. Biological data include counts of aquatic species that indicate healthy ecological conditions.
- Habitat and ancillary data (such as land use data) help interpret the above monitoring information.

Monitoring agencies vary parameters, sampling frequency, and sampling site selection to meet program objectives and funding constraints. Sampling may occur at regular intervals (such as monthly, quarterly, or annually), irregular intervals, or during one-time intensive surveys. Sampling may be conducted at fixed sampling stations, randomly selected stations, stations near suspected water quality problems, or stations in pristine waters.

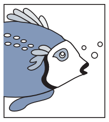


Culture

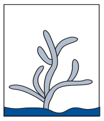
Water quality supports the waterbody's role in Tribal culture and preserves the waterbody's religious, ceremonial, or subsistence significance.

The States, Tribes, and other jurisdictions assign levels of use support to each of their waterbodies (Table 1). If possible, the States, Tribes, and other jurisdictions determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State, Tribe, or other jurisdiction may determine the level of use support with qualitative information. Valid qualitative information includes land use data, fish and game surveys, and predictive model results. **Monitored assessments** are based on recent monitoring data collected during the past 5 years. **Evaluated assessments** are based on qualitative information or monitored information more than 5 years old.

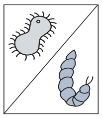
For waterbodies with more than one designated use, the States, Tribes, and other jurisdictions consolidate the individual use support information into a summary use support determination:



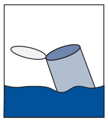
Good/Fully Supporting All Uses – All designated beneficial uses are fully supported.



Good/Threatened for One or More Uses – One or more designated beneficial uses are threatened and the remaining uses are fully supported.

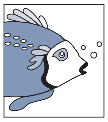
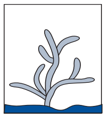
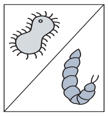
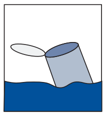


Impaired for One or More Uses – One or more designated beneficial uses are partially or not supported and the remaining uses are fully supported or threatened. These waterbodies are considered impaired.



Not Attainable – The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support of one or more designated beneficial uses is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations* (40 CFR Section 131.10). These conditions include naturally high concentrations of pollutants (such as metals); other natural physical features that create unsuitable

Table 1. Levels of Summary Use Support

Symbol	Use Support Level	Water Quality Condition	Definition
	**Fully Supporting All Uses**	Good	Water quality meets designated use criteria.
	**Threatened for One or More Uses**	Good	Water quality supports beneficial uses now but may not in the future unless action is taken.
	**Impaired for One or More Uses**	Impaired	Water quality fails to meet designated use criteria at times.
	**Not Attainable**	________	The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations*.

aquatic life habitat (such as inadequate substrate, riffles, or pools); low flows or water levels; dams and other hydrologic modifications that permanently alter waterbody characteristics; poor water quality resulting from human activities that cannot be reversed without causing further environmental degradation; and poor water quality that cannot be improved without imposing more stringent controls than those required in the CWA, which would result in widespread economic and social impacts.

- **Impaired Waters** – Waterbodies either partially supporting uses or not supporting uses.

The EPA then aggregates the use support information submitted by the States, Tribes, and other jurisdictions into a national assessment of the Nation's water quality.

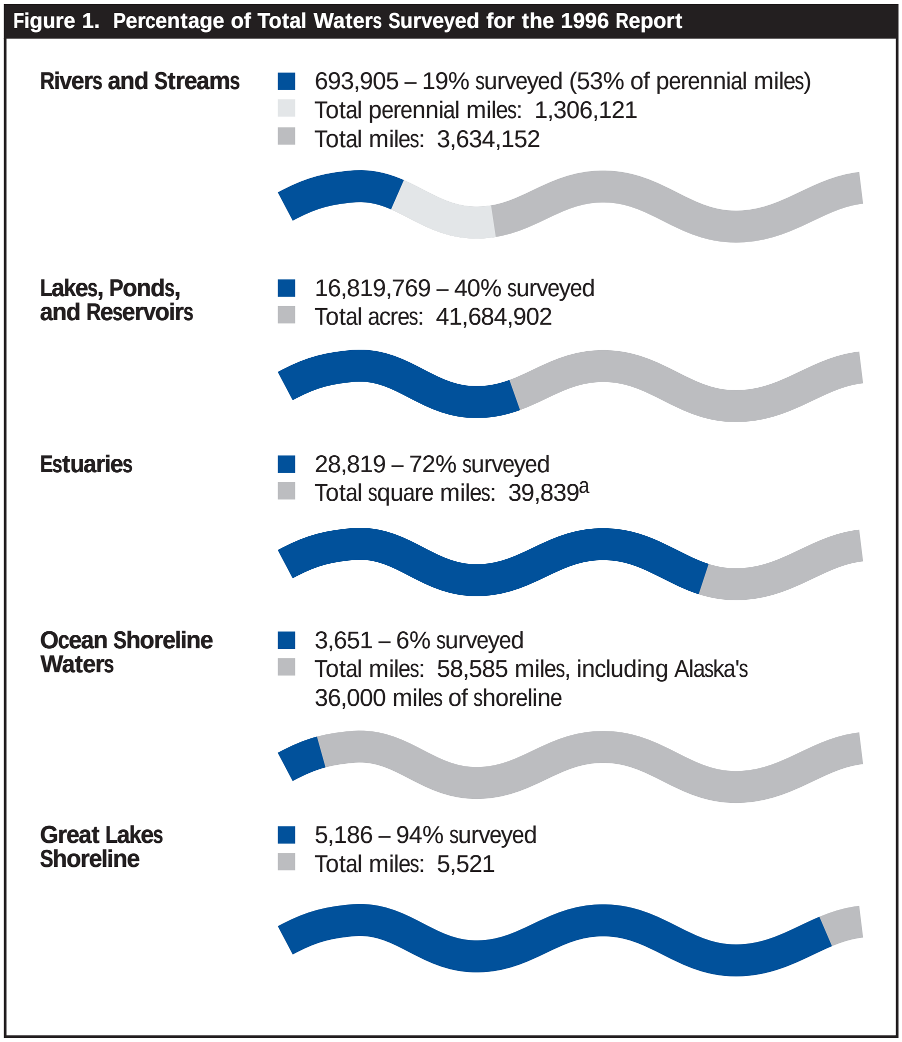
How Many of Our Waters Were Surveyed for 1996?

National estimates of the total waters of our country provide the foundation for determining the percentage of waters surveyed by the States, Tribes, and other jurisdictions and the portion impaired by pollution. For the 1992 reporting period, EPA provided the States with estimates of total river miles and lake acres derived from the EPA Reach File, a database containing traces of waterbodies adapted from 1:100,000 scale maps prepared by the U.S. Geological Survey. The States modified these total water estimates where necessary. Based on the 1992 EPA/State figures, the national estimate of total river miles doubled in large part because the EPA/State estimates included nonperennial streams, canals, and ditches that were previously excluded from estimates of total stream miles.

Estimates for the 1996 reporting cycle are a minor refinement of the 1992 figures and indicate that the United States has:

- More than 3.6 million miles of rivers and streams, which range in size from the Mississippi River to small streams that flow only when wet weather conditions exist (i.e., nonperennial streams)
- Approximately 41.7 million acres of lakes, ponds, and reservoirs
- About 39,839 square miles of estuaries (excluding Alaska)

Figure 1. Percentage of Total Waters Surveyed for the 1996 Report



Source: 1996 Section 305(b) reports submitted by the States, Tribes, Territories, and Commissions.

[a] Excluding estuarine waters in Alaska because no estimate was available.

- More than 58,000 miles of ocean shoreline, including 36,000 miles in Alaska
- 5,521 miles of Great Lakes shoreline
- More than 277 million acres of wetlands such as marshes, swamps, bogs, and fens, including 170 million acres of wetlands in Alaska.

Most States do not survey all of their waterbodies during the 2-year reporting cycle required under CWA Section 305(b). Thus, the surveyed waters reported in Figure 1 are a subset of the Nation's total waters. In addition, the summary information based on surveyed waters may not represent general conditions in the Nation's total waters because States, Tribes, and other jurisdictions often focus on surveying major perennial rivers, estuaries, and public lakes with suspected pollution problems in order to direct scarce resources to areas that could pose the greatest risk. Many States, Tribes, and other jurisdictions lack the resources to collect use support information for nonperennial streams, small tributaries, and private ponds. This report does not predict the health of these unassessed waters, which include an unknown ratio of pristine waters to polluted waters.

The National Water Quality Monitoring Council

In 1992, the Intergovernmental Task Force on Monitoring Water Quality (ITFM) convened to prepare a strategy for improving water quality monitoring nationwide. The ITFM was a Federal/State partnership of 10 Federal agencies, 9 State and Interstate agencies, and 1 American Indian Tribe. The EPA chaired the ITFM with the USGS as vice chair and Executive Secretariat as part of their Water Information Coordination Program pursuant to OMB memo 92-01.

The mission of the ITFM was to develop and aid implementation of a national strategic plan to achieve effective collection, interpretation, and presentation of water quality data and to improve the availability of existing information for decisionmaking at all levels of government and the private sector. A permanent successor to the ITFM, the National Monitoring Council provides guidelines and support for institutional collaboration, comparable field and laboratory methods, quality assurance/quality control, environmental indicators, data management and sharing, ancillary data, interpretation and techniques, and training.

The National Monitoring Council is also producing products that can be used by monitoring programs nationwide, such as an outline for a recommended monitoring program, environmental indicator selection criteria, and a matrix of indicators to support assessment of State and Tribal designated uses.

For a copy of the first, second, and final ITFM reports, contact:

The U.S. Geological Survey
417 National Center
Reston, VA 22092
1-800-426-9000

Pollutants and Processes That Degrade Water Quality

Where possible, States, Tribes, and other jurisdictions identify the pollutants or processes that degrade water quality and indicators that document impacts of water quality degradation. The most widespread pollutants and processes identified in rivers, lakes, and estuaries are presented in Table 2. Pollutants include sediment, nutrients, and chemical contaminants (such as dioxins and metals). Processes that degrade waters include habitat modification (such as destruction of streamside vegetation) and hydrologic modification (such as flow reduction). Indicators of water quality degradation include physical, chemical, and biological parameters. Examples of biological parameters include species diversity and abundance. Examples of physical and chemical parameters include pH, turbidity, and temperature. Following are descriptions of the effects of the pollutants and processes most commonly identified in rivers, lakes, estuaries, coastal waters, wetlands, and ground water.

Low Dissolved Oxygen

Dissolved oxygen is a basic requirement for a healthy aquatic ecosystem. Most fish and beneficial aquatic insects “breathe” oxygen dissolved in the water column. Some fish and aquatic organisms (such as carp and sludge worms) are adapted to low oxygen conditions, but most desirable fish species (such as trout and salmon) suffer if dissolved oxygen concentrations fall below 3 to 4 mg/L (3 to 4 milligrams of oxygen dissolved in 1 liter of water, or 3 to 4 parts of oxygen per million parts of water). Larvae and juvenile fish are more sensitive and require even higher concentrations of dissolved oxygen.

Many fish and other aquatic organisms can recover from short periods of low dissolved oxygen availability. However, prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/L or less can result in “dead”waterbodies. Prolonged exposure to low dissolved oxygen conditions can suffocate adult fish or reduce their reproductive survival by suffocating sensitive eggs and larvae or can starve fish by killing aquatic insect larvae and other prey. Low dissolved oxygen concentrations also favor anaerobic bacterial activity that produces noxious gases or foul odors often associated with polluted waterbodies.

Oxygen concentrations in the water column fluctuate under natural conditions, but severe oxygen depletion usually results from human activities that introduce large quantities of biodegradable organic materials into surface waters. Biodegradable organic materials contain plant, fish, or animal matter. Leaves, lawn clippings, sewage, manure, shellfish processing waste, milk solids, and other food processing wastes are examples of oxygen-depleting organic materials that enter our surface waters.

In both pristine and polluted waters, beneficial bacteria use oxygen to break apart (or decompose) organic materials. Pollution-containing organic wastes provide a continuous glut of food for the bacteria, which accelerates bacterial activity and population growth. In polluted waters, bacterial consumption of oxygen can rapidly outpace oxygen replenishment from the atmosphere and photosynthesis performed by algae and aquatic plants. The result is a net decline in oxygen concentrations in the water.

Toxic pollutants can indirectly lower oxygen concentrations by killing algae, aquatic weeds, or fish, which provides an abundance of food for oxygen-consuming bacteria. Oxygen depletion can also result from chemical reactions that do not involve bacteria. Some pollutants trigger chemical reactions that place a chemical oxygen demand on receiving waters.

Other factors (such as temperature and salinity) influence the amount of oxygen dissolved in water. Prolonged hot weather will depress oxygen concentrations and may cause fish kills even in clean waters because warm water cannot hold as much oxygen as cold water. Warm conditions further aggravate oxygen depletion by stimulating bacterial activity and respiration in fish, which consume oxygen. Removal of streamside vegetation eliminates shade, thereby raising water temperatures, and accelerates runoff of organic debris. Under such conditions, minor additions of pollution-containing organic materials can severely deplete oxygen.

Nutrients

Nutrients are essential building blocks for healthy aquatic communities, but excess nutrients (especially nitrogen and phosphorus compounds) overstimulate the growth of aquatic weeds and algae. Excessive growth of these organisms, in

Table 2. Five Leading Causes of Water Quality Impairment

Rank	Rivers	Lakes	Estuaries
1	Siltation	Nutrients	Nutrients
2	Nutrients	Metals	Bacteria
3	Bacteria	Siltation	Priority Toxic Organic Chemicals
4	Oxygen-Depleting Substances	Oxygen-Depleting Substances	Oxygen-Depleting Substances
5	Pesticides	Noxious Aquatic Plants	Oil and Grease

Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

turn, can clog navigable waters, interfere with swimming and boating, outcompete native submerged aquatic vegetation (SAV), and, with excessive decomposition, lead to oxygen depletion. Oxygen concentrations can fluctuate daily during algal blooms, rising during the day as algae perform photosynthesis, and falling at night as algae continue to respire, which consumes oxygen. Beneficial bacteria also consume oxygen as they decompose the abundant organic food supply in dying algae cells.

Lawn and crop fertilizers, sewage, manure, and detergents contain nitrogen and phosphorus, the nutrients most often responsible for water quality degradation. Rural areas are vulnerable to ground water contamination from nitrates (a compound containing nitrogen) found in fertilizer and manure. Very high concentrations of nitrate (>10 mg/L) in drinking water cause methemoglobinemia, or blue baby syndrome, an inability to fix oxygen in the blood.

Nutrients are difficult to control because lake and estuarine ecosystems recycle nutrients. Rather than leaving the ecosystem, the nutrients cycle among the water column, algae and plant tissues, and the bottom sediments. For example, algae may temporarily remove all the nitrogen from the water column, but the nutrients will return to the water column when the algae die and are decomposed by bacteria. Therefore, gradual inputs of nutrients tend to accumulate over time rather than leave the system.

Suzanne Unger, Chapel Hill, NC

Sedimentation and Siltation

In a water quality context, sedimentation usually refers to soil particles that enter the water column from eroding land. Sediment consists of particles of all sizes, including fine clay particles, silt, sand, and gravel. Water quality managers use the term “siltation” to describe the suspension and deposition of small sediment particles in waterbodies.

Sedimentation and siltation can severely alter aquatic communities. Sediment may clog and abrade fish gills, suffocate eggs and aquatic insect larvae on the bottom, and fill in the pore space between bottom cobbles where fish lay eggs. Suspended silt and sediment interfere with recreational activities and aesthetic enjoyment at waterbodies by reducing water clarity and filling in waterbodies. Sediment may also carry other pollutants into waterbodies. Nutrients and toxic chemicals may attach to sediment particles on land and ride the particles into surface waters where the pollutants may settle with the sediment or detach and become soluble in the water column.

Rain washes silt and other soil particles off of plowed fields, construction sites, logging sites, urban areas, and strip-mined lands into waterbodies. Eroding stream banks also deposit silt and sediment in waterbodies. Removal of vegetation on shore can accelerate streambank erosion.

Bacteria and Pathogens

Some waterborne bacteria, viruses, and protozoa cause human illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. These organisms may enter waters through a number of routes, including inadequately treated sewage, stormwater drains, septic systems, runoff from livestock pens, and sewage dumped overboard from recreational boats. Because it is impossible to test waters for every possible disease-causing organism, States and other jurisdictions usually measure indicator bacteria that are found in great numbers in the stomachs and intestines of warm-blooded animals and people. The presence of indicator bacteria suggests that the waterbody may be contaminated with untreated sewage and that other, more dangerous organisms may be present. The States, Tribes, and other jurisdictions use bacterial criteria to determine if waters are safe for recreation and shellfish harvesting.

Paul Kazyac, Maryland Department of Natural Resources

Toxic Organic Chemicals and Metals

Toxic organic chemicals are synthetic compounds that contain carbon, such as polychlorinated biphenyls (PCBs), dioxins, and the pesticide DDT. These synthesized compounds often persist and accumulate in the environment because they do not readily break down in natural ecosystems. Many of these compounds cause cancer in people and birth defects in other predators near the top of the food chain, such as birds and fish.

Metals occur naturally in the environment, but human activities (such as industrial processes and mining) have altered the distribution of metals in the environment. In most reported cases of metals contamination, high concentrations of metals appear in fish tissues rather than the water column because the metals accumulate in greater concentrations in predators near the top of the food chain.

pH

Acidity, the concentration of hydrogen ions, drives many chemical reactions in living organisms. The standard measure of acidity is pH, and a pH value of 7 represents a neutral condition. A low pH value (less than 5) indicates acidic conditions; a high pH (greater than 9) indicates alkaline conditions. Many biological processes, such as reproduction, cannot function in acidic or alkaline waters. Acidic conditions also aggravate toxic contamination problems because sediments release toxicants in acidic waters. Common sources of acidity include mine drainage, runoff from mine tailings, and atmospheric deposition.

Habitat Modification/ Hydrologic Modification

Habitat modifications include activities in the landscape, on shore, and in waterbodies that alter the physical structure of aquatic ecosystems and have adverse impacts on aquatic life. Examples of habitat modifications to streams include:

- Removal of streamside vegetation that stabilizes the shoreline and provides shade, which moderates instream temperatures

- Excavation of cobbles from a stream bed that provide nesting habitat for fish

- Stream burial

- Excessive suburban sprawl that alters the natural drainage patterns by increasing the intensity, magnitude, and energy of runoff waters.

Hydrologic modifications alter the flow of water. Examples of hydrologic modifications include channelization, dewatering, damming, and dredging.

Other pollutants include salts and oil and grease. Fresh waters may become unfit for aquatic life and some human uses when they become contaminated by salts. Sources of salinity include irrigation runoff, brine used in oil extraction, road deicing operations, and the intrusion of sea water into ground and surface waters in coastal areas. Crude oil and processed petroleum products may be spilled during extraction, processing, or transport or leaked from underground storage tanks.

Sources of Water Pollution

Sources of impairment generate the pollutants that violate use support criteria (Table 3). Point sources discharge pollutants directly into surface waters from a conveyance. Point sources include industrial facilities, municipal sewage treatment plants, and combined sewer overflows. Nonpoint sources deliver pollutants to surface waters from diffuse origins. Nonpoint sources include urban runoff, agricultural runoff, and atmospheric deposition of contaminants in air pollution. Habitat alterations, such as hydromodification, dredging, and streambank destabilization, can also degrade water quality.

Throughout this document, EPA rates the significance of causes and sources of pollution by the percentage of impaired waters impacted by each individual cause or source (obtained from the Section 305(b) reports submitted by the States, Tribes, and other jurisdictions). Note that the cause and source rankings do not describe the condition of all waters in the United States because the States identify the causes and sources degrading some of their impaired waters, which are a small subset of surveyed waters, which are a subset of the Nation's total waters. For example, the States identified sources degrading some of the 248,028 impaired river miles, which represent 36% of the surveyed river miles and only 7% of the Nation's total stream miles.

Table 3. Pollution Source Categories Used in This Report

Category	Examples
Industrial	Pulp and paper mills, chemical manufacturers, steel plants, metal process and product manufacturers, textile manufacturers, food processing plants
Municipal	Publicly owned sewage treatment plants that may receive indirect discharges from industrial facilities or businesses
Combined Sewer Overflows (CSOs)	Single facilities that treat both storm water and sanitary sewage, which may become overloaded during storm events and discharge untreated wastes into surface waters.
Storm Sewers/ Urban Runoff	Runoff from impervious surfaces including streets, parking lots, buildings, and other paved areas.
Agricultural	Crop production, pastures, rangeland, feedlots, animal operations
Silvicultural	Forest management, tree harvesting, logging road construction
Construction	Land development, road construction
Resource Extraction	Mining, petroleum drilling, runoff from mine tailing sites
Land Disposal	Leachate or discharge from septic tanks, landfills, and hazardous waste sites
Hydrologic Modification	Channelization, dredging, dam construction, flow regulation
Habitat Modification	Removal of riparian vegetation, streambank modification, drainage/filling of wetlands

"The term 'point source' means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture."

Clean Water Act, Section 502(14)

Table 4 lists the leading sources of impairment related to human activities as reported by States, Tribes, and other jurisdictions for their rivers, lakes, and estuaries. Other sources cited include removal of riparian vegetation, forestry activities, land disposal, petroleum extraction and processing activities, and construction. In addition to human activities, the States, Tribes, and other jurisdictions also reported impairments from natural sources. Natural sources refer to an assortment of water quality problems:

- Natural deposits of salts, gypsum, nutrients, and metals in soils that leach into surface and ground waters
- Warm weather and dry conditions that raise water temperatures, depress dissolved oxygen concentrations, and dry up shallow waterbodies
- Low-flow conditions and tannic acids from decaying leaves that lower pH and dissolved oxygen concentrations in swamps draining into streams.

With so many potential sources of pollution, it is difficult and expensive for States, Tribes, and other jurisdictions to identify specific sources responsible for water quality impairments. Many States and other jurisdictions lack funding for monitoring to identify all but the most apparent sources degrading waterbodies. Local management priorities may focus monitoring budgets on other water quality issues, such as identification of contaminated fish populations that pose a human health risk. Management priorities may also direct monitoring efforts to larger waterbodies and overlook sources impairing smaller waterbodies. As a result, the States, Tribes, and other jurisdictions do not associate every impacted waterbody with a source of impairment in their 305(b) reports, and the summary cause and source information presented in this report applies exclusively to a subset of the Nation's impaired waters.

Table 4. Five Leading Sources of Water Quality Impairment Related to Human Activities

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Industrial Discharges
2	Municipal Point Sources	Unspecified Nonpoint Sources	Urban Runoff/ Storm Sewers
3	Hydrologic Modification	Atmospheric Deposition	Municipal Point Sources
4	Habitat Modification	Urban Runoff/ Storm Sewers	Upstream Sources
5	Resource Extraction	Municipal Point Sources	Agriculture

Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

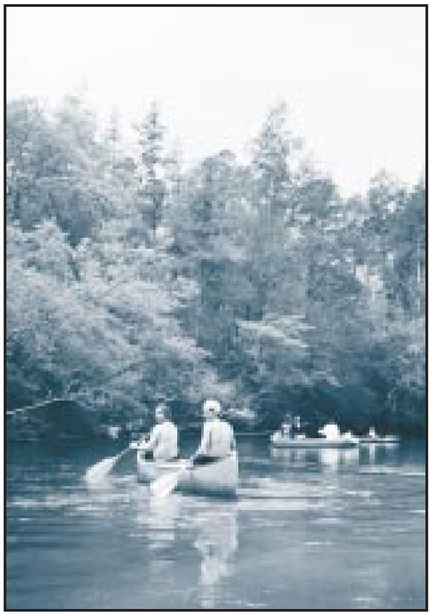
Rivers and Streams

Rivers and streams are characterized by flow. **Perennial** rivers and streams flow continuously, all year round. **Nonperennial** rivers and streams stop flowing for some period of time, usually due to dry conditions or upstream withdrawals. Many rivers and streams originate in nonperennial headwaters that flow only during snowmelt or heavy showers. Nonperennial streams provide critical habitats for nonfish species, such as amphibians and dragonflies, as well as safe havens for juvenile fish to escape from predation by larger fish.

The health of rivers and streams is directly linked to habitat integrity on shore and in adjacent wetlands. Stream quality will deteriorate if activities damage shoreline (i.e., riparian) vegetation and wetlands, which filter pollutants from runoff and bind soils. Removal of vegetation also eliminates shade that moderates stream temperature as well as the land temperature that can warm runoff entering surface waters. Stream temperature, in turn, affects the availability of dissolved oxygen in the water column for fish and other aquatic organisms.

Overall Water Quality

For the 1996 Report, 54 States, Territories, Tribes, Commissions, and the District of Columbia surveyed 693,905 miles (19%) of the Nation's total 3.6 million miles of rivers and streams (Figure 2). The surveyed rivers and streams represent 53% of the 1.3 million miles of perennial rivers and streams that flow year round in the lower 48 States.



Georgia Minnich, Durham, NC

Altogether, the States and Tribes surveyed 78,099 more river miles in 1996 than in 1994. Although most States surveyed about the same number of river miles in both reporting cycles, Illinois, Maryland, North Dakota, and Tennessee collectively account for an increase of over 75,000 surveyed river miles. Since 1994, Illinois, North Dakota, and Tennessee have refined their stream estimates, increasing the mileages associated with surveyed streams.

The following discussion applies exclusively to surveyed waters and cannot be extrapolated to describe conditions in the Nation's rivers as a whole because the States, Tribes, and other jurisdictions do not consistently use statistical or probabilistic survey methods to characterize all their waters at this time. EPA is working with the States, Tribes, and other jurisdictions to expand survey coverage of the Nation's waters and expects future survey information to cover a greater portion of the Nation's rivers and streams.

Figure 2. River Miles Surveyed

Total rivers = 3.6 million miles
Total surveyed = 693,905 miles

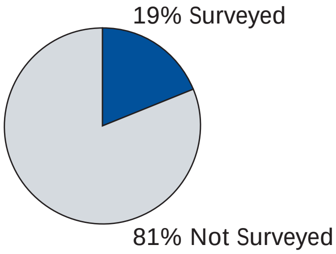
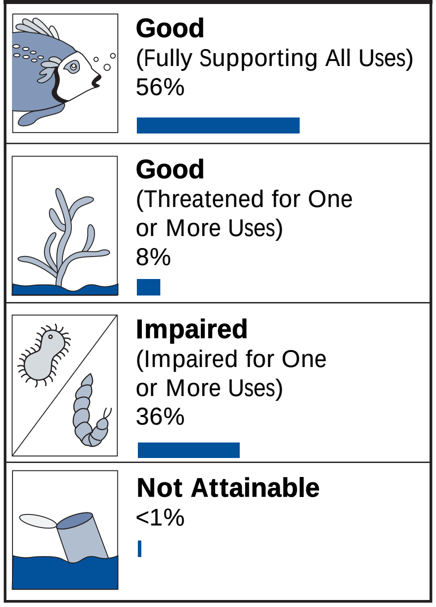


Figure 3. Levels of Overall Summary Support – Rivers



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Of the Nation's 693,905 surveyed river miles, the States, Tribes, and other jurisdictions found that 64% have good water quality. Of these waters, 56% fully support their designated uses, and an additional 8% support uses but are threatened and may become impaired if pollution control actions are not taken (Figure 3). Some form of pollution or habitat degradation prevents the remaining 36% (248,028 miles) of the surveyed river miles from fully supporting a healthy aquatic community or human activities all year round.

What Is Polluting Our Rivers and Streams?

The States and Tribes report that siltation, composed of tiny soil particles, remains one of the most widespread pollutants impacting rivers and streams, impairing 126,763 river miles (18% of surveyed river miles (Figure 4).

Siltation is the most widespread pollutant in rivers and streams, affecting 18% of the surveyed river miles.

Siltation alters aquatic habitat and suffocates fish eggs and bottom-dwelling organisms. Excessive siltation can also interfere with drinking water treatment processes and recreational use of a river.

In addition to siltation, the States and Tribes also reported that nutrients, bacteria, oxygen-depleting substances, habitat alterations, and metals impact more miles of rivers and streams than other pollutants and processes. Often, several pollutants and processes impact a single river segment. For example, a process, such as removal of shoreline vegetation, may accelerate erosion of sediment and nutrients into a stream.

Where Does This Pollution Come From?

The States and Tribes reported that agriculture is the most widespread source of pollution in the Nation's surveyed rivers (Figure 4). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 173,629 river miles (25% of the surveyed river miles) in 50 States and Tribes.

Twenty-four States reported the size of rivers impacted by specific types of agricultural activities:

- Nonirrigated Crop Production – crop production that relies on rain as the sole source of water.
- Irrigated Crop Production – crop production that uses irrigation systems to supplement rainwater.
- Rangeland – land grazed by animals that is seldom enhanced by the application of fertilizers or pesticides, although managers sometimes modify plant species to a limited extent.
- Pastureland – land upon which a crop (such as alfalfa) is raised to feed animals, either by grazing the animals among the crops or harvesting the crops.
- Feedlots – facilities where animals are fattened and confined at high densities.
- Animal Operations – generally livestock facilities other than large cattle feedlot operations.
- Animal Holding Areas – facilities where animals are confined briefly before slaughter.

The States reported that nonirrigated crop production impaired the most river miles, followed by irrigated crop production, rangeland, feedlots, pastureland, and animal operations.

Many States reported declines in pollution from sewage treatment plants and industrial discharges as a result of sewage treatment plant construction and upgrades and permit controls on industrial discharges. Despite the improvements, municipal sewage treatment plants remain the second most common source of pollution in rivers (impairing 35,087 miles) because population growth increases the burden on our municipal facilities.

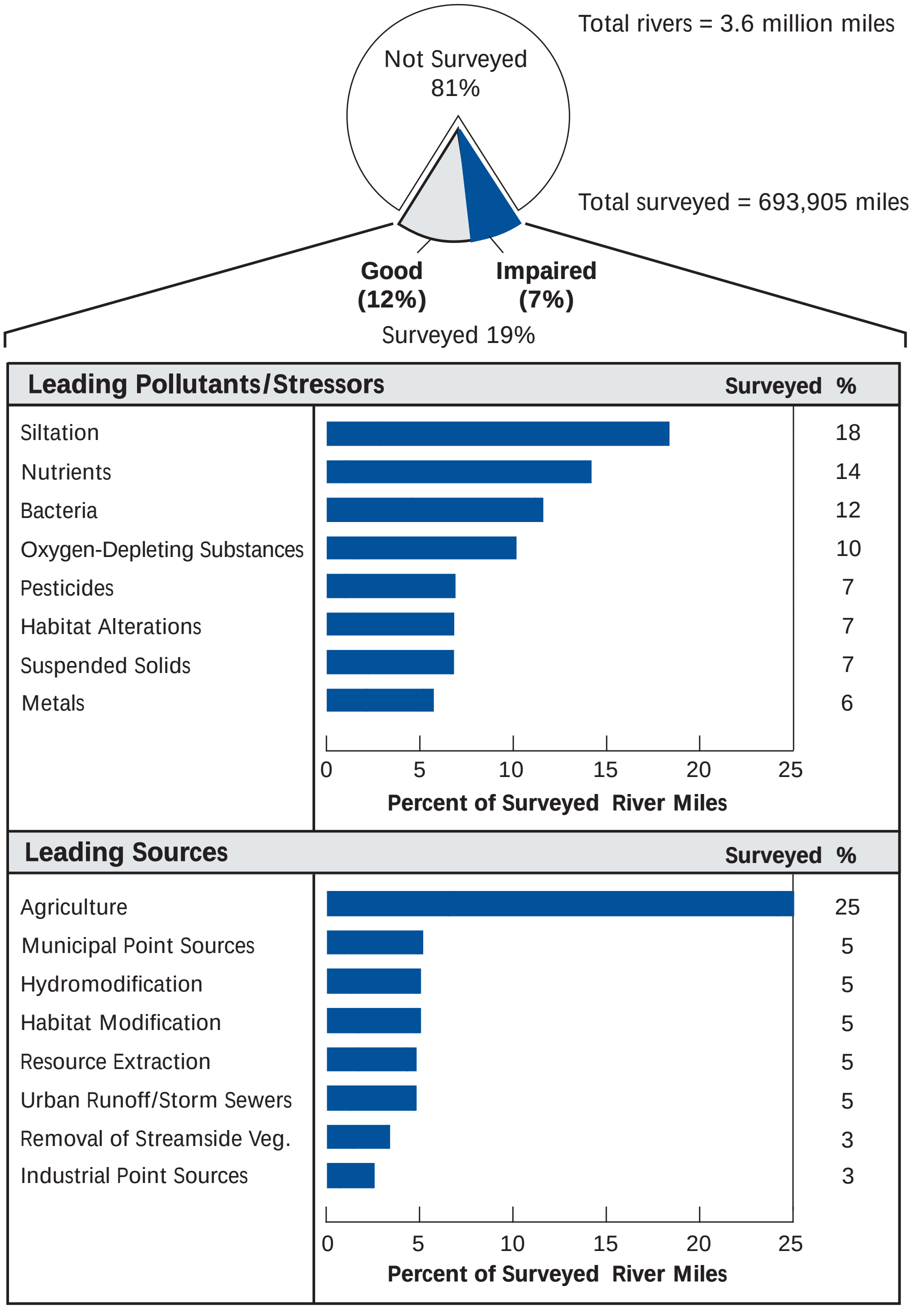
Agriculture is the leading source of impairment in the Nation's rivers, contributing to impairment of 25% of the surveyed river miles.

Hydrologic modifications and habitat alterations are a growing concern to the States. Hydrologic modifications include activities that alter the flow of water in a stream, such as channelization, dewatering, and damming of streams. Habitat alterations include removal of streamside vegetation that protects the stream from high temperatures and scouring of stream bottoms. Additional gains in water quality conditions will be more subtle and require innovative management strategies that go beyond point source controls.

The States, Tribes, and other jurisdictions also reported that resource extraction impairs 33,051 river miles (5% of the surveyed rivers), and urban runoff and storm sewers impair 32,637 river miles (5% of the surveyed rivers).

The States, Tribes, and other jurisdictions also report that "natural" sources impair significant stretches of rivers and streams. "Natural" sources, such as low flow and soils with arsenic deposits, can prevent waters from supporting uses in the absence of human activities.

Figure 4. Surveyed River Miles: Pollutants and Sources



Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a river segment.

Lakes, Ponds, and Reservoirs

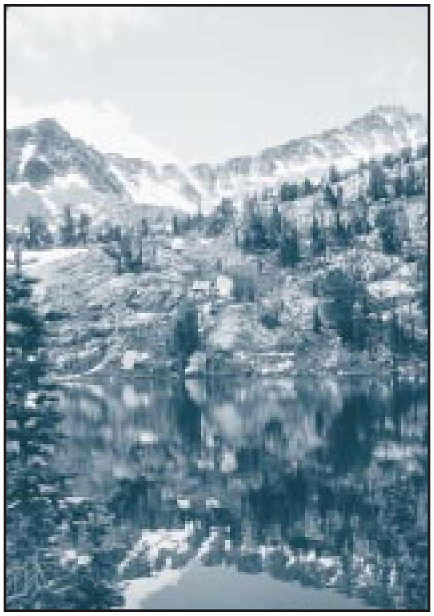
Lakes are sensitive to pollution inputs because lakes flush out their contents relatively slowly. Even under natural conditions, lakes undergo eutrophication, an aging process that slowly fills in the lake with sediment and organic matter (see sidebar on next page). The eutrophication process alters basic lake characteristics such as depth, biological productivity, oxygen levels, and water clarity. Eutrophication is commonly defined by a series of trophic states as described in the sidebar.

Overall Water Quality

Forty-five States, Tribes, and other jurisdictions surveyed overall use support in more than 16.8 million lake acres representing 40% of the approximately 41.7 million total acres of lakes, ponds, and reservoirs in the Nation (Figure 5). For 1996, the States surveyed about 300,000 fewer lake acres than in 1994.

The number of surveyed lake acres declined because several States faced funding constraints that limited the number of lakes sampled.

The States and Tribes reported that 61% of their surveyed 16.8 million lake acres have good water quality. Waters with good quality include 51% of the surveyed lake acres fully supporting uses and 10% of the surveyed lake acres that are threatened and might deteriorate if we fail to manage potential sources of pollution (Figure 6). Some form of pollution or habitat degradation impairs the remaining 39% of the surveyed lake acres.



Greg Despopoulos, Raleigh, NC

What Is Polluting Our Lakes, Ponds, and Reservoirs?

Forty-one States, the District of Columbia, and Puerto Rico reported the number of lake acres impacted by individual pollutants and processes.

The States and Puerto Rico identified more lake acres polluted by nutrients and metals than other pollutants or processes (Figure 7). The States and Puerto Rico reported that metals and extra nutrients pollute 3.3 million lake acres (51% of the impaired lake acres). Healthy lake ecosystems contain nutrients in small quantities, but extra inputs of nutrients from human activities unbalance lake ecosystems. States consistently report metals as a major cause of impairment to lakes. This is mainly

Figure 5. Lake Acres Surveyed

Total lakes = 41.7 million acres
Total surveyed = 16.8 million acres

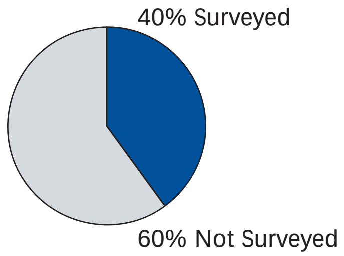
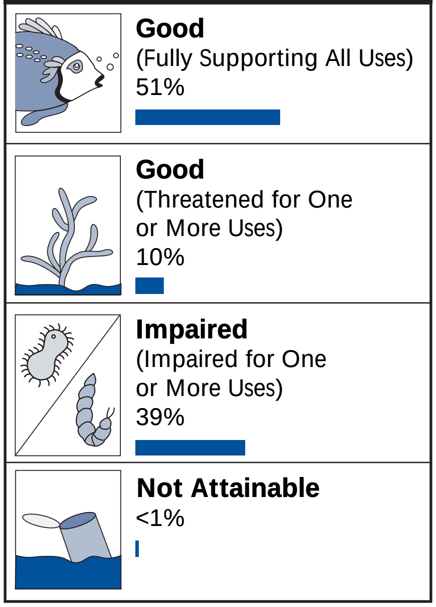


Figure 6. Levels of Summary Use Support – Lakes



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

due to the widespread detection of mercury in fish tissue samples. States are actively studying the extent of the mercury problem, which is complex because it involves transport from power-generating facilities and other sources.

In addition to nutrients and metals, the States, Puerto Rico, and the District of Columbia report that siltation pollutes 1.6 million lake acres (10% of the surveyed lake acres), enrichment by organic wastes that deplete oxygen impacts 1.4 million lake acres (8% of the surveyed lake acres), and noxious aquatic plants impact 1.0 million acres (6% of the surveyed lake acres).

States reported more impairments due to metals and nutrients than other pollutants.

Thirty-seven States also surveyed trophic status, which is associated with nutrient enrichment, in 8,951 of their lakes. Nutrient enrichment tends to increase the proportion of lakes in the eutrophic and hypereutrophic categories. These States reported that 16% of the lakes they surveyed for trophic status were oligotrophic, 38% were

Trophic States

Oligotrophic	Clear waters with little organic matter or sediment and minimum biological activity.
Mesotrophic	Waters with more nutrients and, therefore, more biological productivity.
Eutrophic	Waters extremely rich in nutrients, with high biological productivity. Some species may be choked out.
Hypereutrophic	Murky, highly productive waters, closest to the wetlands status. Many clearwater species cannot survive.
Dystrophic	Low in nutrients, highly colored with dissolved humic organic matter. (Not necessarily a part of the natural trophic progression.)

The Eutrophication Process

Eutrophication is a natural process, but human activities can accelerate eutrophication by increasing the rate at which nutrients and organic substances enter lakes from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded streambanks, and similar sources can enhance the flow of nutrients and organic substances into lakes. These substances can overstimulate the growth of algae and aquatic plants, creating conditions that interfere with the recreational use of lakes and the health and diversity of native fish, plant, and animal populations. Enhanced eutrophication from nutrient enrichment due to human activities is one of the leading problems facing our Nation’s lakes and reservoirs.

Acid Effects on Lakes

Increases in lake acidity can radically alter the community of fish and plant species in lakes and can increase the solubility of toxic substances and magnify their adverse effects. Eighteen States reported the results of lake acidification assessments. These States assessed pH (a measure of acidity) at 5,269 lakes and detected acidic conditions in 194 lakes and a threat of acidic conditions in 1,087 lakes. Most of the States that assessed acidic conditions are located in the Northeast, upper Midwest, and the South.

Only 13 States identified sources of acidic conditions. Maine and New Hampshire attributed most of their acid lake conditions to acid deposition from acidic rain, fog, or dry deposition in conjunction with natural conditions that limit a lake’s capacity to neutralize acids. Alabama, Kansas, Maryland, Oklahoma, Tennessee, and West Virginia reported that acid mine drainage resulted in acidic lake conditions or threatened lakes with the potential to generate acidic conditions.

mesotrophic, 36% were eutrophic, 9% were hypereutrophic, and less than 1% were dystrophic. This information may not be representative of national lake conditions because States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes—which are probably less impaired—are underrepresented in these assessments.

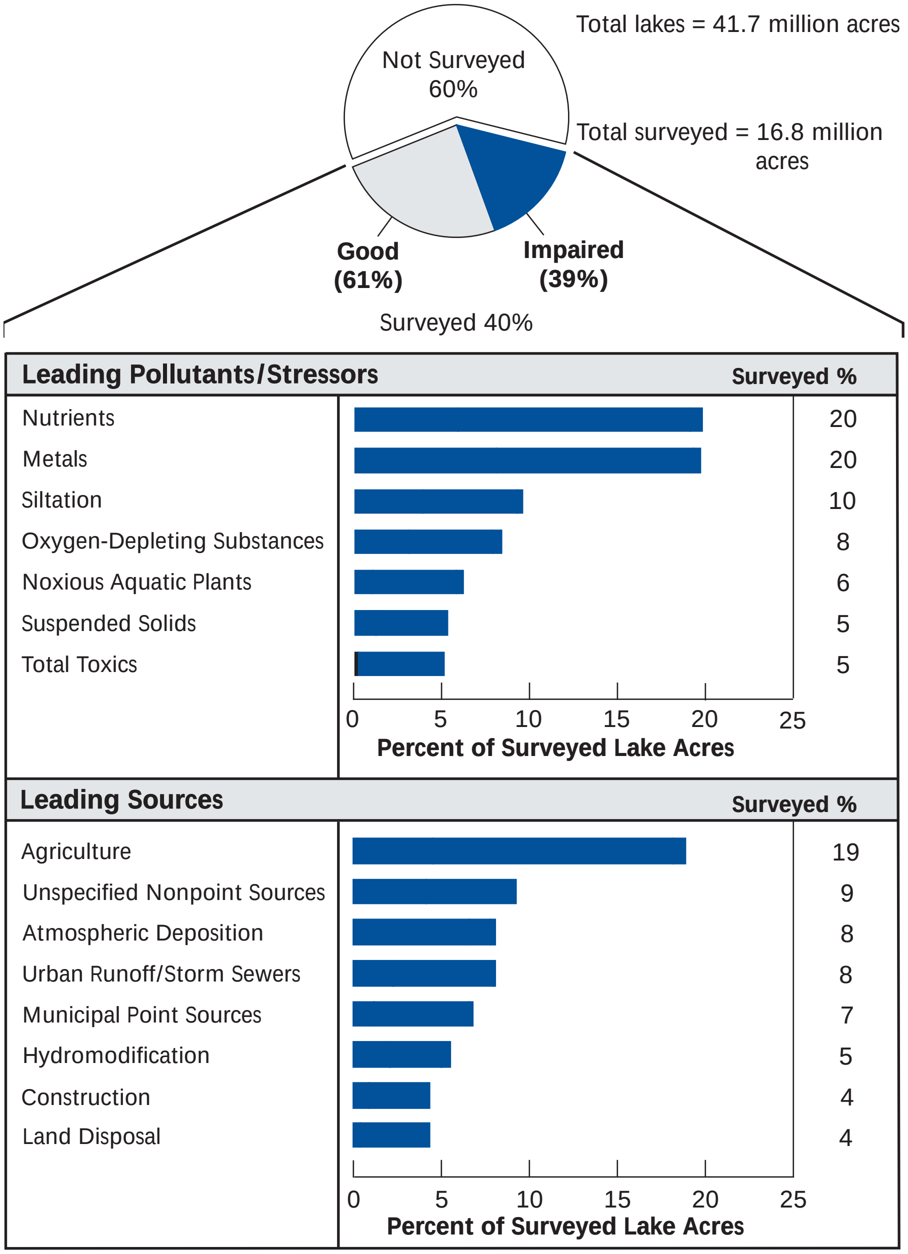
Where Does This Pollution Come From?

Forty-one States and Puerto Rico reported sources of pollution in some of their impacted lakes, ponds, and reservoirs. These States and Puerto Rico reported that agriculture is the most widespread source of pollution in the Nation's surveyed lakes (Figure 7). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 3.2 million lake acres (19% of the surveyed lake acres).

Agriculture is the leading source of impairment in lakes, affecting 19% of surveyed lake acres.

The States and Puerto Rico also reported that unspecified nonpoint sources pollute 1.6 million lake acres (9% of the surveyed lake acres), atmospheric deposition of pollutants impairs 1.4 million lake acres (8% of the surveyed lake acres), urban runoff and storm sewers pollute 1.4 million lake acres (8% of the surveyed lake acres), municipal

Figure 7. Surveyed Lake Acres: Pollutants and Sources



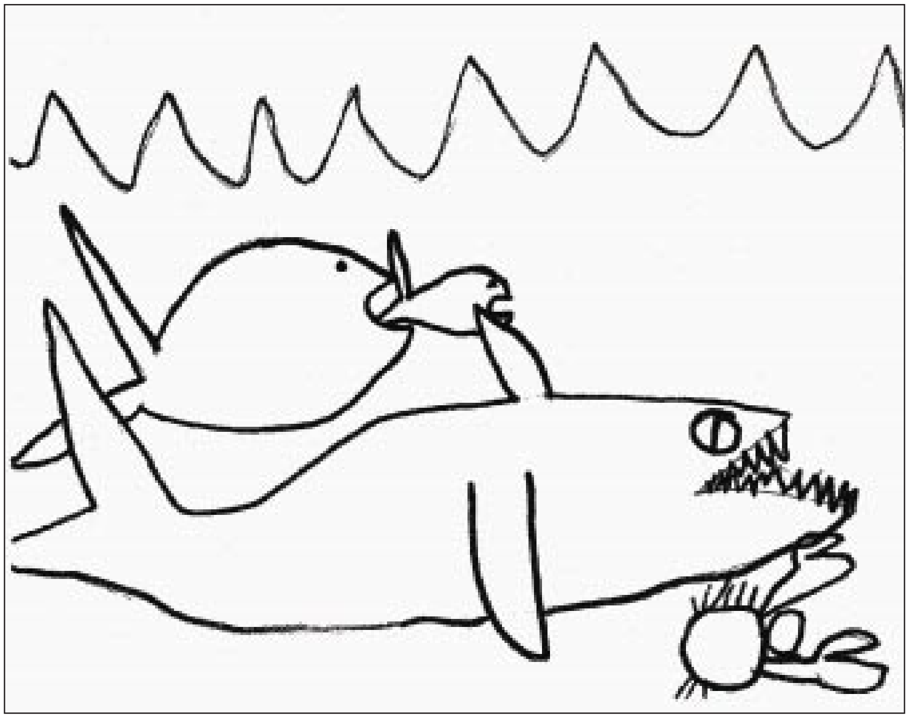
Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a lake.

sewage treatment plants pollute 1.2 million lake acres (7% of the surveyed lake acres), and hydrologic modifications degrade 924,000 lake acres (5% of the surveyed lake acres). Many more States reported lake degradation from atmospheric deposition in 1996 than in past reporting cycles. This is due, in part, to a growing awareness of the magnitude of the atmospheric deposition problem.

The States and Puerto Rico listed numerous sources that impact several hundred thousand lake acres, including land disposal of wastes, construction, industrial point sources, onsite wastewater systems (including septic tanks), forestry activities, habitat modification, flow regulation, contaminated sediments, highway maintenance and runoff, resource extraction, and combined sewer overflows.

Ed Carney, Kansas Department of Health and Environment



Sam Baskir, 1st grade, Estes Hills Elementary, Chapel Hill, NC

The Great Lakes

The Great Lakes contain one-fifth of the world's fresh surface water and are stressed by a wide range of pollution sources, including air pollution. Many of the pollutants that reach the Great Lakes remain in the system indefinitely because the Great Lakes are a relatively closed water system with few natural outlets. Despite dramatic declines in the occurrence of algal blooms, fish kills, and localized "dead" zones depleted of oxygen, less visible problems continue to degrade the Great Lakes.

Overall Water Quality

The States surveyed 94% of the Great Lakes shoreline miles for 1996 and reported that fish consumption advisories and aquatic life concerns are the dominant water quality problems, overall, in the Great Lakes (Figure 8). The States reported that most of the Great Lakes nearshore waters are safe for swimming and other recreational activities and can be used as a source of drinking water with normal treatment. However, only 2% of the surveyed nearshore waters fully support designated uses, and 1% support all uses but are threatened for one or more uses (Figure 9). About 97% of the surveyed waters do not fully support designated uses because fish consumption advisories are posted throughout the nearshore waters of the Great Lakes and water quality conditions are unfavorable for supporting aquatic life in many cases. Aquatic life impacts result from persistent toxic pollutant burdens in birds, habitat degradation and destruction, and competition

John Theilgard, Bynum, NC

Figure 8. Great Lakes Shore Miles Surveyed

Total Great Lakes = 5,521 miles
Total surveyed = 5,186 miles

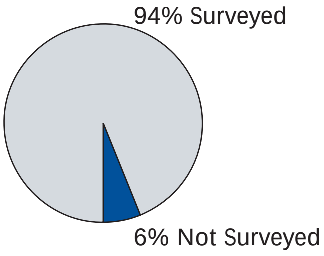
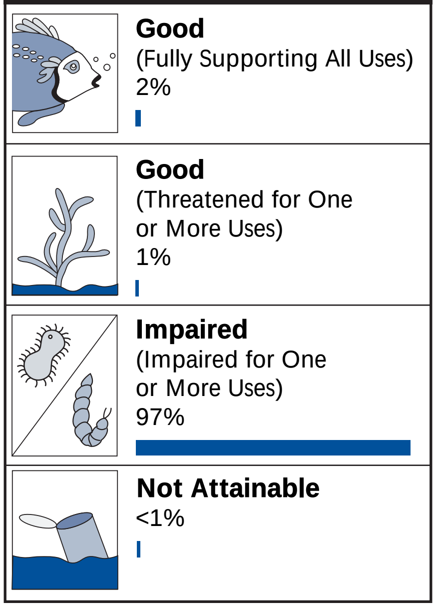


Figure 9. Levels of Summary Use Support – Great Lakes



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

and predation by nonnative species such as the zebra mussel and the sea lamprey.

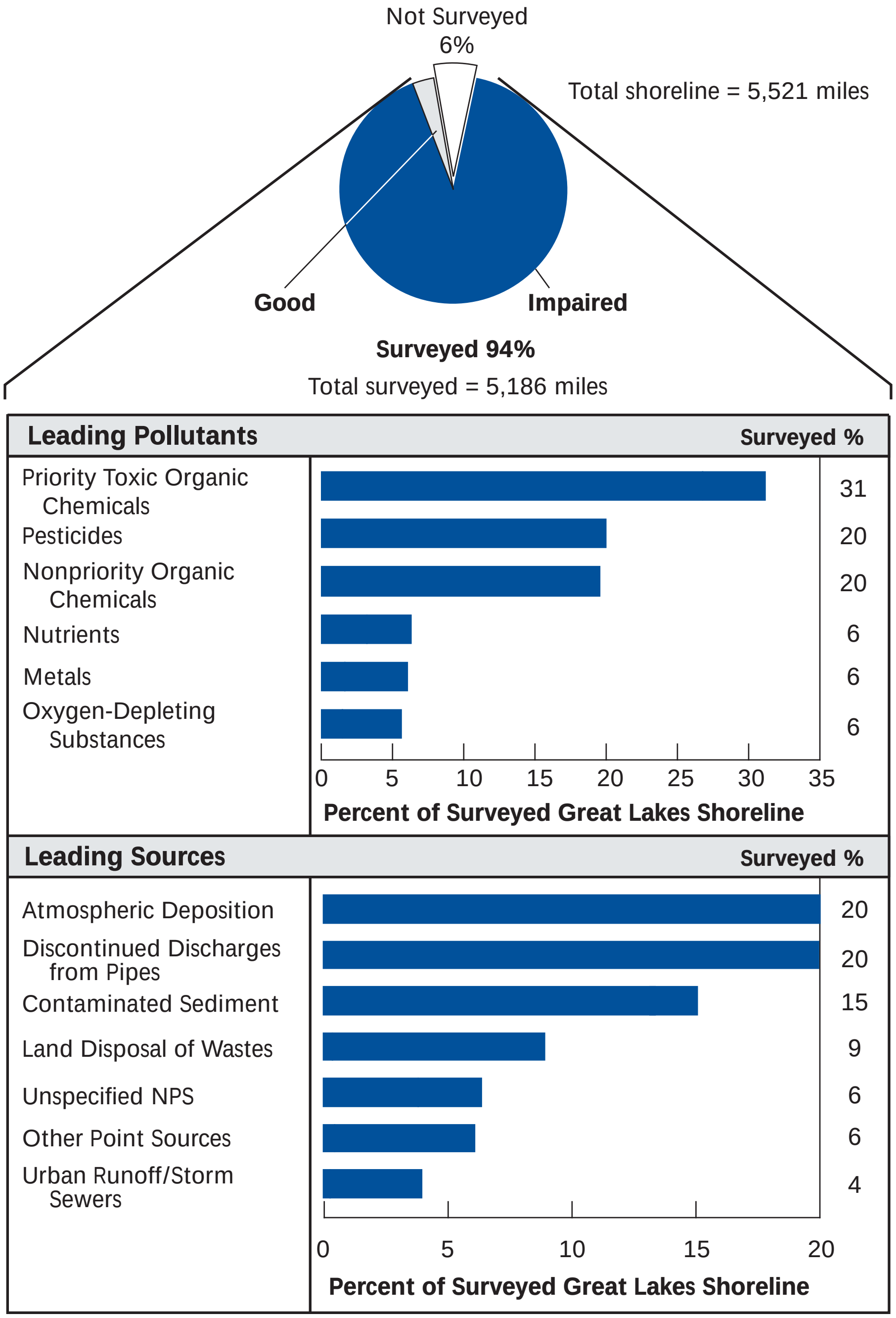
Considerable progress has been made in controlling conventional pollutants, but the Great Lakes are still subject to the effects of toxic pollutants.

These figures do not address water quality conditions in the deeper, cleaner, central waters of the Lakes.

What Is Polluting the Great Lakes?

The States reported that most of the Great Lakes shoreline is polluted by toxic organic chemicals—primarily PCBs—that are often found in fish tissue samples. The Great Lakes States reported that toxic organic chemicals impact 32% of the surveyed Great Lakes shoreline miles. Other leading causes of impairment include pesticides, affecting 21%; nonpriority organic chemicals, affecting 20%; nutrients, affecting 7%; metals, affecting 6%; and oxygen-depleting substances, affecting 6% (Figure 10).

Figure 10. Surveyed Great Lakes Shoreline: Pollutants and Sources



Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Where Does This Pollution Come From?

Only three of the eight Great Lakes States measured the size of their Great Lakes shoreline polluted by specific sources. These States have jurisdiction over one-third of the Great Lakes shoreline, so their findings do not necessarily reflect conditions throughout the Great Lakes Basin.

- Wisconsin identifies atmospheric deposition and discontinued discharges as a source of pollutants contaminating all 1,017 of their surveyed shoreline miles. Wisconsin also identified smaller areas impacted by contaminated sediments, nonpoint sources, industrial and municipal discharges, agriculture, urban runoff and storm sewers, combined sewer overflows, and land disposal of waste.

- Ohio reports that nonpoint sources pollute 86 miles of its 236 miles of shoreline, contaminated sediment impacts 33 miles, and land disposal of waste impacts 24 miles of shoreline.

- New York identifies many sources of pollutants in their Great Lakes waters, but the State attributes the most miles of degradation to contaminated sediments (439 miles) and land disposal of waste (374 miles).

Barry Burgan, U.S. EPA

Estuaries

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity, complex water movements affected by ocean tides and river currents, and high turbidity levels. They are also highly productive ecosystems with a range of habitats for many different species of plants, shellfish, fish, and animals.

Many species permanently inhabit the estuarine ecosystem; others, such as shrimp, use the nutrient-rich estuarine waters as nurseries before traveling to the sea.

Estuaries are stressed by the particularly wide range of activities located within their watersheds. They receive pollutants carried by rivers from agricultural lands and cities; they often support marinas, harbors, and commercial fishing fleets; and their surrounding lands are highly prized for development. These stresses pose a continuing threat to the survival of these bountiful waters.

Overall Water Quality

Twenty-three coastal States and jurisdictions surveyed 72% of the Nation’s total estuarine waters in 1996 (Figure 11). The States and other jurisdictions reported that 62% of the surveyed estuarine waters have good water quality that fully supports designated uses (Figure 12). Of these waters, 4% are threatened and might deteriorate if we fail to manage potential sources of pollution. Some form of pollution or habitat degradation impairs the remaining 38% of the surveyed estuarine waters.

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What Is Polluting Our Estuaries?

The States identified more square miles of estuarine waters polluted by nutrients than any other pollutant or process (Figure 13). Eleven States reported that extra nutrients pollute 6,254 square miles of estuarine waters (57% of the impaired estuarine waters). As in lakes, extra inputs of nutrients from human activities destabilize estuarine ecosystems.

Twenty-one States reported that bacteria pollute 4,634 square miles of estuarine waters (22% of the impaired estuarine waters). Bacteria provide evidence that an estuary is contaminated with sewage that may contain numerous viruses and bacteria that cause illness in people.

Figure 11. Estuary Square Miles Surveyed

Total estuaries = 39,839 square miles
Total surveyed = 28,819 square miles

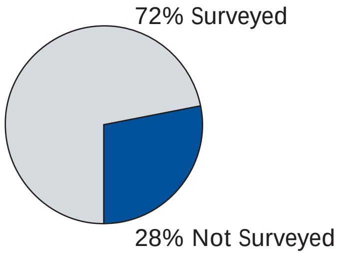
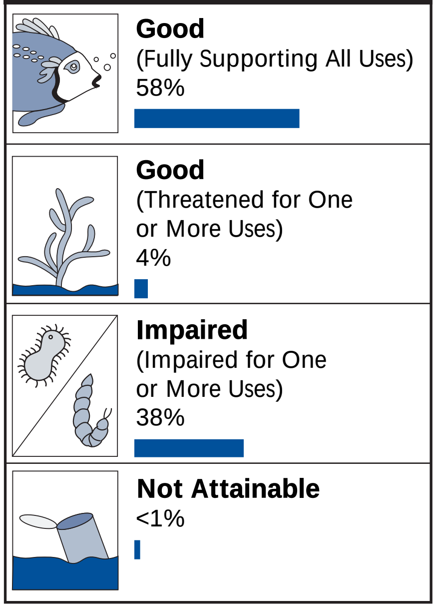
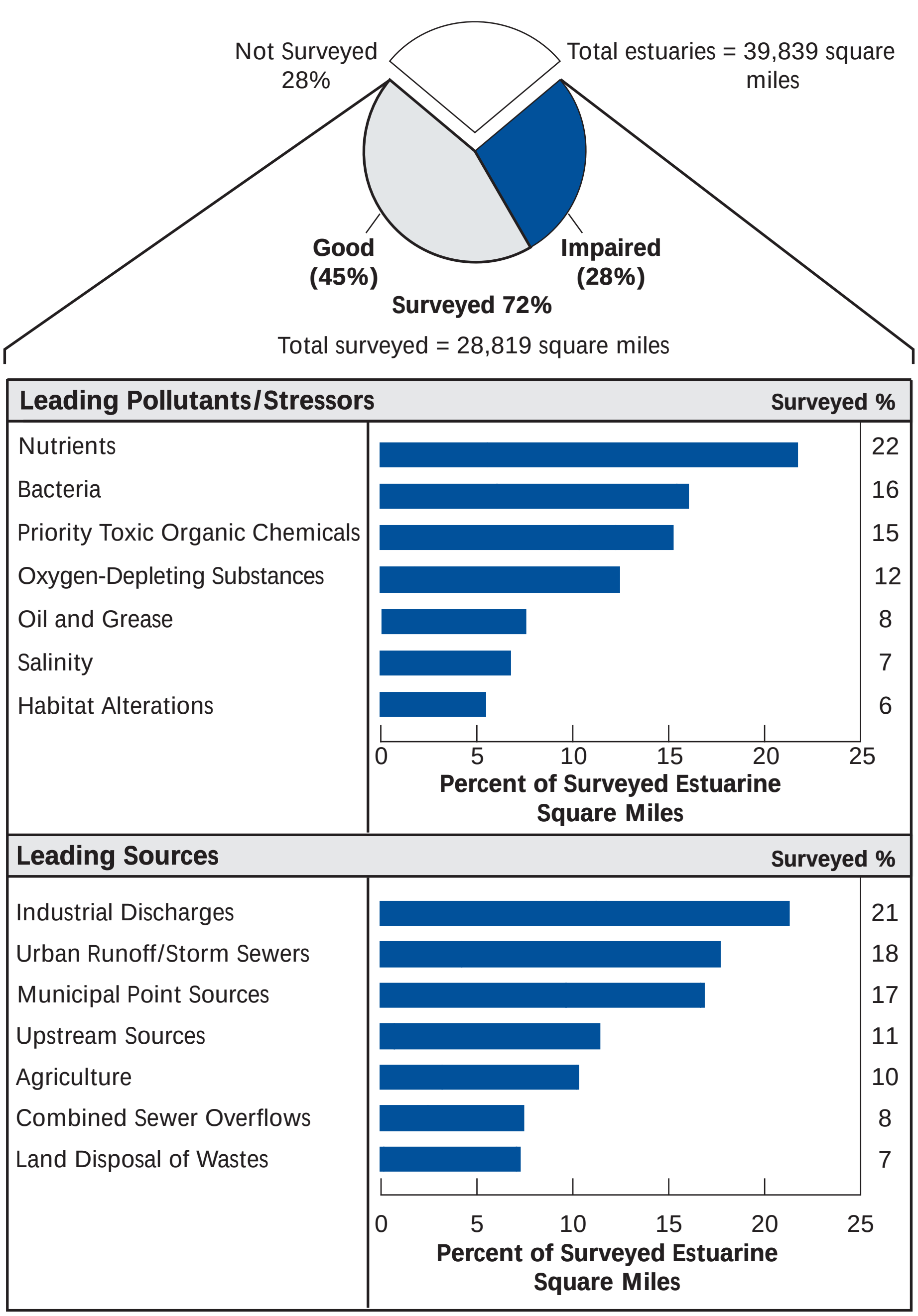


Figure 12. Levels of Summary Use Support – Estuaries



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Figure 13. Surveyed Estuaries: Pollutants and Sources



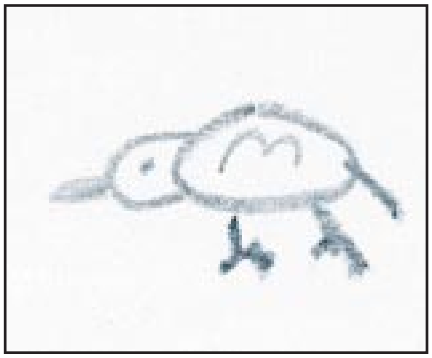
Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair an estuary.

The States also report that priority organic toxic chemicals pollute 4,398 square miles (15% of the surveyed estuarine waters); oxygen depletion from organic wastes impacts 3,586 square miles (12% of the surveyed estuarine waters); oil and grease pollute 2,170 square miles (8% of the surveyed estuarine waters); salinity, total dissolved solids, and/or chlorine impact 1,944 square miles (7% of the surveyed estuarine waters); and habitat alterations degrade 1,586 square miles (6% of the surveyed estuarine waters).

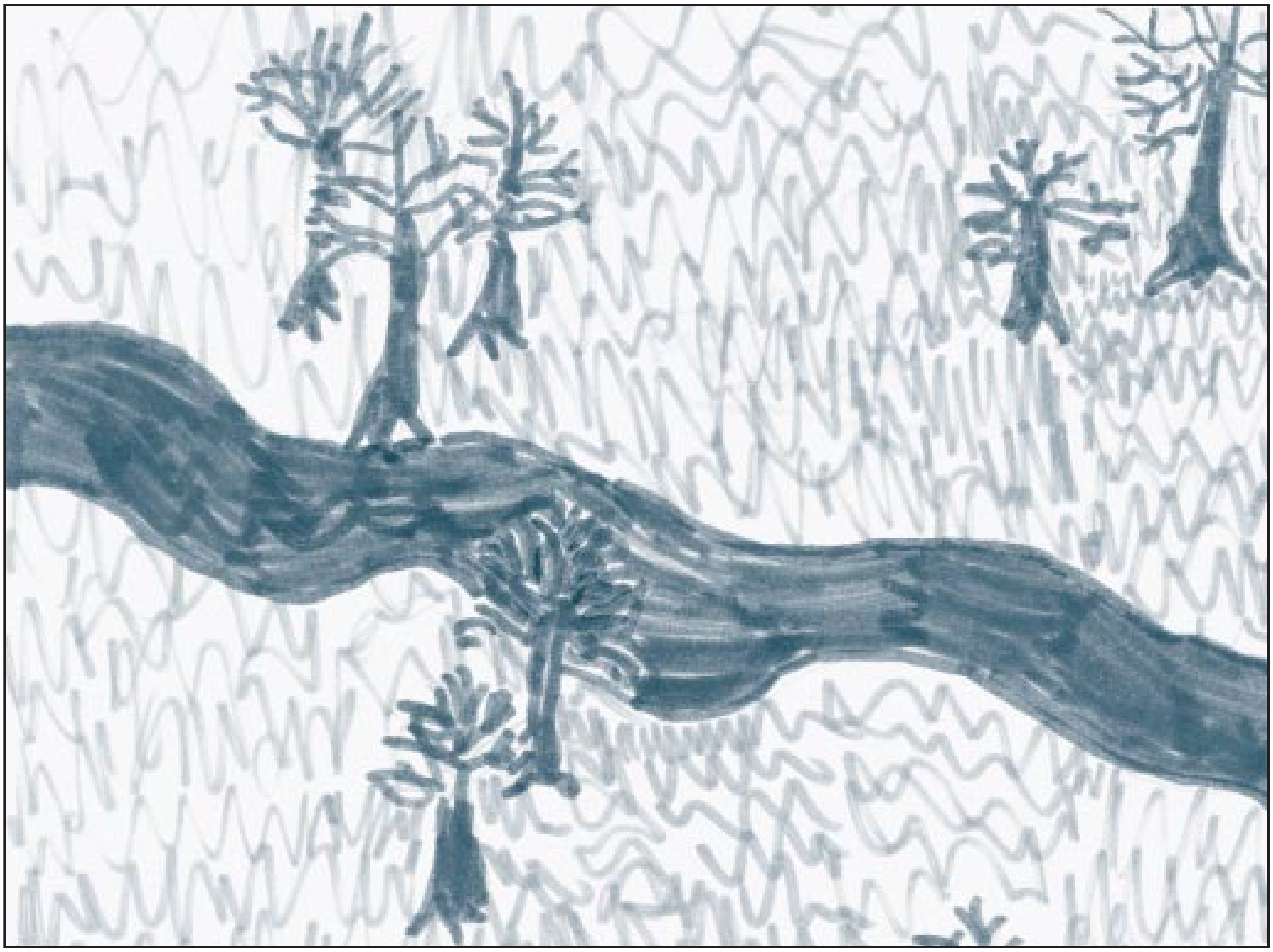
Where Does This Pollution Come From?

Twenty-one States reported that industrial discharges are the most widespread source of pollution in the Nation's surveyed estuarine waters. Pollutants in industrial discharge degrade aquatic life or interfere with public use of 6,145 square miles of estuarine waters (21% of the surveyed estuarine waters) (Figure 13).



Sydney Locker, Quaker Ridge School, Scarsdale, NY

The States also reported that urban runoff and storm sewers pollute 5,099 square miles of estuarine waters (18% of the surveyed estuarine waters), municipal discharges pollute 4,874 square miles of estuarine waters (17% of the surveyed estuarine waters), and upstream sources pollute 3,295 square miles (11% of the surveyed estuarine waters). Urban sources contribute more to the degradation of estuarine waters than agriculture because urban centers are located adjacent to most major estuaries.



Dana Soady, 4th Grade, Burton GeoWorld, Durham, NC

Ocean Shoreline Waters

Paul Goetz, Cary, NC

Although the oceans are expansive, they are vulnerable to pollution from numerous sources, including city storm sewers, ocean outfalls from sewage treatment plants, overboard disposal of debris and sewage, oil spills, and bilge discharges that contain oil and grease. Nearshore ocean waters, in particular, suffer from the same pollution problems that degrade our inland waters.

Overall Water Quality

Ten of the 27 coastal States and Territories surveyed only 6% of the Nation's estimated 58,585 miles of ocean coastline (Figure 14). Most of the surveyed waters (3,085 miles, or 87%) have good quality that supports a healthy aquatic community and public activities (Figure 15). Of these waters, 315 miles (9% of the surveyed shoreline) are threatened and may deteriorate in the future. Some form of pollution or habitat degradation impairs the remaining 13% of the surveyed shoreline (467 miles).

Only six of the 27 coastal States identified pollutants and sources of pollutants degrading ocean shoreline waters. General conclusions cannot be drawn from this limited source of information. The six States identified impacts in their ocean shoreline waters from bacteria, turbidity, nutrients, oxygen-depleting substances, suspended solids, acidity (pH), oil and grease, and metals. The six States reported that urban runoff and storm sewers, land disposal of wastes, septic systems, municipal sewer discharges, industrial discharges, recreational marinas, and spillls and illegal dumping pollute their coastal shoreline waters.

Figure 14. Ocean Shoreline Waters Surveyed

Total ocean shore = 58,585 miles
including Alaska's shoreline
Total surveyed = 3,651 miles

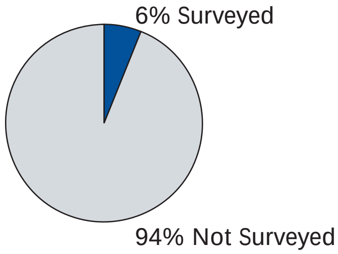
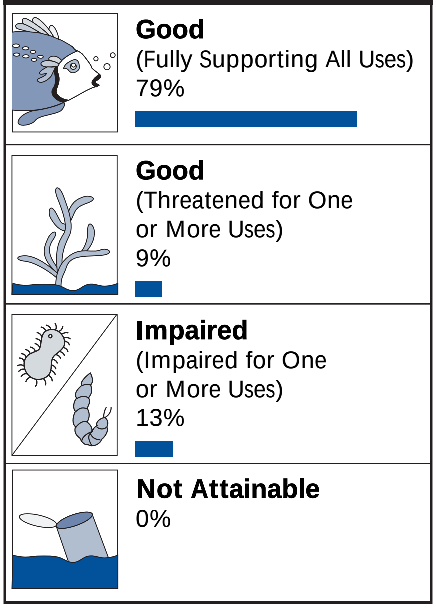


Figure 15. Levels of Summary Use Support – Ocean Shoreline Waters



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages may not add up to 100% due to rounding.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands, which are found throughout the United States, generally include swamps, marshes, bogs, and similar areas.

Wetlands are now recognized as some of the most unique and important natural areas on earth. They vary in type according to differences in local and regional hydrology, vegetation, water chemistry, soils, topography, and climate. Coastal wetlands include estuarine marshes; mangrove swamps found in Puerto Rico, Hawaii, Louisiana, and Florida; and Great Lakes coastal wetlands. Inland wetlands, which may be adjacent to a waterbody or isolated, include marshes and wet meadows, bottomland hardwood forests, Great Plains prairie potholes, cypress-gum swamps, and southwestern playa lakes.

In their natural condition, wetlands provide many benefits, including food and habitat for fish and wildlife, water quality improvement, flood protection, shoreline erosion control, ground water exchange, as well as natural products for human use and opportunities for recreation, education, and research.

Sam Becker, Stennis, MS

Wetlands help maintain and improve water quality by intercepting surface water runoff before it reaches open water, removing or retaining nutrients, processing chemical and organic wastes, and reducing sediment loads to receiving waters. As water moves through a wetland, plants slow the water, allowing sediment and pollutants to settle out. Plant roots trap sediment and are then able to metabolize and detoxify pollutants and remove nutrients such as nitrogen and phosphorus.

Wetlands function like natural basins, storing either floodwater that overflows riverbanks or surface water that collects in isolated depressions. By doing so, wetlands help protect adjacent and downstream property from flood damage. Trees and other wetlands vegetation help slow the speed of flood waters. This action, combined with water storage, can lower flood heights and reduce the water's erosive potential. In agricultural areas, wetlands can help reduce the likelihood of flood damage to crops. Wetlands within and upstream of urban areas are especially valuable for flood protection because urban development increases the rate and volume of surface water runoff, thereby increasing the risk of flood damage.

Wetlands produce a wealth of natural products, including fish and shellfish, timber, wildlife, and wild rice. Much of the Nation's fishing and shellfishing industry harvests wetlands-dependent species. A national survey conducted by the Fish and Wildlife Service (FWS) in 1991 illustrates the economic value of some of the wetlands-dependent products. Over 9 billion pounds of fish and shellfish landed in the United States in 1991 had a direct, dockside value of $3.3 billion. This served as the basis of a seafood processing and sales industry that generated total expenditures of $26.8 billion. In addition, 35.6 million anglers spent $24 billion on freshwater and saltwater fishing. It is estimated that 71% of commercially valuable fish and shellfish depend directly or indirectly on coastal wetlands.

Overall Water Quality

The States, Tribes, and other jurisdictions are making progress in developing specific designated uses and water quality standards for wetlands, but many States and Tribes still lack specific water quality criteria and monitoring programs for wetlands. Without criteria and monitoring data, most States and Tribes cannot evaluate use support. To date, only nine States and Tribes reported the designated use support status for some of their wetlands. Only Kansas used quantitative data as a basis for the use support decisions.

EPA cannot derive national conclusions about water quality conditions in all wetlands because the States used different methodologies to survey only 3% of the total wetlands in the Nation. Summarizing State wetlands data would also produce misleading results because two States (North Carolina and Louisiana) contain 91% of the surveyed wetlands acreage.

What Is Polluting Our Wetlands and Where Does This Pollution Come From?

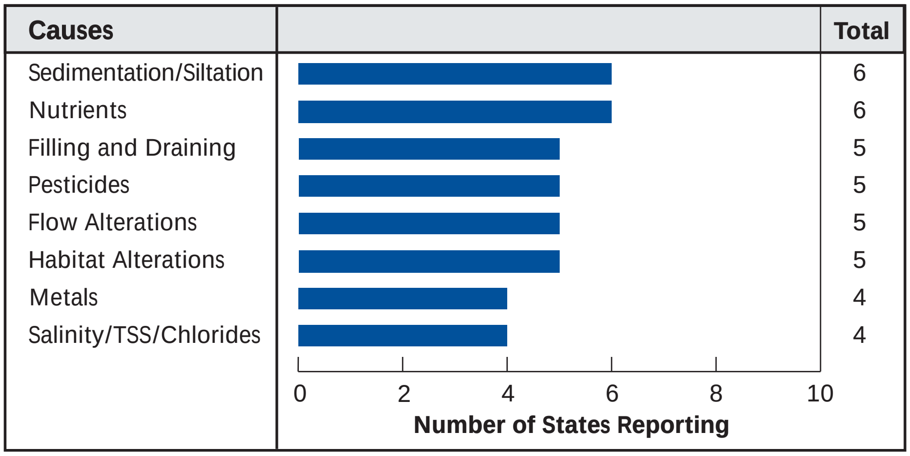
The States have even fewer data to quantify the extent of pollutants degrading wetlands and the sources of these pollutants. Although most States cannot quantify wetlands area impacted by individual causes and sources of degradation, nine States identified causes and sources known to degrade wetlands integrity to some extent. These States listed sediment and nutrients as the most widespread causes of degradation impacting wetlands, followed by draining and pesticides (Figure 16). Agriculture and hydrologic modifications topped the list of sources degrading wetlands, followed by urban runoff, draining, and construction (Figure 17).

Wetlands Loss: A Continuing Problem

It is estimated that over 200 million acres of wetlands existed in the lower 48 States at the time of European settlement. Since then, extensive wetlands acreage has been lost, with many of the original wetlands drained and converted to farmland and urban development. Today, less than half of our original wetlands remain. The losses amount to an area equal to the size of California. According to the U.S. Fish and Wildlife Service's *Wetlands Losses in the United States 1780's to 1980's*, the three States that have sustained the greatest percentage of wetlands loss are California (91%), Ohio (90%), and Iowa (89%).

According to FWS status and trends reports, the average annual loss of wetlands has decreased over the past 40 years. The average annual loss from the mid-1950s to the mid-1970s was 458,000 acres, and from the mid-1970s to the mid-1980s it was 290,000 acres. Agriculture was responsible for 87% of the loss from the mid-1950s to the mid-1970s and 54% of the loss from the mid-1970s to the mid-1980s.

Figure 16. Causes Degrading Wetlands Integrity (10 States Reporting)



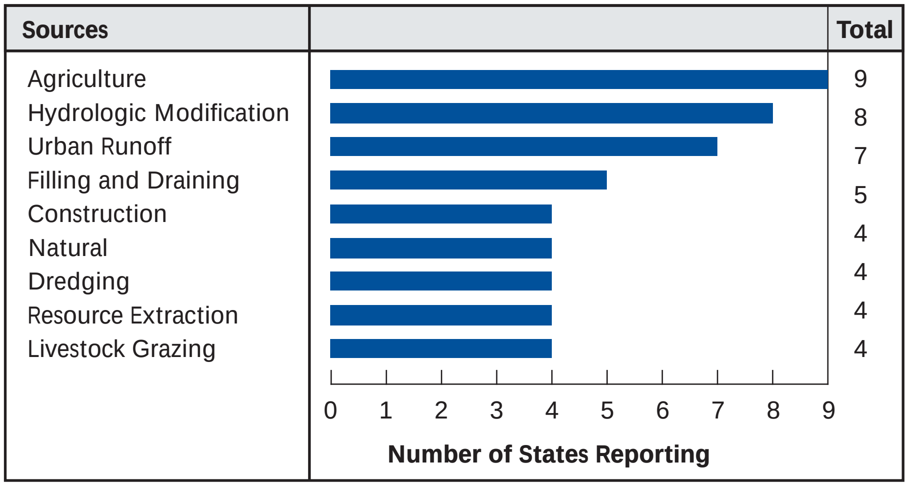
Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

A more recent estimate of wetlands losses from the National Resources Inventory (NRI), conducted by the Natural Resources Conservation Service (NRCS), indicates that 792,000 acres of wetlands were lost on non-Federal lands between 1982 and 1992 for a yearly loss estimate of 70,000 to 90,000 acres. This net loss is the result of gross losses of 1,561,300 acres of wetlands and gross gains of 768,700 acres of wetlands over the 10-year period. The NRI estimates are consistent with the trend of declining wetlands losses reported by FWS. Although losses have decreased, we still have to make progress toward our interim goal of no overall net loss of the Nation's remaining wetlands and the long-term goal of increasing the quantity and quality of the Nation's wetlands resource base.

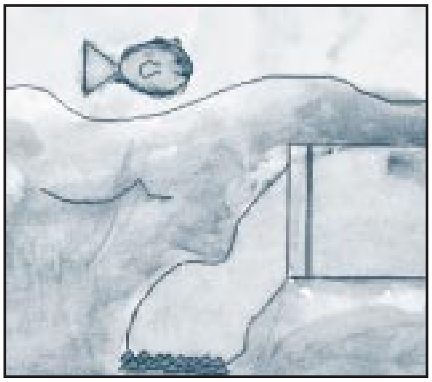
The decline in wetlands losses is a result of the combined effect of several trends: (1) the decline in profitability in converting wetlands for agricultural production; (2) passage of Swampbuster provisions in the 1985, 1990, and 1996 Farm Bills that denied crop subsidy benefits to farm operators who converted wetlands to cropland after 1985; (3) presence of the CWA Section 404 permit programs as well as development of State management programs; (4) greater public interest and support for wetlands protection; and (5) implementation of wetlands restoration programs at the Federal, State, and local level.

Twelve States listed sources of recent wetlands losses in their 1996 305(b) reports. Residential development and urban growth was cited as the leading source of current losses. Other losses were due to agriculture; construction of roads, highways, and bridges; hydrologic modifications; channelization; and industrial development. In addition to human activities, a few States also reported that natural sources, such as rising lake levels, resulted in wetlands losses and degradation.

Figure 17. Sources Degrading Wetlands Integrity (9 States Reporting)



Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.



Dorothy Scott, 4th Grade, Burton GeoWorld, Durham, NC

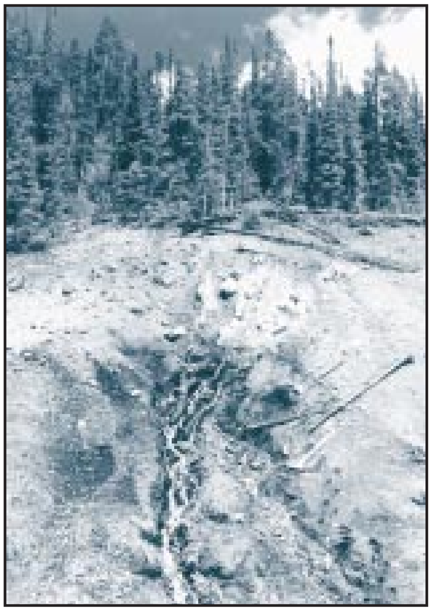
More information on wetlands can be obtained from the EPA Wetlands Hotline at 1-800-832-7828.

Ground Water

Although 75% percent of the earth's surface is covered by water, only 3% is fresh water available for our use. It has been estimated that more than 90% of the world's fresh water reserve is stored in the earth as ground water. Ground water—water found in natural underground rock formations called aquifers—is a vital national resource that is used for myriad purposes. Unfortunately, this resource is vulnerable to contamination, and ground water contaminant problems are being reported throughout the country.

To ascertain the extent to which our Nation's ground water resources have been impacted by human activities, Section 106(e) of the Clean Water Act requests that each State monitor ground water quality and report the findings to Congress in their 305(b) State Water Quality Reports. Recognizing that an accurate representation of our Nation's ambient ground water quality conditions required developing guidelines that would ultimately yield quantitative data, EPA, in partnership with interested States, developed new guidelines for assessing ground water quality. It was these guidelines that were used by States for reporting the 1996 305(b) ground water data.

Despite variations in reporting style, the 1996 305(b) State Water Quality Reports represent a first step in improving the assessment of State ambient ground water quality. Forty States, one Territory, and two Tribes used the new guidelines to assess and report ground water quality data. For the first time, States provided quantitative data describing ground water quality. Furthermore, States provided quantitative information pertaining to contamination sources that have impacted ground water quality.



Jeff Reynolds, Raleigh, NC

Ground Water Contamination

Not too long ago, it was thought that soil provided a protective "filter" or "barrier" that immobilized the downward migration of contaminants released on the land surface and prevented ground water resources from being adversely impacted or contaminated. The discovery of pesticides and other contaminants in ground water demonstrated that ground water resources were indeed vulnerable to contamination resulting from human activities. The potential for a contaminant to affect ground water quality is dependent upon its being introduced to the environment and its ability to migrate through the overlying soils to the underlying ground water resource.

Ground water provides drinking water for 51% of the population.

Ground water contamination can occur as relatively well defined plumes emanating from specific sources such as spills, landfills, waste lagoons, and/or industrial facilities. Contamination can also occur as a general deterioration of ground water quality over a wide area due to diffuse nonpoint sources such as agricultural fertilizer and pesticide applications, septic systems, urban runoff, leaking sewer networks, application of lawn chemicals, highway deicing materials, animal feedlots, salvage yards, and mining activities. Ground water quality degradation from diffuse nonpoint sources affects large areas, making it difficult to specify the exact source of the contamination.

Ground water contamination is most common in highly developed areas, agricultural areas, and industrial complexes. Frequently ground water contamination is discovered long after it has occurred. One reason for this is the slow movement of ground water through aquifers, sometimes on the order of less than an inch per day. Contaminants in the ground water do not mix or spread quickly, but remain concentrated in slow-moving plumes that may persist for many years. This often results in a delay in the detection of ground water contamination. In some cases, contaminants introduced into the subsurface more than 10 years ago are only now being discovered.

Ground Water Contaminant Sources

As reported by States, it is evident that ground water quality may be adversely impacted by a variety of potential contaminant sources. In 1996, EPA requested each State to indicate the 10 top sources that potentially threaten their ground water resources. The list was not considered comprehensive and States added sources as was necessary based on State-specific concerns. Factors that were considered by States in their selection include the number of each type of source in the State, the location of the various sources relative to ground water used for drinking water purposes, the size of the population at risk from contaminated drinking water, the risk posed to human health and/or the environment from releases, hydrogeologic sensitivity (the ease with which contaminants enter and travel through soil and reach aquifers), and the findings of the State's ground water protection strategy and/or related studies.

Thirty-seven States provided information related to contaminant sources. Those most frequently reported by States include:

- **Leaking underground storage tanks**. Leaking underground storage tanks (USTs) were cited as the highest priority contaminant source of concern to States. The primary causes of leakage in USTs are faulty installation and corrosion of tanks and pipelines. As of March 1996, more than 300,000 releases from USTs had been confirmed. EPA estimates that nationally 60% of these leaks have impacted ground water quality, and, in some States, the percentage is as high as 90%.

- **Landfills**. Landfills were cited by States as the second highest contaminant source of concern. Landfills are used to dispose of sanitary (municipal) and industrial wastes. Municipal wastes, some industrial wastes, and relatively inert substances such as plastics are disposed of in sanitary landfills. Common materials that may be disposed of in industrial landfills include plastics, metals, fly ash, sludges, coke, tailings, waste pigment particles, low-level radioactive wastes, polypropylene, wood, brick, cellulose, ceramics, synthetics, and other similar substances. States indicated that the most common contaminants associated with landfills were metals, halogenated solvents, and petroleum compounds. To a lesser extent, organic and inorganic pesticides were also cited as a contaminant of concern.

- **Septic systems**. Septic systems were cited by 29 out of 37 States as a potential source of ground water contamination. Ground water may be contaminated by releases from septic systems when the systems are poorly designed (tanks are installed in areas with inadequate soils or shallow depth to ground water), poorly constructed; have poor well seals; are improperly used, located, or maintained; or are abandoned. Typical contaminants from domestic septic systems include bacteria, nitrates, viruses, phosphates from detergents, and other chemicals that might originate from household cleaners.

Ground Water Quality Assessments

Thirty-three States reported data summarizing ground water quality. In total, data were reported for 162 specific aquifers and other hydrogeologic settings. States used data from ambient monitoring networks, public water supply systems (PWSs), private and unregulated wells, and special studies. Nationally, more States reported data for nitrates, metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) than any other parameter grouping. Nitrates, metals, SVOCs, and VOCs generally represent instances of ground water degradation resulting from human activities.

Due to the importance of ground water as a drinking water resource, many of the aquifers that were evaluated for 1996 are used to supply water for public and private consumption. The aquifers are also used for irrigation, commercial, livestock, and industrial purposes. In general, water quality problems affected irrigation, commercial, livestock, and industry uses less frequently than drinking water. This may reflect the high water quality standards set for drinking water.

Water Quality Protection Programs

Although significant strides have been made in reducing the impacts of discrete pollutant sources, our aquatic resources remain at risk from a combination of point sources and complex nonpoint sources, including air pollution. Since 1991, EPA has promoted the watershed protection approach as a holistic framework for addressing complex pollution problems.

The watershed protection approach is a place-based strategy that integrates water quality management activities within hydrologically defined drainage basins–watersheds–rather than areas defined by political boundaries. Thus, for a given watershed, the approach encompasses not only the water resource (such as a stream, lake, estuary, or ground water aquifer), but all the land from which water drains to the resource. To protect water resources, it is increasingly important to address the condition of land areas within the watershed because water carries the effects of human activities throughout the watershed as it drains off the land into surface waters or leaches into the ground water.

Under the Watershed Protection Approach (WPA), a "watershed" is a hydrogeologic area defined for addressing water quality problems. For example, a WPA watershed may be a river basin, a county-sized watershed, or a small drinking water supply watershed.


John Theilgard, Bynum, NC

EPA's Office of Water envisions the watershed protection approach as the primary mechanism for achieving clean water and healthy, sustainable ecosystems throughout the Nation. The watershed protection approach enables stakeholders to take a comprehensive look at ecosystem issues and tailor corrective actions to local concerns within the coordinated framework of a national water program. The emphasis on public participation also provides an opportunity to incorporate environmental justice issues into watershed restoration and protection solutions.

In May of 1994, the EPA Assistant Administrator for Water, Robert Perciasepe, created the Watershed Management Policy Committee to coordinate the EPA water program's support of the watershed protection approach. Since then, EPA's water program managers, under the direction of the Watershed Management Policy Committee, evaluated their programs and identified additional activities needed to support the watershed protection approach in an action plan.

EPA's Office of Water will continue to promote and support the watershed protection approach and build upon its experience with established place-based programs, such as the Chesapeake Bay Program and the Great Lakes National Program to eliminate barriers to the approach. These integrated programs laid the foundation for the Agency's shift toward comprehensive watershed management and continue to provide models for implementing the "place-based" approach to environmental problem-solving.

The Clean Water Act

A number of laws provide the authority to develop and implement pollution control programs. The primary statute providing for water quality protection in the Nation's rivers, lakes, wetlands, estuaries, and coastal waters is the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act.

The CWA and its amendments are the driving force behind many of the water quality improvements we have witnessed in recent years. Key provisions of the CWA provide the following pollution control programs.

Water quality standards and criteria – States, Tribes, and other jurisdictions adopt EPA-approved standards for their waters that define water quality goals for individual waterbodies. Standards consist of designated beneficial uses to be made of the water, criteria to protect those uses, and antidegradation provisions to protect existing water quality.

Effluent guidelines – EPA develops nationally consistent guidelines limiting pollutants in discharges from industrial facilities and municipal sewage treatment plants. These guidelines are then used in permits issued to dischargers under the National Pollutant Discharge Elimination System (NPDES) program. Additional controls may be required if receiving

The Watershed Protection Approach (WPA)

Several key principles guide the watershed protection approach:

- **Place-based focus** – Resource management activities are directed within specific geographic areas, usually defined by watershed boundaries, areas overlying or recharging ground water, or a combination of both.
- **Stakeholder involvement and partnerships** – Watershed initiatives involve the people most likely to be affected by management decisions in the decision making process. Stakeholder participation ensures that the objectives of the watershed initiative will include economic stability and that the people who depend on the water resources in the watershed will participate in planning and implementation activities. Watershed initiatives also establish partnerships between Federal, State, and local agencies and nongovernment organizations with interests in the watershed.
- **Environmental objectives** – The stakeholders and partners identify environmental objectives (such as "populations of striped bass will stabilize or increase") rather than programmatic objectives (such as "the State will eliminate the backlog of discharge permit renewals") to measure the success of the watershed initiative. The environmental objectives are based on the condition of the ecological resource and the needs of people in the watershed.
- **Problem identification and prioritization** – The stakeholders and partners use sound scientific data and methods to identify and prioritize the primary threats to human and ecosystem health within the watershed. Consistent with the Agency's mission, EPA views ecosystems as the interactions of complex communities that include people; thus, healthy ecosystems provide for the health and welfare of humans as well as other living things.
- **Integrated actions** – The stakeholders and partners take corrective actions in a comprehensive and integrated manner, evaluate success, and refine actions if necessary. The watershed protection approach coordinates activities conducted by numerous government agencies and nongovernment organizations to maximize efficient use of limited resources.

waters are still affected by water quality problems after permit limits are met.

Total Maximum Daily Loads – The development of Total Maximum Daily Loads, or TMDLs, establishes the link between water quality standards and point/nonpoint source pollution control actions such as permits or Best Management Practices (BMPs). A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides the quantitative basis for pollution reduction necessary to meet water quality standards. States, Tribes, and other jurisdictions develop and implement TMDLs for high-priority impaired or threatened waterbodies.

Permits and enforcement – All industrial and municipal facilities that discharge wastewater must have an NPDES permit and are responsible for monitoring and reporting levels of pollutants in their discharges. EPA issues these permits or can delegate that permitting authority to qualifying States or other jurisdictions. The States, other qualified jurisdictions, and EPA inspect facilities to determine if their discharges comply with permit limits. If dischargers are not in compliance, enforcement action is taken.

Loans – The Clean Water State Revolving Fund (CW-SRF) is an innovative water quality financing program that is designed to provide low-cost project financing to solve important water quality problems. The SRF program is made up of 51 state-level infrastructure funds (Puerto Rico has one, too) that operate much like banks. These funds were created by the 1987 Amendments to the Clean Water Act and are intended to provide permanent and independent sources of funding for municipal sewage treatment, nonpoint source, and estuary projects. EPA and the States are capitalizing or providing “seed money” to establish these revolving funds. The goal is to capitalize the 51 programs so that they can provide in excess of $2 billion in loans for water quality projects each year for the foreseeable future. The CW-SRF is, by far, the most powerful financial tool available to the water quality program.

The 1996 Amendments to the Safe Drinking Water Act (SDWA) created the new Drinking Water State Revolving Fund (DW-SRF) program. The primary purpose of this program is to upgrade drinking water infrastructure to facilitate compliance with the SDWA. Congress has appropriated $2 billion to begin the capitalization of this program. The long-term strategy is to continue capitalization of this program so that the SRFs will be able to provide in excess of $500 million each year in assistance for priority drinking water projects. In January 1997, EPA released the first Drinking Water Needs Survey, which identified $138.4 billion in needs over the next 20 years. EPA is currently working with the States to set up their drinking water SRFs.

Grants – EPA provides States with financial assistance to help support many of their pollution control programs. The programs funded include water quality monitoring, permitting, and enforcement; nonpoint source; ground water; National Estuary Program; and wetlands.

Nonpoint source control – EPA provides program guidance, technical support, and funding to help the States, Tribes, and other jurisdictions control nonpoint source pollution. The States, Tribes, and other jurisdictions are responsible for analyzing the extent and severity of their nonpoint source pollution problems and developing and implementing needed water quality management actions.

The CWA also established pollution control and prevention programs for specific waterbody categories, such as the Clean Lakes Program. Other statutes that also guide the development of water quality protection programs include:

- **The Safe Drinking Water Act**, under which States establish standards for drinking water quality, monitor wells and local water supply systems, implement drinking water protection programs, and implement Underground Injection Control (UIC) programs.

- **The Resource Conservation and Recovery Act**, which establishes State and EPA programs for ground water and surface water protection and cleanup and emphasizes prevention of releases through management standards in addition to other waste management activities.

- **The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Program)**, which provides EPA with the authority to clean up contaminated waters during remediation at contaminated sites.

- **The Pollution Prevention Act of 1990**, which requires EPA to promote pollutant source reduction rather than focus on controlling pollutants after they enter the environment.

Protecting and Restoring Lakes

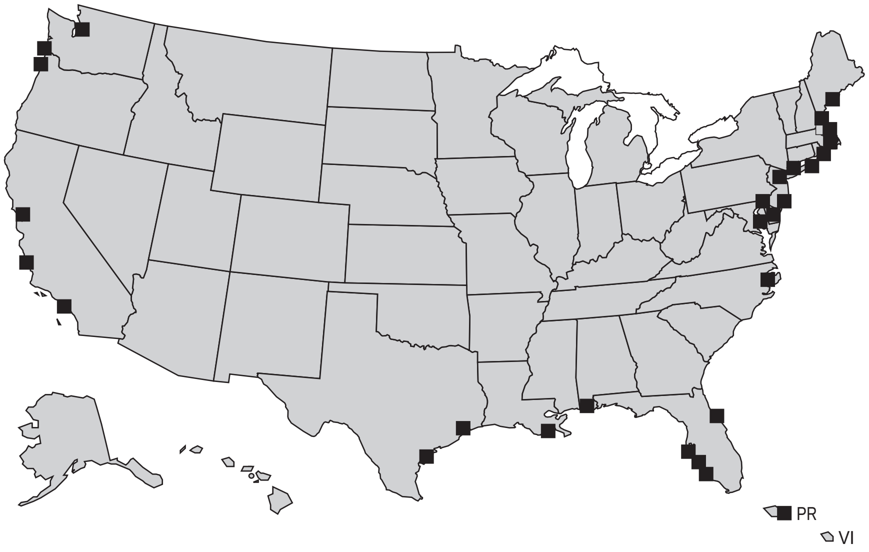
Since the 1980s, EPA has encouraged States to develop lake projects with a watershed perspective. This ensures that protection and restoration activities are long term and comprehensive. EPA offers sources of funding assistance for lake projects and also encourages States to develop their own independent mechanisms to provide resources for their lake management programs.

A good example of a State-based lakes initiative is the Illinois Conservation 2000 Clean Lakes program. Illinois' system adopted major features of the Federal Clean Lakes program. The process leading to the Conservation 2000 program can be traced back to legislative actions in the late 1980s that set up the basic framework and identified agency roles and responsibilities. The program now has assured ongoing funding to support lake restoration projects and to underwrite a variety of technical support and educational activities.

At the Federal level, EPA offers support for watershed-oriented lake projects through Nonpoint Source 319(h) grants included under State Nonpoint Source Management Programs. Other EPA resources may be available under provisions of the reauthorized Safe Drinking Water Act, with its emphasis on source water protection.

Jerome Pitt, U.S. EPA, Region 9

Figure 18. Locations of National Estuary Program Sites



Successful lake programs require local stakeholder support and an awareness on the part of stakeholders of how to identify pollution concerns as well as knowledge of appropriate lake protection and restoration management measures. EPA provides support for a variety of local stakeholder outreach and education initiatives. A good example is the Great American Secchi Dip-In, an event held for the past 4 years, in which volunteer lake and reservoir monitoring programs from across the country take a Secchi disk measurement on one day in a period surrounding July 4th. Secchi disks are typically flat, black and white disks that are used to measure the transparency of water. Transparency is one indicator of the impact of human activity on lake water quality.

The National Estuary Program

Section 320 of the Clean Water Act (as amended by the Water Quality Act of 1987) established the National Estuary Program (NEP) to protect and restore water quality and living resources in estuaries. The NEP adopts a geographic or watershed approach by planning and implementing pollution abatement activities for the estuary and its surrounding land area as a whole.

The NEP embodies the ecosystem approach by building coalitions, addressing multiple sources of contamination, pursuing habitat protection as a pollution control mechanism, and investigating cross-media transfer of pollutants from air and soil into specific estuarine waters. Under the NEP, a State governor nominates an estuary in his or her State for participation in the program. The State must demonstrate a likelihood of success in protecting candidate estuaries and provide evidence of institutional, financial, and political commitment to solving estuarine problems.

If an estuary meets the NEP guidelines, the EPA Administrator convenes a management conference of representatives from interested Federal, Regional, State, and local governments; affected industries; scientific and academic institutions; and citizen organizations. The management conference defines program goals and objectives, identifies problems, and designs strategies to control pollution and manage natural resources in the estuarine basin. Each management conference develops and initiates implementation of a Comprehensive Conservation and Management Plan (CCMP) to restore and protect the estuary.

The NEP currently supports 28 estuary projects.

The NEP integrates science and policy by bringing water quality managers, elected officials, and stakeholders together with scientists from government agencies, academic institutions, and the private sector. Because the NEP is not a research program, it relies heavily on past and ongoing research of other agencies and institutions to support development of CCMPs.

With the addition of seven estuary sites in July of 1995, the NEP currently supports 28 estuary projects (see Figure 18). These 28 estuaries are nationally significant in their economic value as well as in their ability to support living

The 1993 Wetlands Plan

Shortly after coming into office, the Clinton Administration convened an interagency working group to address concerns with Federal wetlands policy. After hearing from States, developers, farmers, environmental interests, members of Congress, and scientists, the working group developed a comprehensive 40-point plan for wetlands protection to make wetlands programs more fair, flexible, and effective. This plan was issued on August 24, 1993.

The Administration's Wetlands Plan emphasizes improving Federal wetlands policy by

- Streamlining wetlands permitting programs
- Increasing cooperation with private landowners to protect and restore wetlands
- Basing wetlands protection on good science and sound judgment
- Increasing participation by States, Tribes, local governments, and the public in wetlands protection.

resources. The project sites also represent a broad range of environmental conditions in estuaries throughout the United States and its Territories so that the lessons learned through the NEP can be applied to other estuaries.

Each of the 28 estuaries in the NEP is unique. Yet the estuaries share common threats and stressors. Each estuary faces expanding human activity near its shores that may degrade water quality and habitat. Eutrophication, toxic substances (including metals), pathogens, and changes to living resources and habitats top the list of problems being addressed by NEP Management Conferences.

Protecting Wetlands

A variety of public and private programs protect wetlands. Section 404 of the CWA continues to provide the primary Federal vehicle for regulating certain activities in wetlands. Section 404 establishes a permit program for discharges of dredged or fill material into waters of the United States, including wetlands.

The U.S. Army Corps of Engineers (COE) and EPA jointly implement the Section 404 program. The COE is responsible for reviewing permit applications and making permit decisions. EPA establishes the environmental criteria for making permit decisions and has the authority to review and veto Section 404 permits proposed for issuance by the COE. EPA is also responsible for determining geographic jurisdiction of the Section 404 permit program, interpreting statutory exemptions, and overseeing Section 404 permit programs assumed by individual States. To date, only two States (Michigan and New Jersey) have assumed the Section 404 permit program from the COE. The COE and EPA share responsibility for enforcing Section 404 requirements.

The COE issues individual Section 404 permits for specific projects or general permits (Table 5). Applications for individual permits go through a review process that includes opportunities for EPA, other Federal agencies (such as the U.S. Fish and Wildlife Service and the National Marine Fisheries

Table 5. Federal Section 404 Permits

General Permits (streamlined permit review procedures)				Individual Permits
Nationwide Permits	**Regional Permits**	**Programmatic Permits**		
		State Programmatic Permits	**Others**	
• Cover 39 types of activities that the COE determines to have minimal adverse impacts on the environment	• Developed by COE District Offices to cover activities in a specified region	• COE defers permit decisions to State agency while reserving authority to require an individual permit	• Special Management Agencies • Watershed Planning Commissions	• Required for major projects that have the potential to cause significant adverse impacts • Project must undergo interagency review • Opportunity for public comment • Opportunity for 401 certification review

Service), State agencies, and the public to comment. However, the vast majority of activities proposed in wetlands are covered by Section 404 general permits. For example, in FY96, over 64,000 people applied to the COE for a Section 404 permit. Eighty-five percent of these applications were covered by general permits and were processed in an average of 14 days. It is estimated that another 90,000 activities are covered by general permits that do not require notification of the COE at all.

General permits allow the COE to permit certain activities without performing a separate individual permit review. Some general permits require notification of the COE before an activity begins. There are three types of general permits:

- Nationwide permits (NWPs) authorize specific activities across the entire Nation that the COE determines will have only minimal individual and cumulative impacts on the environment, including construction of minor road crossings and farm buildings, bank stabilization activities, and the filling of up to 10 acres of isolated or headwater wetlands.

- Regional permits authorize types of activities within a geographic area defined by a COE District Office.

- Programmatic general permits are issued to an entity that the COE determines may regulate activities within its jurisdictional wetlands. Under a programmatic general permit, the COE defers its permit decision to the regulating entity but reserves its authority to require an individual permit.

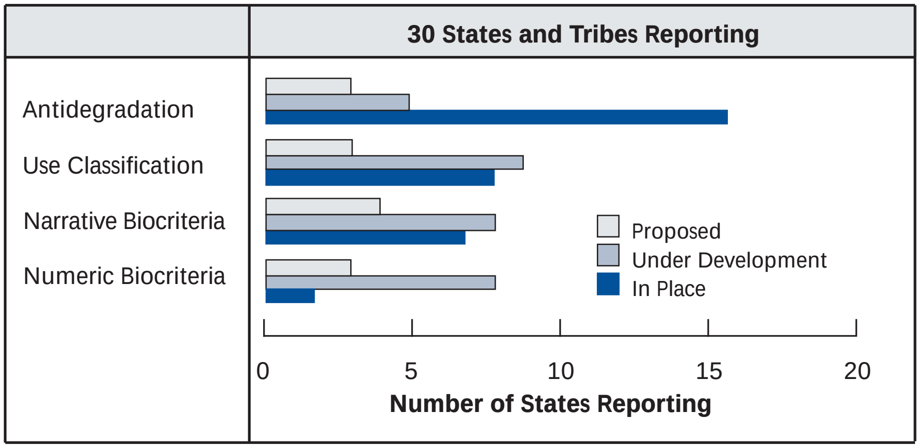
Currently, the COE and EPA are promoting the development of State programmatic general permits (SPGPs) to increase State involvement in wetlands protection and minimize duplicative State and Federal review of activities proposed in wetlands. Each SPGP is a unique arrangement developed by a State and the COE to take advantage of the strengths of the individual State wetlands program. Several States have adopted comprehensive SPGPs that replace many or all COE-issued nationwide general permits. SPGPs simplify the regulatory process and increase State control over their wetlands resources. Carefully developed SPGPs can improve wetlands protection while reducing regulatory demands on landowners.

Water quality standards for wetlands ensure that the provisions of CWA Section 303 that apply to other surface waters are also applied to wetlands. In July 1990, EPA issued guidance to States for the development of wetlands water quality standards. Water quality standards consist of designated beneficial uses, numeric criteria, narrative criteria, and antidegradation statements. Figure 19 indicates the State's progress in developing these standards.

Standards provide the foundation for a broad range of water quality management activities under the CWA including, but not limited to, monitoring for the Section 305(b) report, permitting under Sections 402 and 404, water quality certification under Section 401, and the control of nonpoint source pollution under Section 319.

States, Territories, and Tribes are well positioned between Federal and local government to take the lead in integrating and expanding wetlands protection and management programs. They are experienced in managing federally mandated environmental programs, and they are uniquely equipped to help resolve local and regional conflicts

Figure 19. Development of State Water Quality Standards for Wetlands



and identify the local economic and geographic factors that may influence wetlands protection.

Section 401 of the CWA gives States and eligible American Indian Tribes the authority to grant, condition, or deny certification of federally permitted or licensed activities that may result in a discharge to U.S. waters, including wetlands. Such activities include discharge of dredged or fill material permitted under CWA Section 404, point source discharges permitted under CWA Section 402, and Federal Energy Regulatory Commission's hydropower licenses. States review these permits to ensure that they meet State water quality standards.

Section 401 certification can be a powerful tool for protecting wetlands from unacceptable degradation or destruction especially when implemented in conjunction with wetlands-specific water quality standards. If a State or an eligible Tribe denies Section 401 certification, the Federal permitting or licensing agency cannot issue the permit or license.

Until recently, many States waived their right to review and certify Section 404 permits because these States had not defined water quality standards for wetlands or codified regulations for implementing their 401 certification program into State law. Now, most States report that they use the Section 401 certification process to review Section 404 projects and to require mitigation if there is no alternative to degradation of wetlands. Ideally, 401 certification should be used to augment State programs because activities that do not require Federal permits or licenses, such as some ground water withdrawals, are not covered.

State/Tribal Wetlands Conservation Plans (SWCPs) are strategies that integrate regulatory and cooperative approaches to achieve State wetlands management goals, such as no overall net loss of wetlands. SWCPs are not meant to create a new level of bureaucracy. Instead, SWCPs improve government and private-sector effectiveness and efficiency by identifying gaps in wetlands protection programs and identifying opportunities to improve wetlands programs.

States, Tribes, and other jurisdictions protect their wetlands with a variety of other approaches, including permitting programs, coastal management programs, wetlands acquisition programs, natural heritage programs, and integration with other programs. The following trends emerged from individual State and Tribal reporting:

■ Most States have defined wetlands as waters of the State, which offers general protection through antidegradation clauses and designated uses that apply to all waters of a State. However, most States have not developed specific wetlands water quality standards and designated uses that protect wetlands' unique functions, such as flood attenuation and filtration.

■ Without specific wetlands uses and standards, the Section 401 certification process relies heavily on antidegradation clauses to prevent significant degradation of wetlands.

■ In many cases, the States use the Section 401 certification process to add conditions to Section 404 permits that minimize the size of wetlands destroyed or degraded by proposed activities to the extent practicable. States often add conditions that require compensatory mitigation for destroyed wetlands, but the States do not have the resources to perform enforcement inspections or followup monitoring to ensure that the wetlands are constructed and functioning properly.

■ More States are monitoring selected, largely unimpacted wetlands to establish baseline conditions in healthy wetlands. The States will use this information to monitor the relative performance of constructed wetlands and to help establish biocriteria and water quality standards for wetlands.

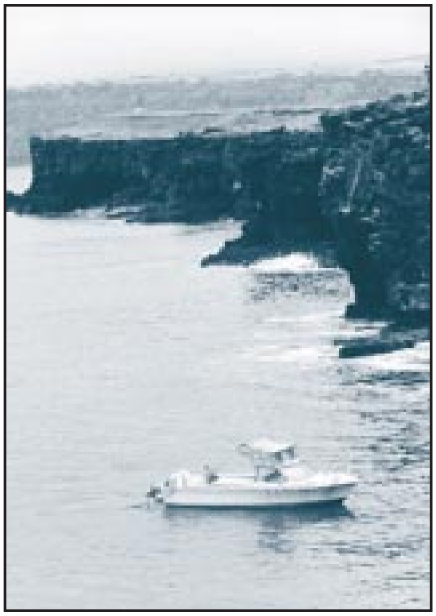
Although the States, Tribes, and other jurisdictions report that they are making progress in protecting wetlands, they also report that the pressure to develop or destroy wetlands remains high. EPA and the States, Tribes, and other jurisdictions will continue to pursue new mechanisms for protecting wetlands that rely less on regulatory tools.

Protecting the Great Lakes

Restoring and protecting the Great Lakes requires cooperation from numerous organizations because the pollutants that enter the Great Lakes originate in both the United States and Canada, as well as in other countries, and pollutants enter the lakes via multiple media (i.e., air, ground water, and surface water). The International Joint Commission (IJC), established by the 1909 Boundary Waters Treaty, provides a framework for the cooperative management of the Great Lakes. Representatives from the United States and Canada, the Province of Ontario, and the eight States bordering the Lakes sit on the IJC's Water Quality Board. The Water Quality Board recommends actions for protecting and restoring the Great Lakes and evaluates the environmental policies and actions implemented by the United States and Canada.

The EPA Great Lakes National Program Office (GLNPO) coordinates activities within the United States at all government levels and works with academia, industry, and nongovernment organizations to protect and restore the lakes. The GLNPO provides leadership through its annual Great Lakes Program Priorities and Funding Guidance. The GLNPO also serves as a liaison to the Canadian members of the IJC and the Canadian environmental agencies.

The 1978 Great Lakes Water Quality Agreement (as amended in 1987) lay the foundation for ongoing efforts to restore and protect the Great Lakes. The Agreement committed the United States and Canada to developing Remedial Action Plans (RAPs) for Areas of Concern and Lakewide Management Plans (LaMPs) for each lake. Areas of Concern are specially designated waterbodies around the Great Lakes that show symptoms of serious water quality degradation. Most of the 42 Areas of Concern are located in harbors, bays, or river mouths entering the Great Lakes. RAPs identify impaired uses and examine management options for addressing degradation in an Area of Concern. LaMPs use an ecosystem approach to examine water quality issues that have more widespread impacts within each Great Lake. Public involvement is a critical component of both LaMP development and RAP development.


Paul Goetz, Cary, NC

EPA advocates pollution prevention as the most effective approach for achieving the virtual elimination of persistent toxic discharges into the Great Lakes. The GLNPO has funded numerous pollution prevention grants throughout the Great Lakes Basin since FY93. The GLNPO is targeting its grant dollars to support projects that further the goal of virtual elimination of persistent toxic substances. As part of the efforts to protect Lake Superior, EPA, the States, and Canada are implementing a virtual elimination initiative for Lake Superior that seeks to eliminate new contributions of critical pollutants, especially mercury.

The Great Lakes Water Quality Initiative is a key element of the environmental protection efforts undertaken by the United States in the Great Lakes Basin. The purpose of the Initiative is to provide a consistent level of protection in the Basin from the effects of toxic pollutants. In 1989, the Initiative was organized by EPA at the request of the Great Lakes States to promote consistency in their environmental programs in the Great Lakes Basin with minimum requirements.

Initiative efforts were well under way when Congress enacted the Great Lakes Critical Programs Act of 1990. The Act requires EPA to publish proposed and final water quality guidance that specifies minimum water quality criteria for the Great Lakes System. The Act also requires the Great Lakes States to adopt provisions that are consistent with the EPA final guidance within 2 years of EPA's publication. In addition, Indian Tribes authorized to administer an NPDES program in the Great Lakes Basin must also adopt provisions consistent with EPA's final guidance.

To carry out the Act, EPA proposed regulations for implementing the guidance on April 16, 1993, and invited the public to comment. The States and EPA conducted public meetings in all of the Great Lakes States during the comment period. As a result, EPA received over 26,500 pages of comments from over 6,000 commenters. EPA reviewed all of the comments and published the final guidance in March of 1995.

The final guidance prioritizes control of long-lasting pollutants that accumulate in the food web—bioaccumulative chemicals of concern (BCCs). The final guidance includes provisions to phase out mixing zones for BCCs (except in limited circumstances), more extensive data requirements to ensure that BCCs are not underregulated due to a lack of data, and water quality criteria to protect wildlife that feed on aquatic prey. Publication of the final guidance was a milestone in EPA's move toward increasing stakeholder participation in the development of innovative and comprehensive programs for protecting and restoring our natural resources.

The Chesapeake Bay Program

The Chesapeake Bay is an enormously complex and dynamic system of fish, waterfowl, and vegetation in an estuary where salt water from the Atlantic Ocean and fresh water from its many tributaries in the 64,000-square-mile watershed come together. The extremely shallow and productive Bay presents formidable challenges to the understanding and management of this great estuary. In many areas of the Bay, water quality is not sufficient to support living resources year round. In the warmer months, large portions of the Bay contain little or no dissolved oxygen, which may cause fish eggs and larvae to die. The growth and reproduction of oysters, clams, and other bottom-dwelling animals are impaired. Adult fish find their habitat reduced and their feeding inhibited.

Many areas of the Bay also have cloudy water from excess sediment in the water or an overgrowth of algae (stimulated by excessive nutrients in the water). Turbid waters block the sunlight needed to support the growth and survival of Bay grasses, also known as submerged aquatic vegetation (SAV). Without SAV, critical habitat for fish and crabs is lost. Although there has been a recent resurgence of SAV in some areas of the Bay, most areas still do not support abundant populations as they once did.

The main causes of the Bay's poor water quality and aquatic habitat loss are elevated levels of the nutrients nitrogen and phosphorus. Both are natural fertilizers found in animal wastes, soil, and even the atmosphere. These nutrients have always existed in the Bay, but not at the present elevated concentrations. When the Bay was surrounded primarily by forests and wetlands, very little nitrogen and phosphorus ran off the land into the water. Most of it was absorbed or held in place by the natural vegetation. As the use of the land has changed and the watershed's population has grown, the amount of nutrients entering the Bay has increased tremendously.

The Chesapeake Bay Program is a unique regional partnership leading and directing the restoration of Chesapeake Bay since 1983. The Chesapeake Bay Program partners include the States of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission; and EPA. The Chesapeake Executive Council, made up of the governors of Maryland, Pennsylvania, and Virginia; the mayor of the District of Columbia; the EPA administrator; and the chair of the Chesapeake Bay Commission, provides leadership for the Bay Program and establishes program policies to restore and protect the Bay and its living resources.

The Bay Program has set itself apart by adopting strong numerical goals and commitments with deadlines, and tracking progress with an extensive array of environmental indicators. In the 1987 Chesapeake Bay Agreement, Chesapeake Bay Program partners set a goal to reduce the nutrients nitrogen and phosphorus entering the Bay by 40% by the year 2000. In the 1992 amendments to the Agreement, partners agreed to maintain the 40% goal beyond the year 2000 and to attack nutrients at their source—upstream in the tributaries. Recent agreements have outlined a regional focus to address toxic problem areas, set specific goals and commitments for federally owned lands throughout the watershed, involved the 1,650 local governments in the Bay restoration effort, and addressed land use management in the watershed, including a riparian buffer initiative.

Since its inception, the Chesapeake Bay Program's highest priority has been the restoration of the Bay's living resources—its finfish, shellfish, Bay grasses, and other aquatic life and wildlife. Now, the Chesapeake is clearly on the upswing. Bay grasses have increased by 70% since 1984, with recent population changes suggesting that many of these populations may rebound if water quality conditions are improved and maintained. Striped bass populations have reached historically high levels and wild shad are increasing in numbers as hatchery-reared shad successfully reproduce and their offspring make their runs back up into tributaries. Bald eagles are also returning to the Chesapeake Bay, with over 500 young produced in 1996, up from only 63 young in 1977.

Other improvements have also been observed in the Bay. The Bay Program, through 1996, has reopened 272 miles of fish spawning habitat through its fish passage initiative. According to the Toxics Release Inventory, chemical releases in the Bay watershed have shown a 55% drop between 1988 and 1994, and Toxics of Concern have declined by 62% during the same period.

In spite of near record-high flows in 3 of the past 4 years, most of the Bay's major rivers are running cleaner than they were 10 years ago. Phosphorus concentrations have shown significant reductions throughout most of the Bay, and nitrogen levels have remained steady in spite of the high flows and population increases. Overall, these nutrient trends indicate that water quality conditions in this important tributary are improving basinwide.

Despite these promising trends in nutrients, dissolved oxygen levels are still low enough to cause severe impacts and stressful conditions in the mainstem of the Bay and several of the larger tributaries. A long-term decline in the abundance of the native waterfowl is also of great concern. The necessary corrective action to reverse this trend is habitat improvement and resurgence of SAV.

Sam Mohar, 4th Grade, Burton GeoWorld, Durham, NC

The blue crab is currently the most important commercial and recreational fishery in the Bay. With increasing fishing pressures and relatively low harvests in recent years, there is growing concern for the health of the stocks. While scientists agree that neither the crab population nor the fishery are on the verge of collapse, they concur that the stock is fully exploited. The 1997 Blue Crab Fisheries Management Plan contains recommendations to maintain regulations, limit access to the fishery, prevent exploitation and improve research and monitoring and incorporates an enhanced habitat section recommending protection and restoration of Bay grasses and water quality.

Overall, the Chesapeake Bay still shows symptoms related to stress from an expanding population and the changes such growth brings about in land use. However, the concentrated restoration and management effort begun 12 years ago has produced tangible results. When taken as a whole, results from cooperative monitoring of input from the Bay's rivers generally show very encouraging signs.

The Gulf of Mexico Program

The Gulf of Mexico Program (GMP) was established in August 1988 as a partnership to provide a broad geographic focus on the major environmental issues in the Gulf before they become irreversible or too costly to correct. Its main purpose is to develop and implement strategies for protecting, restoring, and maintaining the health and productivity of the Gulf of Mexico in ways consistent with the economic well being of the

Region. This partnership also includes representatives from State and local government, Federal agencies, and the citizenry in each of the five Gulf States, the private sector (business, industry, and agriculture), and the academic community. The partnership provides:

- A mechanism for addressing complex problems that cross Federal, State, and international jurisdictional lines
- Better coordination among Federal, State, and local programs, increasing the effectiveness and efficiency of the long-term commitment to manage and protect Gulf resources
- A regional perspective to access and provide the information and address research needs required for effective management decisions
- A forum for affected groups using the Gulf, for public and private educational institutions, and for the general public to participate in the solution process.

Through its partnerships, the GMP is working with the scientific community, policy makers at the Federal, State and local levels, and the public to help preserve and protect America's abundant sea. It has made significant progress identifying the environmental issues in the Gulf Ecosystem and organizing a program to address those issues. Eight issue areas were initially identified as Program concerns:

- Habitat degradation in such areas as coastal wetlands, seagrass beds, and sand dunes
- Freshwater inflow changes in the volume and timing of flow resulting from reservoir construction; diversions for municipal, industrial, and agricultural purposes; and modifications to watersheds with concomitant alteration of runoff patterns
- Nutrient enrichment resulting from such sources as municipal wastewater treatment plants, storm water, industries, and agriculture
- Toxic substances and pesticides contamination originating from industrial, urban, and agricultural sources
- Coastal and shoreline erosion caused by natural and human-related activities
- Public health threats from swimming in, and eating seafood products coming from, contaminated water
- Marine debris from land-based and marine recreational and commercial sources
- Sustainability of the living aquatic resources of the Gulf of Mexico ecosystem.

The current focus of the GMP is on nutrient enrichment, shellfish restoration, critical habitat, and introduction of exotic species.

The GMP is now focusing its limited resources on implementation of actions to address specific problems that emerged as the Program concerns were characterized. The current focus is on nutrient enrichment, shellfish restoration, critical habitat, and introduction of exotic species. Other operational efforts provide public education and outreach and data and information transfer.

Since its formation in 1988, the GMP has been committed to sponsoring projects that will benefit the environmental health of the region. These projects, numbering over 200, vary immensely, from "shovel-in-the-ground" demonstration projects to scientific research to public education. Examples include a wetlands restoration project in Texas' Galveston Bay System, a Bay Rambo Artificial Oyster Reef project in Louisiana, a Shellfish Growing Water Restoration project in Mississippi, a demonstration project in sewage management in Alabama, and a health professional education program in Florida.

Ground Water Protection Programs

The sage adage that "An ounce of prevention is worth a pound of cure" is being borne out in the field of ground water protection. Studies evaluating the cost of prevention versus the cost of cleaning up contaminated ground water have found that there are real cost advantages to promoting protection of our Nation's ground water resources.

Numerous laws, regulations, and programs play a vital role in protecting ground water. The following Federal laws and programs enable, or provide incentives for,

Jeff Reynolds, Raleigh, NC

EPA and/or States to regulate or voluntarily manage and monitor sources of ground water pollution:

- The Safe Drinking Water Act (SDWA) authorizes EPA to ensure that water is safe for human consumption. One of the most fundamental ways to ensure consistently safe drinking water is to protect the source of that water (i.e., ground water). Source water protection is achieved through three SDWA programs: the Wellhead Protection Program, the Sole Source Aquifer Program, and the Underground Injection Control Program. The 1996 Amendments to the SDWA also created the Source Water Assessment Program to ensure that States conduct assessments to determine the vulnerability of drinking water to contamination.

- The Resource Conservation and Recovery Act (RCRA) addresses the problem of safe disposal of the huge volumes of solid and hazardous waste generated nationwide each year. RCRA is part of EPA's comprehensive program to protect ground water resources through the development of regulations and methods for handling, storing, and disposing of hazardous material and through the regulation of underground storage tanks—the most frequently cited source of ground water contamination.

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 created several programs operated by EPA, States, Territories, and Tribes that act to protect and restore contaminated ground water. Restoration of contaminated ground water is one of the primary goals of the Superfund program. As stated in the National Contingency Plan, EPA expects to return usable ground waters to their beneficial uses, wherever possible, within a time frame that is reasonable given the particular circumstances of the site.

- Clean Water Act Sections 319(h) and (i) and 518 provide funds to State agencies and Indian Tribes to implement EPA-approved nonpoint source management programs and ground water protection activities. Such activities include assessing and characterizing ground water resources; delineating wellhead protection areas; and addressing ground water protection priorities.

Comprehensive State Ground Water Protection Programs

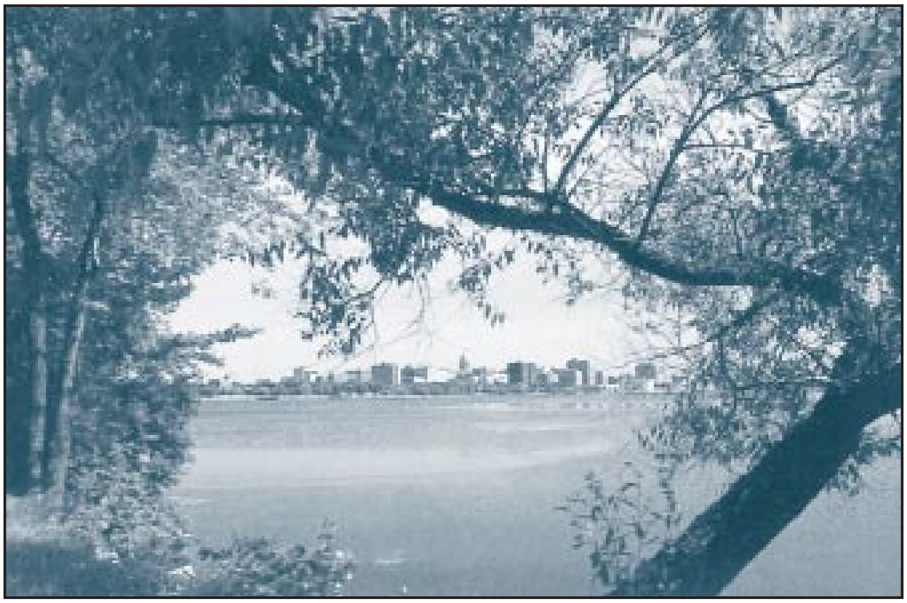
A Comprehensive State Ground Water Protection Program (CSGWPP) is composed of six "strategic activities." They are:

- Establishing a prevention-oriented goal
- Establishing priorities, based on the characterization of the resource and identification of sources of contamination
- Defining roles, responsibilities, resources, and coordinating mechanisms
- Implementing all necessary efforts to accomplish the State's ground water protection goal
- Coordinating information collection and management to measure progress and reevaluate priorities
- Improving public education and participation.

- Section 102 of the Clean Water Act grants States the authority to develop Comprehensive State Ground Water Protection Programs (CSGWPPs) tailored to their goals and priorities for the protection of ground water resources. CSGWPPs attempt to combine all of the above efforts and emphasize contamination prevention. The programs provide a framework for EPA to give greater flexibility to a State for management and protection of its ground water resources. CSGWPPs guide the future implementation of all State and Federal ground water programs and provide a framework for States to coordinate and set priorities for all ground-water-related activities.

Another means of protecting our Nation's ground water resources is through the implementation of Wellhead Protection Plans (WHPs). EPA's Office of Ground Water and Drinking Water is supporting the development and implementation of WHP Programs at the local level through many efforts. For example, EPA-funded support is provided through the National Rural Water Association (NRWA) Ground Water/ Wellhead Protection programs. As of December 31, 1996, over 2,600 communities had become involved in developing local WHP plans. These 2,600 communities represent over 6 million people. Over 1,600 of these communities have completed their plans and are managing their wellhead protection areas to ensure the community that their water supplies are protected.

As a result of the 1996 Amendments to the SDWA, source water protection has become a national priority. Accordingly, EPA included a source water protection goal in a draft of *Environmental Goals for America With Milestones for 2005*, which was released in January 1996. The draft goal states that "by the year 2005, 60% of the population served by community water systems will receive their water from systems with source water protection programs in place." This goal will be achieved using a three-phased approach, which builds upon key accomplishments and foundations, such as the WHP Program, and maximizes the use of new tools and resources provided for under the 1996 Amendments. The new emphasis on public involvement and new State Source Water Assessment Programs should lead to State Source Water Protection Programs. Also, the Amendments provide States an unprecedented opportunity for source water assessment and protection programs to use new funds from the Drinking Water State Revolving Fund (DW-SRF) program for eligible set-aside activities.



Meg Turville-Heitz, Madison, WI

Comprehensive State ground water protection programs support State-directed priorities in resource protection.

What You Can Do

Federal and State programs have helped clean up many waters and slow the degradation of others. But government alone cannot solve the entire problem, and water quality concerns persist. Nonpoint source pollution, in particular, is everybody's problem, and everybody needs to solve it.

Examine your everyday activities and think about how you are contributing to the pollution problem. Here are some suggestions on how you can make a difference.

Paul Kazyak, Maryland Department of Natural Resources

Be Informed

You should learn about water quality issues that affect the communities in which you live and work. Become familiar with your local water resources. Where does your drinking water come from? What activities in your area might affect the water you drink or the rivers, lakes, beaches, or wetlands you use for recreation?

Learn about procedures for disposing of harmful household wastes so they do not end up in sewage treatment plants that cannot handle them or in landfills not designed to receive hazardous materials.

Be Responsible

In your yard, determine whether additional nutrients are needed before you apply fertilizers, and look for alternatives where fertilizers might run off into surface waters. Consider selecting plants and grasses that have low maintenance requirements. Water your lawn conservatively. Preserve existing trees and plant new trees and shrubs to help prevent erosion and promote infiltration of water into the soil. Restore bare patches in your lawn to prevent erosion. If you own or manage land through which a stream flows, you may wish to consult your local county extension office about methods of restoring stream banks in your area by planting buffer strips of native vegetation.

Around your house, keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Use the minimum amount of water needed when you wash your car. Never dispose of any household, automotive, or gardening wastes in a storm drain. Keep your septic tank in good working order.

Within your home, fix any dripping faucets or leaky pipes and install water-saving devices in shower heads and toilets. Always follow directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal sites such as approved service stations or designated landfills.

Be Involved

As a citizen and a voter there is much you can do at the community level to help preserve and protect our Nation's water resources. Look around. Is soil erosion being controlled at construction sites? Is the community sewage plant being operated efficiently and correctly? Is the community trash dump in or along a stream? Is road deicing salt being stored properly?

Become involved in your community election processes. Listen and respond to candidates' views on water quality and environmental issues. Many communities have recycling programs; find out about them, learn how to recycle, and volunteer to help out if you can. One of the most important things you can do is find out how your community protects water quality, and speak out if you see problems.

Volunteer Monitoring: You Can Become Part of the Solution

In many areas of the country, citizens are becoming personally involved in monitoring the quality of our Nation's water. As a volunteer monitor, you might be involved in taking ongoing water quality measurements, tracking the progress of protection and restoration projects, or reporting special events, such as fish kills and storm damage.

Volunteer monitoring can be of great benefit to State and local governments. Some States stretch their monitoring budgets by using data collected by volunteers, particularly in remote areas that otherwise might not be monitored at all. Because you are familiar with the water resources in your own neighborhood, you are also more likely to spot unusual occurrences such as fish kills.

The benefits to you of becoming a volunteer are also great. You will learn about your local water resources and have the opportunity to become personally involved in a nationwide campaign to protect a vital, and mutually shared, resource. If you would like to find out more about organizing or joining volunteer monitoring programs in your State, contact your State department of environmental quality, or write to:

Alice Mayio
Volunteer Monitoring
Coordinator
U.S. EPA (4503F)
401 M St. SW
Washington, DC 20460
(202) 260-7018

For further information on water quality in your State or other jurisdiction, contact your Section 305(b) coordinator listed at the back of this document. Additional water quality information may be obtained from the Regional offices of the U.S. Environmental Protection Agency (see inside back cover).

Nancy Malmgren, Seattle, WA

For Further Reading

EPA's Volunteer Monitoring Program. EPA-841-F-95-001. February 1995. Contains a brief description of EPA activities to promote volunteer monitoring.

Volunteer Monitoring. EPA-800-F-93-008. September 1993. A brief fact sheet about volunteer monitoring, including examples of how volunteers have improved the environment.

National Directory of Citizen Volunteer Environmental Monitoring Programs, Fourth Edition. EPA-841-B-94-001. January 1994. Contains information about 519 volunteer monitoring programs across the Nation.

Volunteer Stream Monitoring: A Methods Manual. EPA-841-D-95-001. 1995. Presents information and methods for volunteer monitoring of streams.

Volunteer Estuary Monitoring: A Methods Manual. EPA-842-B-93-004. December 1993. Presents information and methods for volunteer monitoring of estuarine waters.

Volunteer Lake Monitoring: A Methods Manual. EPA-440/4-91-002. December 1991. Discusses lake water quality issues and methods for volunteer monitoring of lakes.

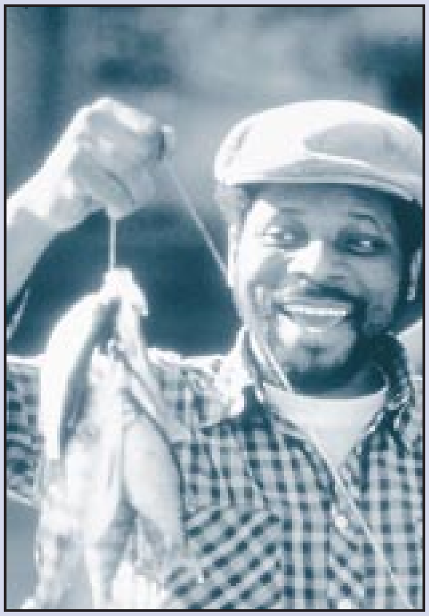
Many of these publications can also be accessed on the Internet at **http://www.epa.gov/volunteer/epasvmp.html**.

Fish Consumption Advisories

States issue fish consumption advisories to protect the public from ingesting harmful quantities of toxic pollutants in contaminated fish and shellfish. Fish may accumulate dangerous quantities of pollutants in their tissues by ingesting many smaller organisms, each contaminated with a small quantity of pollutant. This process is called bioaccumulation or biomagnification. Pollutants also enter fish and shellfish tissues through the gills or skin.

Fish consumption advisories recommend that the public limit the quantity and frequency of consumption of fish caught in specific waterbodies. The States tailor individual advisories to minimize health risks based on contaminant data collected in their fish tissue sampling programs. Advisories may completely ban fish consumption in severely polluted waters, or limit fish consumption to several meals per month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, and nursing mothers), specific fish species, or larger fish that may have accumulated high concentrations of a pollutant over a longer lifetime than a smaller, younger fish.

The EPA fish consumption advisory database tracks advisories issued by States and Tribes. For 1996, the database listed 2,196 fish consumption advisories in effect in 47 States, the District of Columbia, and American Samoa. Fish consumption advisories are unevenly distributed among the States because the States use their own criteria to determine if fish tissue concentrations of toxics pose a health risk that justifies an advisory. States also vary the amount of fish tissue monitoring they conduct and the number of pollutants analyzed. States that conduct more monitoring and use strict criteria will issue more advisories than States that conduct less monitoring and use weaker criteria. For example, 70% of the advisories active in 1996 were issued by the States surrounding the Great Lakes, which support extensive fish sampling programs and follow strict criteria for issuing advisories.


Chesapeake Bay Foundation, Richmond, VA

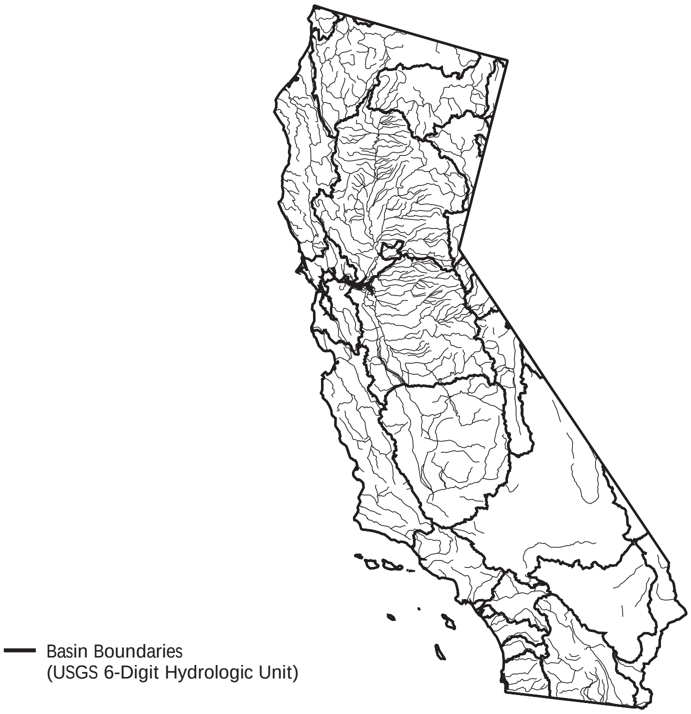
Most of the fish consumption advisories (76%) are due to mercury. The other pollutants most commonly detected in elevated concentrations in fish tissue samples are polychlorinated biphenyls (PCBs), chlordane, dioxins, and DDT (with its byproducts).

Many coastal States report restrictions on shellfish harvesting in estuarine waters. Shellfish–particularly oysters, clams, and mussels–are filter-feeders that extract their food from water. Waterborne bacteria and viruses may also accumulate on their gills and mantles and in their digestive systems. Shellfish contaminated by these microorganisms are a serious human health concern, particularly if consumed raw.

States currently sample water from shellfish harvesting areas to measure indicator bacteria, such as total coliform and fecal coliform bacteria. These bacteria serve as indicators of the presence of potentially pathogenic microorganisms associated with untreated or undertreated sewage. States restrict shellfish harvesting to areas that maintain these bacteria at concentrations in sea water below established health limits.

In 1996, 10 States reported that shellfish harvesting restrictions were in effect for 4,804 square miles of estuarine and coastal waters during the 1994-1996 reporting period. Five States reported that nonpoint sources, point sources, urban runoff and storm sewers, municipal wastewater treatment facilities, marinas, septic tanks, and industrial discharges restricted shellfish harvesting.

California



For a copy of the California 1996 305(b) report, contact:

Nancy Richard
California State Water Resources
Control Board, M&A
Division of Water Quality
P.O. Box 944213
Sacramento, CA 94244-2130
(916) 657-0642

Surface Water Quality

Siltation, metals, nutrients, and bacteria impair the most river miles in California. The leading sources of degradation in California's rivers and streams are agriculture, unspecified nonpoint sources, forestry activities, urban runoff and storm sewers, and municipal point sources. In lakes, siltation, metals, and nutrients are the most common pollutants. Hydrologic/habitat modifications pose the greatest threat to lake water quality, followed by urban runofff/storm sewers, construction/land development, and atmospheric deposition.

Metals, pesticides, trace elements, and unknown toxic contaminants are the most frequently identified pollutants in estuaries, harbors, and bays. Urban runoff and storm sewers are the leading source of pollution in California's coastal waters, followed by municipal sewage treatment plants, agriculture, spills, resource extraction, and industrial dischargers. Oceans and open bays are degraded by industrial and municipal point sources.

Ground Water Quality

Salinity, total dissolved solids, and chlorides are the most frequently identified pollutants impairing use of ground water in California, followed by nutrients and pesticides. Leading sources are septage disposal, agriculture, and dairies. The State also reports that trace inorganic elements, flow alterations, and nitrates degrade over 1,000 square miles of ground water aquifers.

Programs to Restore Water Quality

California's stormwater permit program, which was the first in the Nation, has matured into an aggressive program to reduce pollution associated with stormwater runoff.

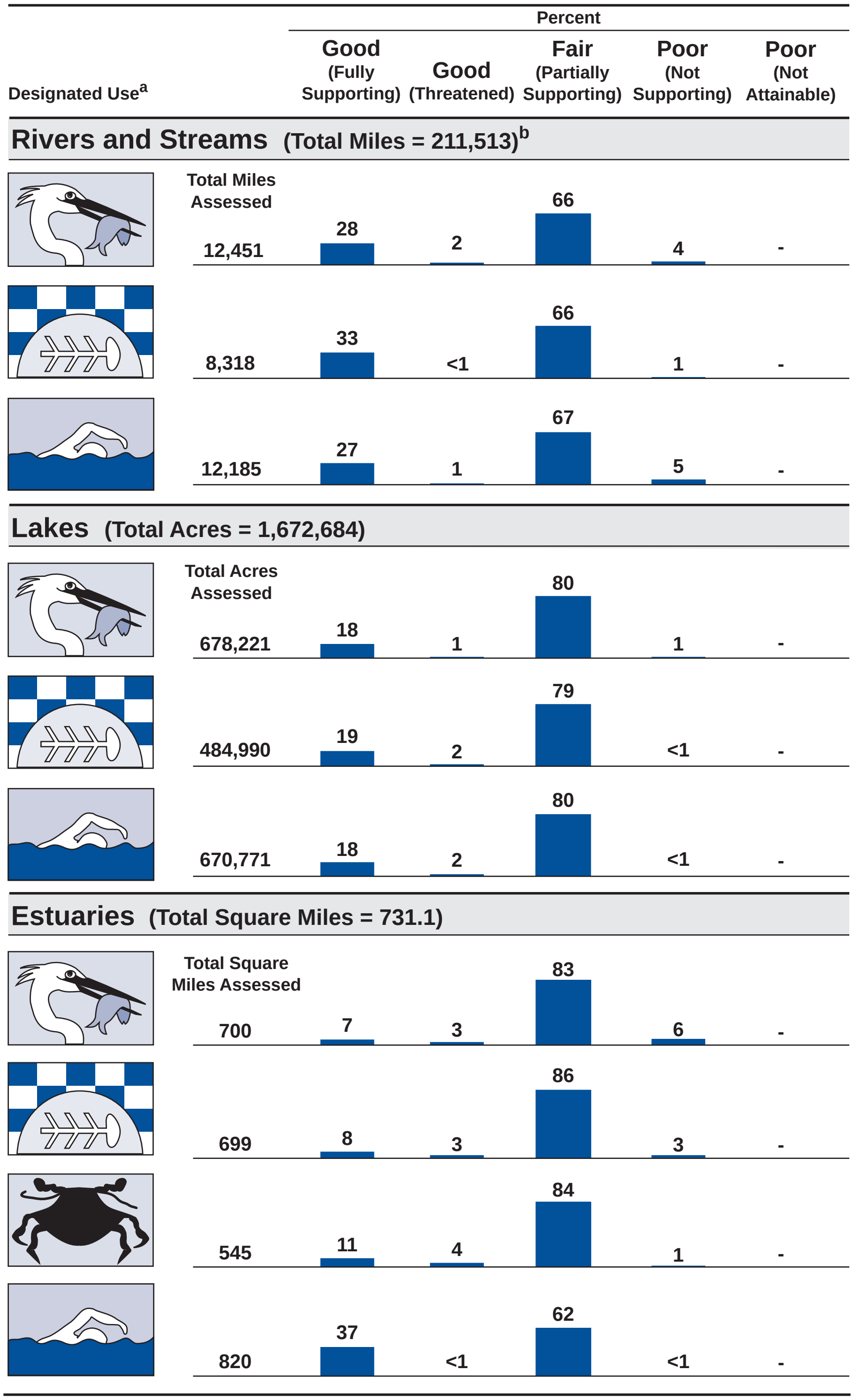
The State Water Resources Control Board (SWRCB) is embarking on a Watershed Management Initiative in order to integrate point and nonpoint pollution source controls on a watershed basis.

Programs to Assess Water Quality

Saltwater monitoring in 1994 and 1995 included shellfish tissue analysis from coastal sites, sediment chemistry and toxicity testing (bioassays) in bays and estuaries, a regional monitoring pilot project along the coast, and water column monitoring for toxic pollutants in San Francisco Bay.

Inland water monitoring included toxicity testing and pesticide analysis in some agricultural areas, statewide fish tissue sampling, biological monitoring in the Sacramento-San Joaquin Delta, and several nonpoint source pollution studies in river basins around the State.

Individual Use Support in California



Designated Use[a]		Good (Fully Supporting)	Good (Threatened)	Fair (Partially Supporting)	Poor (Not Supporting)	Poor (Not Attainable)
Rivers and Streams (Total Miles = 211,513)[b]	Total Miles Assessed					
	12,451	28	2	66	4	-
	8,318	33	<1	66	1	-
	12,185	27	1	67	5	-
Lakes (Total Acres = 1,672,684)	Total Acres Assessed					
	678,221	18	1	80	1	-
	484,990	19	2	79	<1	-
	670,771	18	2	80	<1	-
Estuaries (Total Square Miles = 731.1)	Total Square Miles Assessed					
	700	7	3	83	6	-
	699	8	3	86	3	-
	545	11	4	84	1	-
	820	37	<1	62	<1	-

Percent

– Not reported in a quantifiable format or unknown.

[a] A subset of California's designated uses appear in this figure. Refer to the State's 305(b) report for a full description of the State's uses.

[b] Includes nonperennial streams that dry up and do not flow all year.

Note: Figures may not add to 100% due to rounding.

National Water Quality Inventory: Report to Congress

2004 Reporting Cycle

January 2009

United States Environmental Protection Agency
Office of Water
Washington, DC 20460

EPA 841-R-08-001

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List of Acronyms

ATTAINS	Assessment TMDL Tracking And ImplementatioN System (Water Quality Assessment and TMDL Information)
BEACH Act	Beaches Environmental Assessment and Coastal Health Act of 2000
DIN	dissolved inorganic nitrogen
DIP	dissolved inorganic phosphorus
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
IBI	Index of Biotic Integrity
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
TMDL	total maximum daily load
USGS	U.S. Geological Survey

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Executive Summary

This *National Water Quality Inventory: 2004 Report to Congress,* prepared under section 305(b) of the Clean Water Act, summarizes water quality reports submitted electronically by 44 states, 2 territories, and the District of Columbia to the U.S. Environmental Protection Agency (EPA) for the 2004 reporting cycle. These state water quality assessment findings are contained in EPA's Water Quality Assessment and Total Maximum Daily Load (TMDL) Information database and website, known as ATTAINS (**A**ssessment **T**MDL **T**racking **A**nd **I**mplementatio**N** **S**ystem), for the 2004 reporting cycle. The ATTAINS database is available online at the website http://www.epa.gov/waters/ir.

EPA developed the **A**ssessment **T**MDL **T**racking **A**nd **I**mplementatio**N** **S**ystem (ATTAINS) database and website to combine two formerly separate sites — the National Assessment Database (for 305(b) water quality assessment information) and the National Total Maximum Daily Loads (TMDL) Tracking System (for 303(d) impaired waters information). The ATTAINS database/website includes state-reported assessment decisions on the support of designated uses (such as recreation) in assessed waters; the waters that are impaired; the causes of impairment (such as pathogens); the sources of impairment (such as agriculture); and the status of actions (TMDLs) to help restore impaired waters.

ATTAINS contains this information for each waterbody assessed by the states and summarizes key waterbody information by state, by region, and nationally. If a state did not provide waterbody-specific information electronically to EPA by the reporting deadline, it was not included in this report. EPA worked extensively with the states to assist in data submittal.

Summary findings of the 2004 state water quality reports are presented below. It is important to note that this information is for a relatively small subset of the nation's total waters which may not be representative of the waters that were not assessed. Because many states target their limited monitoring resources to waters that they suspect are impaired, there may be a lower percentage of impaired waters among the non-assessed (and total) waters than among the assessed waters. Information about specific sources and causes of impairment is incomplete because the states do not always report the cause or source of pollution affecting every impaired waterbody. In some cases, states may recognize that water quality does not fully support a designated use; however, they may not have adequate data to document the specific pollutant or source responsible for the impairment. EPA also made changes in how specific causes and sources are categorized for 2004, and these changes in some cases affect how the findings of causes and sources of impairment compare to findings of previous years. Readers are urged to consult the ATTAINS website for detailed listings of the causes and sources of impairment reported by states.

Rivers and Streams

This report includes states' assessments of 16% of the nation's 3.5 million miles of rivers and streams for the 2004 reporting cycle. Of these waterbodies, 44% were reported as impaired or not clean enough to support their designated uses, such as fishing and swimming. States found the remaining 56% to be fully supporting all assessed uses. Pathogens, habitat alterations, and organic enrichment/oxygen depletion were cited as the leading causes of impairment in rivers and streams, and top sources of impairment included agricultural activities, hydrologic modifications (such as water diversions and channelization), and unknown/unspecified sources.

Lakes and Reservoirs

This report includes states' assessments of 39% of the nation's 41.7 million acres of lakes, ponds, and reservoirs during the 2004 reporting cycle. Of these waterbodies, 64% were reported as impaired and 36% were fully supporting all assessed uses. Mercury, polychlorinated biphenyls (PCBs), and nutrients were cited as the leading causes of impairment in lakes. Top sources of pollutants to lakes, ponds, and reservoirs included atmospheric deposition, unknown/unspecified sources, and agriculture.

Bays and Estuaries

This report includes states' assessments of 29% of the nation's 87,791 square miles of bays and estuaries for the 2004 reporting cycle. Of these assessed waterbodies, 30% were reported as impaired, and the remaining 70% fully supported all assessed uses. Pathogens, organic enrichment/oxygen depletion, and mercury were reported as the leading causes of impairment in bays and estuaries. Top sources of impairment to bays and estuaries included atmospheric deposition, unknown/unspecified sources, and municipal discharges/sewage.

Probability Studies of Water Quality

EPA and states have embarked on a series of probability-based surveys that are discussed later in this report. Probability-based surveys complement more traditional targeted monitoring and assessment programs and add substantially to our understanding of state, regional, and national water quality conditions. These studies select sites at random to provide estimates of the condition of a population of waters throughout a state, region, or the nation. They describe the percent of waters in a state or region supporting Clean Water Act goals and the percent of waters affected by the stressors that are included in the study design, which can inform protection and restoration priorities. Probabilistic surveys are a cost-effective approach for tracking changes in condition and stressors across the population of waters of the United States. As more states adopt probabilistic monitoring, EPA will be able to more accurately report on water quality trends. This effort will also help inform water quality policy and ensure resources are appropriately targeted. As of 2008, 30 states were participating in probabilistic water quality surveys, and EPA has set a goal of having participation by all 50 states by 2011. To date, EPA has provided $65 million in additional section 106 grant monitoring funds to help states improve water quality monitoring programs and implement probabilistic survey designs.

Future Reporting

States are working to strengthen their water monitoring and assessment programs by developing long-term monitoring strategies that identify the specific actions needed to move toward more comprehensive and consistent reporting of water quality conditions. These actions include implementing probability-based surveys in combination with more traditional monitoring targeted to waters of interest. In addition, states and EPA have streamlined water quality assessment and reporting by integrating various Clean Water Act reporting requirements and facilitating and improving electronic reporting of water data. The results of these efforts will be more comprehensive and valid information that can be easily accessed by water quality managers and the public in a timely fashion and used to describe water quality on a state, regional, or national scale.

I. Background

Under section 305(b)(1)(A) of the Clean Water Act, states, territories, and other jurisdictions of the United States are required to submit reports on the quality of their waters to the U.S. Environmental Protection Agency (EPA) every 2 years. Historically, states submitted these reports in hardcopy format, and EPA prepared a national hardcopy report that summarized their findings (see http://www.epa.gov/305b/). Under section 303(d) of the Clean Water Act, states also biennially provide a separate prioritized list of those waters that are impaired and require the development of pollution controls (to learn more about section 303(d) reporting, visit http://www.epa.gov/owow/tmdl/).

Beginning with the 2002 reporting cycle, EPA urged states to combine sections 305(b) and 303(d) reporting requirements into one integrated report and to submit these reports electronically. EPA has encouraged states to combine these reports for several reasons. Integrating these reports merges environmental data from a variety of water quality programs, increases the consistency of this information, benefits the public by providing a more informed summary of the quality of assessed state waters, and provides decision makers with better information on the actions necessary to protect and restore these waterbodies. The integrated report also streamlines state reporting burdens by eliminating the need for two separate reports.

For the 2004 reporting cycle, 16 of the 44 water quality reports submitted by the states were fully integrated. Progress toward full integration is expected in coming years. Data for both integrated and non-integrated state reports are available on EPA's new Water Quality Assessment and Total Maximum Daily Load (TMDL) Information database and website, known as ATTAINS (**A**ssessment **T**MDL **T**racking and **I**mplementatio**N** **S**ystem). To facilitate the states' efforts to improve integrated reporting, EPA published reporting guidance in 2005 and a series of clarifying memoranda in subsequent years. For more information on integrated reporting, visit http://www.epa.gov/owow/tmdl/guidance.html#tmdl.

About the Water Quality Assessment and TMDL Information Database (ATTAINS)

The Water Quality Assessment and TMDL Information database, known as ATTAINS (for **A**ssessment **T**MDL **T**racking and **I**mplementatio**N** **S**ystem), presents electronic water quality information submitted since 2002 by the states, territories, and the District of Columbia. ATTAINS allows the user to view, via the Internet, dynamic tables and charts that summarize state-reported data for the nation as a whole, for individual states, for individual waters, and for the ten EPA regions. It shows which waters have been assessed, which are impaired, and which have plans (e.g., TMDLs) completed to help restore them. By displaying data in one location, ATTAINS allows for a more informed summary of the quality of state waters that have been assessed and provides decision makers with better information on the actions necessary to protect and restore assessed waters of the U.S.

To view ATTAINS, go to http://www.epa.gov/waters/ir and click on the map to find summary information and assessment results for specific states, EPA regions, watersheds, and waterbodies of interest. You can select information for a specific biennial reporting cycle (e.g., 2002, 2004, etc) or the most recent available information across multiple cycles. A series of tables and charts also summarize the status of assessed waters across the nation.

For this report, EPA has included ATTAINS data from 44 states, the District of Columbia, the U.S. Virgin Islands and Puerto Rico. Pennsylvania, Maryland, Florida, Oregon, Idaho, Hawaii, the tribal nations, and the island territories of the Pacific did not provide data electronically that could be used for the 2004 reporting cycle. Although Pennsylvania, Florida, and Oregon did publish hard copy section 305(b) water quality reports, EPA relies on the electronic submittal by states of assessment information as the source of the water quality findings in this report. Maryland and Hawaii submitted only impaired waters lists under section 303(d) in 2004 and did not provide information on assessed waters that were not impaired. Idaho is submitting a combined 2004/2006/2008 integrated report in 2008. Although only 2004 reporting cycle data were used for this report, it is important to note that the ATTAINS database contains all available waterbody-specific data reported by the states and territories from 2002 on.

About half the states conduct their own probability-based surveys (based on statistical random sampling design) to complement this information and to draw state-wide conclusions about the state's water resources. EPA fully supports these state efforts to provide more complete assessments of their waters and to increase their percentage of assessed waters. Because state-level probabilistic monitoring efforts are in their initial stages in many states, the results of these state-scale probability surveys for the most part are not included in the 2004 ATTAINS database. We expect that the 2008 version of the database will begin to do so, and that we will be able to move toward water quality reports that assess all the states' waters, providing a valuable complement to current knowledge on the subset of waters with targeted monitoring.

Comparability of Water Quality Data

Although the information in ATTAINS provides a picture of state assessment results, these data should not be used to compare water quality conditions between states, identify trends in statewide or national water quality, or compare the impacts of specific causes or sources of impairment over time. The following are reasons for this lack of comparability:

- The methods states use to monitor and assess their waters, including what and how they monitor and how they report their findings to EPA, vary from state to state and within individual states over time. Many states target their limited monitoring resources to waters they suspect are impaired, or to address local priorities and concerns; therefore, the small percentage of waters assessed may not reflect statewide conditions. States may monitor a different set of waters from one reporting cycle to another, or may monitor fewer waters when state budgets are limited. It is also important to note that six states did not provide electronic data for the 2004 reporting cycle, and that the lack of data from these states affects the summary statistics.
- The science of monitoring and assessment varies over time, and many states are better able to identify problems as their monitoring and analytical methods improve. For example, states are conducting more fish tissue sampling than in previous years. The use of improved assessment methods to collect better information may result in more extensive and protective fish consumption advisories, even though water quality conditions themselves may not have changed.
- For the 2004 reporting cycle, EPA re-evaluated how it grouped sources and causes reported by the states into larger overall categories (such as municipal discharges/sewage or metals other than mercury) for national reporting purposes. The purpose of this re-evaluation was to more accurately categorize the source and cause information reported by the states. Some overall source and cause categories were renamed, and some state-reported sub-categories were moved into different overall categories compared to the 2002 reporting cycle. (See the section *Sources of Impairment* in this report for more information.)
- Under the Clean Water Act, each state has the authority to set its own water quality standards; therefore, a state's definition of its designated uses (for example, Warm Water Fishery or Livestock Watering) may differ from definitions used by other states, along with the criteria against which states determine impairments. (See the section *Assessing Water Quality*, below, for more information.)

Assessing Water Quality

States assess the quality of their waters based on water quality standards they develop in accordance with the Clean Water Act. Water quality standards may differ from state to state, but must meet minimum requirements. EPA must approve these standards before they become effective under the Clean Water Act.

Designated Use Categories in this Report

The states have different names for the various uses they have designated for their waters. For example, one state might designate as Class A those waters that are capable of supporting fish species of commercial and recreational value (e.g., salmon, trout), whereas another state might classify similar waters as Cold Water Fishery waters. The ATTAINS database groups state-reported uses according to the following overall categories:

- **Fish, Shellfish, and Wildlife Protection and Propagation** – Is water quality good enough to support a healthy, balanced community of aquatic organisms?
- **Recreation** – Can people safely swim or enjoy other recreational activities in and on the water?
- **Public Water Supply** – Does the waterbody safely supply water for drinking after standard treatment?
- **Aquatic Life Harvesting** – Can people safely eat fish caught in the waterbody?
- **Agricultural** – Can the waterbody be used for irrigating fields and watering livestock?
- **Industrial** – Can the water be used for industrial processes?
- **Aesthetic Value** – Is the waterbody aesthetically appealing?
- **Exceptional Recreational or Ecological Significance** – Does the waterbody qualify as an outstanding natural resource or support rare or endangered species?

You can find out which state classifications fit under each of these categories by clicking on the individual use category name in the ATTAINS database.

Water quality standards consist of three elements: the **designated uses** assigned to waters (e.g., recreation, public water supply, the protection and propagation of aquatic life); the **criteria** or thresholds (expressed as numeric pollutant concentrations or narrative requirements) that are necessary to protect the designated uses; and the **anti-degradation** policy intended to prevent waters from deteriorating from their current condition. Waters may be designated for more than one use. To learn more about water quality standards, visit http://www.epa.gov/waterscience/standards/.

After setting water quality standards, states assess their waters to determine the degree to which the standards are being met. State water quality assessments are normally based on six broad types of monitoring data: biological integrity, chemical, physical, microbiological, habitat, and toxicity. (Examples of the different types of data used to determine a state’s water quality are shown in the box below.) Each type of monitoring data yields an assessment that must be integrated with other data types for an overall assessment. Depending on the designated use, one data type may be more informative than others for making the final assessment.

Types of Monitoring Data

- **Biological integrity data:** Objective measurements of aquatic biological communities (usually aquatic insects, fish, or algae) used to evaluate the condition of an aquatic ecosystem. Biological data are best used when deciding whether waters support aquatic life uses.
- **Chemical data:** Measurements of key chemical constituents in water, sediments, and fish tissue. Examples of these constituents include metals, oils, pesticides, and nutrients such as nitrogen and phosphorus. Monitoring for specific chemicals helps states assess waters against numerical criteria, as well as identify and trace the source of the impairment.
- **Physical data:** Characteristics of water, such as temperature, flow, suspended solids, sediment, dissolved oxygen, and pH. These physical attributes are often useful indicators of potential problems and can have an effect on the impacts of pollution.
- **Microbiological data:** Measurements of pathogen indicators such as fecal and total coliform bacteria, *E.coli* and *Enterococci.* Monitoring of these indicators helps determine possible contamination by such things as untreated sewage, septic systems, and livestock or pet wastes, and is often used to determine if waters are safe for recreation and shellfish harvesting.
- **Habitat assessments:** Descriptions of sites and surrounding land uses; condition of streamside vegetation; and measurement of features, such as stream width, depth, flow, and substrate. These assessments are used to supplement and interpret other kinds of data.
- **Toxicity testing:** Measurements of mortality of a test population of selected organisms, such as fathead minnows or *Daphnia* (“water fleas”). These organisms are exposed to known dilutions of water taken from the sampling location. The resulting toxicity data indicate whether an aquatic life use is being attained. These tests can help determine whether poor water quality results from toxins or from habitat degradation.

States, tribes, and other jurisdictions monitor for a variety of pollutants, or causes of impairment. Table 1 provides a list of major causes of impairment cited in this report.

Table 1. Major Impairment Cause Categories Used in this Report

Category	Examples
Cause Unknown – Impaired Biota	Impairment or degradation of the biological community (e.g. fish, macroinvertebrates) due to unknown/unidentified cause
Dioxins	Highly toxic, carcinogenic, petroleum-derived chemicals that are persistent in the environment and may be found in fish tissue, water column, or sediments
Flow Alterations	Changes in stream flow due to human activity; includes water diversions for purposes such as irrigation
Habitat Alterations	Modifications to substrate, streambanks, fish habitat; barriers
Metals	Substances identified only as “metals;” also, selenium, lead, copper, arsenic, manganese, others (Note: may, in some cases, include mercury)
Mercury	A toxic metal with neurological and developmental impacts; found in fish tissue, water column, or sediments
Nuisance Exotic Species	Non-native fish, animals, or plants such as Eurasian milfoil, *Hydrilla*, or zebra mussels, which choke out native species and alter the ecological balance of waters
Nutrients	Primarily nitrogen and phosphorus; in excess amounts, these nutrients overstimulate the growth of weeds and algae and can lead to oxygen depletion
Organic Enrichment/ Oxygen Depletion	Low levels of dissolved oxygen; high levels of biochemical oxygen demanding substances (e.g., organic materials such as plant matter, food processing waste, sewage) that use up dissolved oxygen in water when they degrade

Category	Examples
Pathogens	Bacteria and pathogen indicators *E.coli*, total coliforms, fecal coliforms, *Enterococci*; used as indicators of possible contamination by sewage, livestock runoff, and septic tanks
Polychlorinated biphenyls (PCBs)	A toxic mixture of chlorinated chemicals that are no longer used, but are persistent in the environment; used originally in industry and electrical equipment; primarily found in fish tissue or sediments
Pesticides	Substances identified only as "pesticides;" also, chlordane, atrazine, carbofuran, and others; many older pesticides are persistent in the environment
Sediment	Excess sediments, siltation; affects aquatic communities by altering and suffocating habitat and clogging fish gills
Toxic Organics	Chemicals identified only as "toxic organics;" also, priority organic compounds, non-priority organic compounds, polycyclic aromatic hydrocarbons (PAH), and others; often persistent in the environment

Where possible, states, tribes, and other jurisdictions identify the sources of those pollutants associated with water quality impairment. **Point sources** discharge pollutants directly into surface waters from a conveyance, such as a pipe. Point sources include industrial facilities, municipal sewage treatment plants, combined sewer overflows, and storm sewers. **Nonpoint sources** deliver pollutants to surface waters from diffuse origins, such as fields and streets. Nonpoint sources include urban runoff that is not captured in a storm sewer; agricultural runoff from cropland and grazing areas; leaking septic tanks; and deposition of contaminants in the atmosphere due to air pollution. Habitat alterations, dams, channelization, dredging, and stream bank destabilization are also significant sources of water quality degradation. See Table 2 for more information on source categories used in this report.

For 2004 reporting, EPA reorganized many source categories compared to previous reporting cycles; therefore, apparent significant increases or decreases in individual categories (e.g., Municipal Discharges/Sewage) may be attributable to these reporting changes rather than to actual changes in the impact of an individual source category.

Table 2. Major Pollutant Source Categories Used in this Report

Category	Examples
Agriculture	Crop production, feedlots (including concentrated animal feeding operations), grazing, manure runoff
Atmospheric Deposition	Airborne pollution from many diverse sources (such as factory and automobile emissions and pesticide applications) that settles to land or water
Construction	Residential development, bridge and road construction, land development
Habitat Alterations (Not Directly Related to Hydromodification)	Riparian and in-stream habitat modification and loss, filling and draining of wetlands, removal of riparian vegetation, streambank erosion
Hydromodification	Pond construction, channelization, dam construction, dredging, flow alterations from water diversions, flow regulation, hydropower generation, streambank destabilization and modification, upstream impoundments
Industrial	Factories, industrial and commercial areas, cooling water intake structures, mill tailings

Category	Examples
Land Application/Waste Sites/Tanks	Salt storage piles, land application of biosolids, land disposal, landfills, leaking underground storage tanks
Legacy/Historical Pollutants	Brownfield sites, contaminated sediments, in-place contaminants
Municipal Discharges/Sewage	Septic systems, sewage treatment plants, domestic sewage lagoons, sanitary sewer overflows, municipal dry and wet weather discharges, unpermitted discharges of domestic wastes, combined sewer overflows, septage disposal
Natural/Wildlife	Flooding, drought-related impacts, waterfowl
Recreation and Tourism	Golf courses, marinas, turf management, boat maintenance
Resource Extraction	Abandoned mining, acid mine drainage, coal mining, dredge mining, mountaintop mining, petroleum/natural gas activities, surface mining
Silviculture (Forestry)	Forest management, forest fire suppression, forest roads, reforestation, woodlot site clearance
Spills/Dumping	Accidental releases/spills, pipeline breaks
Unknown	Source of impairment is unknown
Unspecified Nonpoint Source	Source of impairment is identified as nonpoint, but no further information available
Urban-Related Runoff/Stormwater	Discharges from municipal separate storm sewers (MS4), parking lot and impervious surfaces runoff, highway and road runoff, storm sewers, urban runoff, permitted stormwater discharges

Hundreds of organizations in the United States conduct water quality monitoring. Monitoring organizations include state, interstate, tribal, and local water quality agencies; research organizations such as universities; industries and sewage and water treatment plants; and citizen volunteer programs. EPA, the U.S. Geological Survey (USGS), the National Park Service (NPS), and the National Oceanic and Atmospheric Administration (NOAA) are among the many federal agencies that collect water quality monitoring data. Monitoring organizations collect water quality data for their specific purposes, and many share their data with other users, including government decision makers. States evaluate and use much of these data when preparing their water quality reports.

The states, territories, and tribes maintain monitoring programs to support several objectives, including assessing whether water is safe for drinking, swimming, and fishing. States also use monitoring data to review and revise water quality standards, identify impaired and threatened waters under Clean Water Act section 303(d), develop pollutant-specific TMDLs, determine the effectiveness of control programs, adjust drinking water treatment requirements, measure progress toward clean-water goals, and respond to citizen complaints or events such as spills and fish kills.

Nationally consistent probability surveys are an efficient way to get a good understanding of national water quality conditions and trends. Probability surveys are scientifically based studies designed to sample water quality conditions at randomly selected sites that are statistically representative of the population of waters across the United States. EPA and its monitoring partners have used this methodology to develop a series of *National Coastal Condition Reports* (http://www.epa.gov/nccr/). These reports summarize the findings of the National Coastal Assessment, a probability-based study. Another probability-based project currently underway is the National Study of Chemical Residues in Lake Fish Tissue (www.epa.gov/waterscience/fishstudy), which is the first national freshwater fish contamination survey to have statistically selected sampling sites. EPA also partnered with states to conduct a probability-based Wadeable Streams Assessment (www.epa.gov/owow/streamsurvey) to determine the biological condition of small streams in the United States. The Wadeable Streams Assessment was completed in 2006.

To learn more about the water quality monitoring, assessment, and reporting practices of a specific state, visit the state's water quality Internet site and read the explanatory and programmatic information included in most reports.

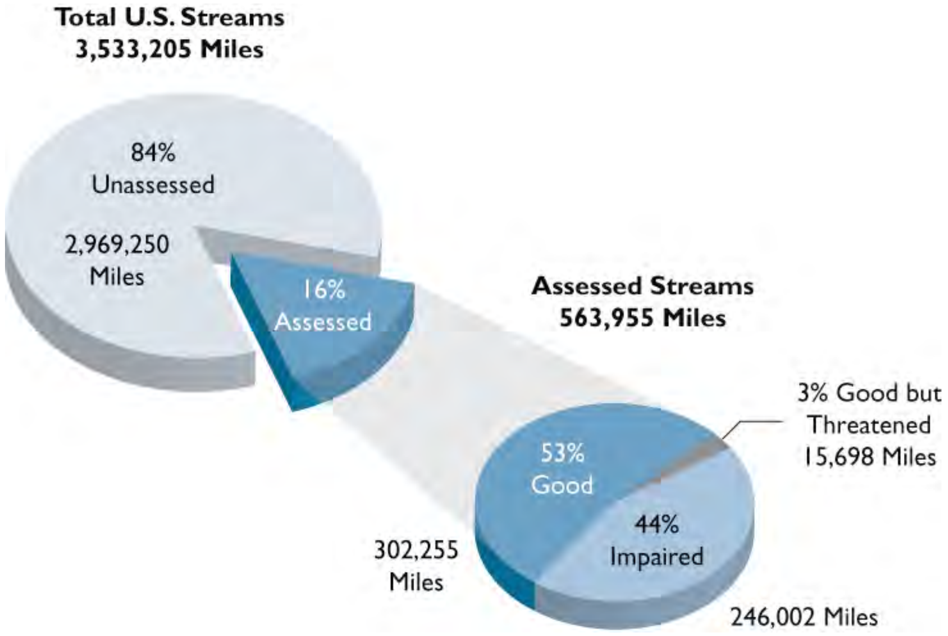
II. Findings

Rivers and Streams

The 2004 ATTAINS database summarizes river and stream designated use support information reported by the states by overall use support and by individual categories of uses. Waters are rated for overall use support as follows:

- Good if they fully support all their designated uses
- Threatened if they fully support all uses, but exhibit a deteriorating trend
- Impaired if they are not supporting one or more designated uses.

This report includes states' 2004 assessments of 563,955 miles of rivers and streams, or 16% of the nation's 3.5 million stream miles (Figure 1). Because six states did not provide specific waterbody data electronically in 2004, the findings of this report address about 130,000 fewer stream miles than were reported in 2002. States identified 44% of the assessed miles as being impaired, or not supporting one or more of their designated uses. The remaining 56% of assessed miles fully supported all uses, and of these, 3% were considered threatened (i.e., water quality supported uses, but exhibited a deteriorating trend).



*Total U.S. river and stream miles based on state 2004 Integrated Reports.
Percents may not add up to 100 because of rounding.

Figure 1. Water quality in assessed river and stream miles.

Individual use support assessments also provide important details about the nature of water quality problems in rivers and streams. Table 3 shows the top five assessed uses in rivers and streams. States evaluated support of the Fish, Shellfish, and Wildlife Protection and Propagation use most frequently, assessing a total of 466,617 stream miles (or 13% of U.S.

stream miles) and reporting that 36% of assessed stream miles were impaired for this use. States assessed 303,317 stream miles for Recreation uses (primary and secondary contact) and found recreation to be impaired in 28% of these waters.

Table 3. Individual Use Support in Assessed River and Stream Miles[a]

Designated Use	Miles Assessed	Percentage of Total U.S. River Miles	Percentage of Waters Assessed		
			Good	Threatened	Impaired
Fish, Shellfish, and Wildlife Protection/Propagation	466,617	13	61	3	36
Recreation	303,317	9	69	3	28
Agricultural	200,817	6	90	<1	10
Aquatic Life Harvesting	154,746	4	56	4	40
Public Water Supply	144,245	4	79	3	18

[a] Waterbodies can have multiple designated uses, resulting in an overlap of river and stream miles assessed.

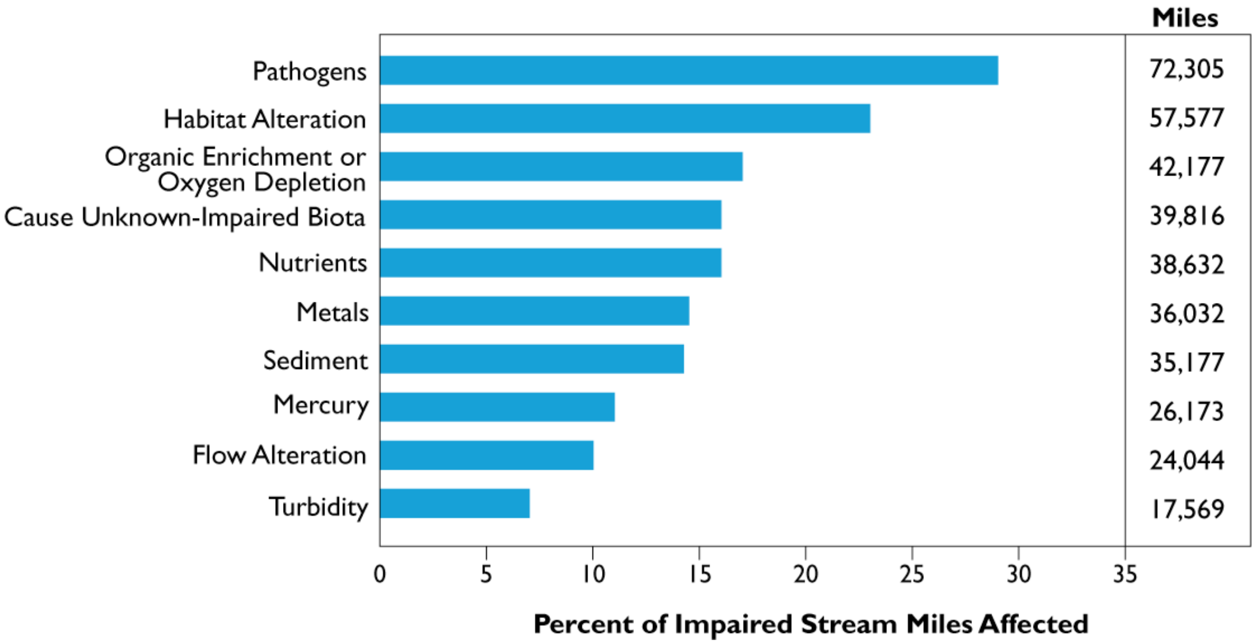
The ATTAINS database provides more detailed information about the sources and causes of impairments in rivers and streams, but it is important to note that the information about specific sources and causes of impairment is incomplete. States do not always report the pollutant or source of pollutants affecting every impaired river and stream. Although states may recognize that water quality does not fully support a designated use, they may not have adequate data in some cases to document the specific pollutant or source responsible for the impairment.

It is also important to note that— in an effort to provide clearer and more specific information— the actual categories of causes of impairment have changed since previous reporting cycles. For example, the cause of impairment category previously identified as Metals has now been divided into two cause categories: Metals and Mercury; however, some states may continue to report mercury under the Metals category.

Similar changes have occurred to the source categories used in this report. For example, a new source category —Unspecified Nonpoint Source— was created in 2004 to capture sources previously part of the Unspecified/Unknown category, but for which *some* information (i.e., their nonpoint source origins) had been identified; therefore, the Unknown/Unspecified category is somewhat smaller in 2004 than it was in 2002. Similarly, the 2002 source category Municipal Permitted Discharges has been renamed Municipal Discharges/Sewage and now captures combined and sanitary sewer overflows; therefore, it is larger than it was in 2002.

Figure 2 shows the top 10 reported causes of impairment in assessed rivers and streams. According to the states, the top causes of river and stream impairment regardless of designated use were the following:

- **Pathogens (bacteria)**, which indicate possible fecal contamination that may cause illness in people;
- **Habitat alteration,** such as disruption of stream beds and riparian areas; and
- **Organic enrichment/oxygen depletion,** or low levels of dissolved oxygen, often due to the decomposition of organic materials.



Note: Percents do not add up to 100% because more than one cause may impair a waterbody.

Figure 2. Top 10 causes of impairment in assessed rivers and streams.

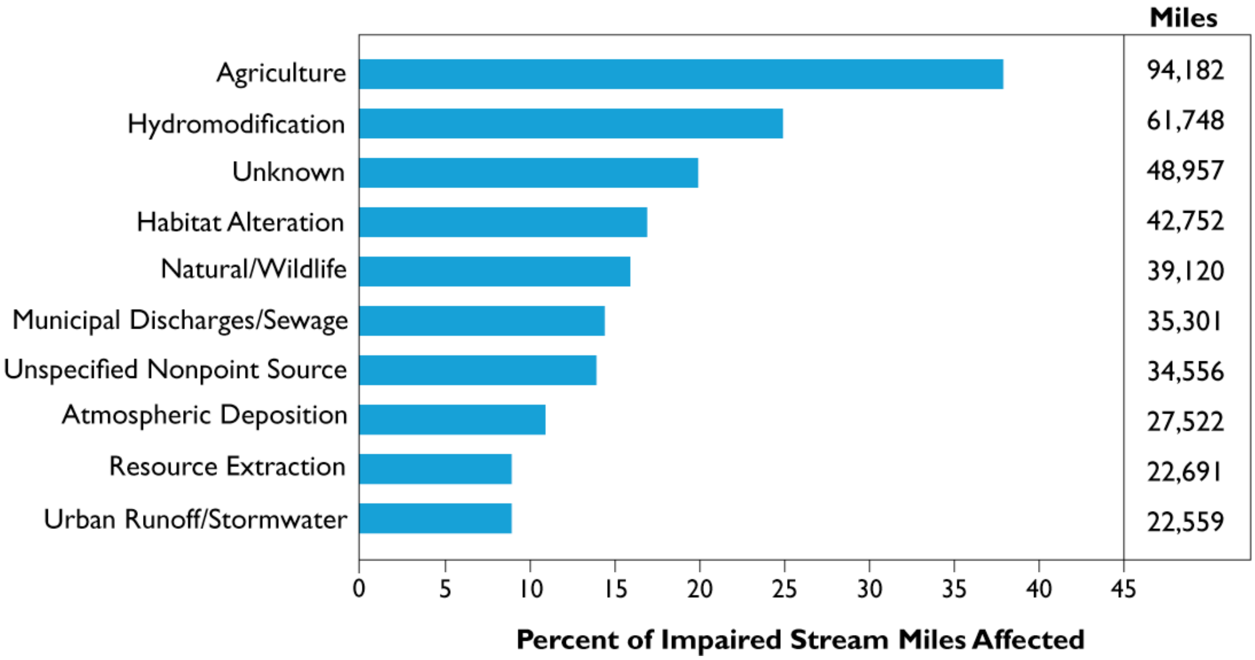
The listed top 10 causes of impairment (above) differ from those reported in 2002. This difference is more likely attributable to reporting changes (e.g., fewer river and stream miles assessed; improved reporting of the results of fish tissue monitoring; and administrative changes in cause category definitions, described above) than to actual changes in water quality.

More detailed information on state-reported causes and sources of impairment is available from the ATTAINS Water Quality Assessment and TMDL Information database at http://www.epa.gov/ir.

Figure 3 shows the top reported sources of impairment in assessed rivers and streams. According to the states, the top sources of river and stream impairment included the following:

- **Agricultural activities**, such as crop production, grazing, and animal feeding operations;
- **Hydromodifications**, such as water diversions, channelization, and dam construction; and
- **Unknown or unspecified sources** (i.e., the states could not identify specific sources).

Other leading sources of impairment in streams included habitat alteration (e.g., loss of streamside habitat), natural sources (e.g., floods, droughts, wildlife), municipal discharges/sewage (which includes sewage treatment plant discharges and combined sewer overflows), and unspecified nonpoint sources.



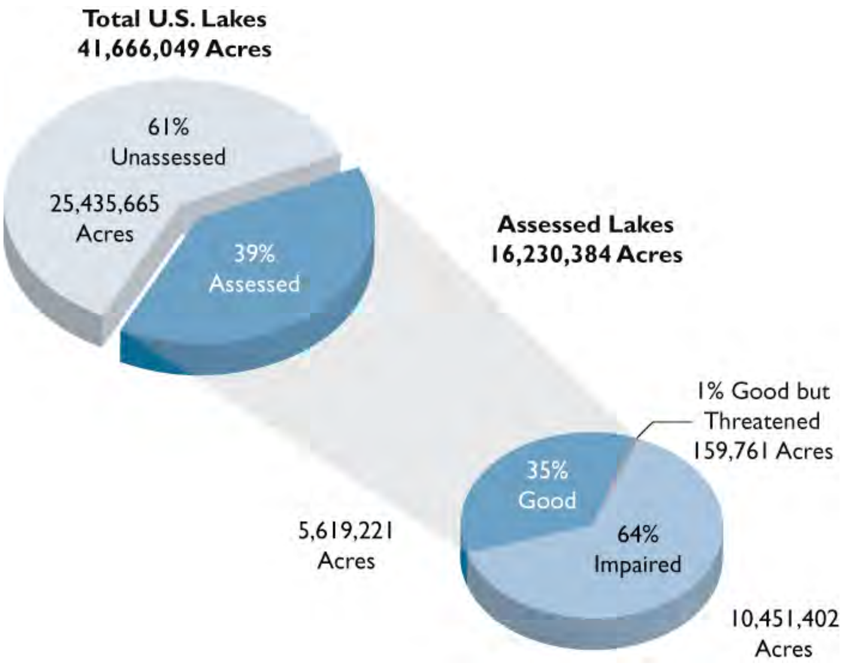
Note: Percents do not add up to 100% because more than one source may impair a waterbody.

Figure 3. Top 10 sources of impairment in assessed rivers and streams.

Lakes, Ponds, and Reservoirs

The 2004 ATTAINS Water Quality Assessment and TMDL Information database summarizes designated use support information reported by the states for lakes, ponds, and reservoirs (referred to hereafter as lakes) by overall use support and by individual categories of uses.

This report includes states' assessments of 16.2 million acres of lakes (excluding the Great Lakes), or 39% of the nation's total 41.7 million lake acres, for the 2004 reporting cycle (Figure 4). States identified 64% of assessed acres as impaired, or not supporting one or more of their designated uses (such as fishing or swimming). The remaining 36% of assessed acres fully supported all uses, and of these, 1% were considered threatened. It should be noted that 3.7 million impaired lake acres—about a third of all impaired lake acres— were reported by one state, Minnesota, due to increased fish tissue and water monitoring activities addressing mercury.



*Total U.S. lake acreage estimate based on 2004 state Integrated Reports.

Figure 4. Water quality in assessed lake acres.

Individual use support assessments provide important details about the nature of water quality problems in lakes and reservoirs. Table 4 shows the top five uses assessed in lakes, ponds, and reservoirs. States assessed 11.8 million lake acres for support of the Fish, Shellfish, and Wildlife Protection and Propagation use, of which 30% were found to be impaired. The Aquatic Life Harvesting use (primarily fish consumption) was assessed in 9.4 million acres; of these, 73% were impaired and 1% were considered threatened (i.e., water quality is deteriorating). This high percentage of lake, pond, and reservoir waters impaired for fish consumption is most likely related to changes in how states report on waters with statewide fish consumption advisories. For example, in previous cycles, some states may not have reported waters with fishing advisories as impaired. Recreational use (e.g., swimming, boating) was assessed in 8.1 million acres of lakes and found to be impaired in 26%.

Table 4. Individual Use Support in Assessed Lake, Reservoir, and Pond Acres[a]

Designated Use	Acres Assessed	Percentage of Total U.S. Lake Acres	Percentage of Waters Assessed		
			Good	Threatened	Impaired
Fish, Shellfish, and Wildlife Protection/Propagation	11,770,370	28%	66%	4%	30%
Aquatic Life Harvesting	9,390,396	23%	26%	1%	73%
Recreation	8,069,018	19%	70%	4%	26%
Public Water Supply	6,427,687	15%	78%	1%	20%
Industrial	2,848,335	7%	82%	<1%	17%

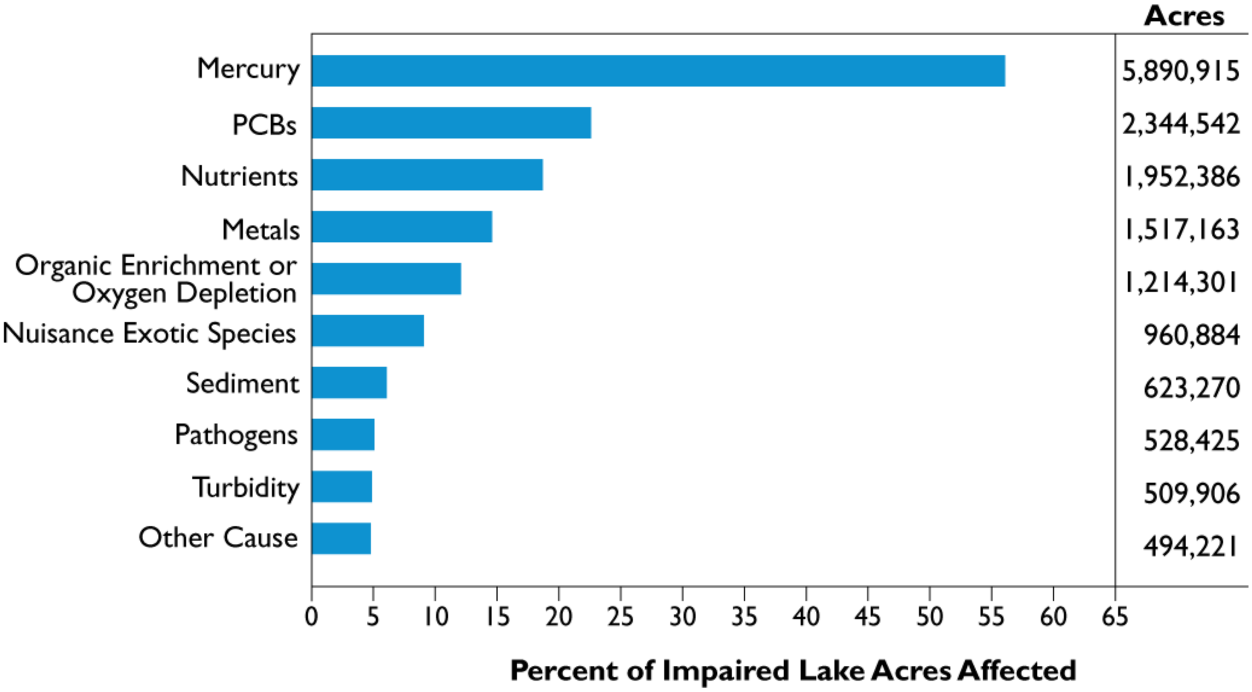
[a] Waterbodies can have multiple designated uses, resulting in an overlap of acres assessed.

The ATTAINS database provides more detailed information on the sources and causes of impairments in lakes, but it is important to note that the information about specific sources and causes of impairment is incomplete. The states do not always report the pollutant or source of pollutants affecting every impaired lake, pond, and reservoir. In some cases, states may recognize that water quality does not fully support a designated use; however, they may not have adequate data to document the specific pollutant or source responsible for the impairment. The states may then simply report the cause or source of impairment as "unknown" or "unspecified."

It is also important to note that, in some cases, groupings of causes and sources may have changed since previous reporting cycles. These changes were made to more accurately categorize the source and cause information reported by the states.

Figure 5 shows the top causes of impairment in assessed lakes, ponds, and reservoirs. According to the states, the top causes of lake impairment were the following:

- **Mercury**, which has been widely detected in fish tissue, where it may pose a health risk to people and animals who eat fish;
- **PCBs**, which are hazardous chemicals released via industrial and municipal waste disposal, spills, and leaks; and
- **Nutrients,** such as phosphorus and nitrogen, which disrupt lake ecosystems by stimulating growth of undesirable algae and aquatic weeds.



Note: Percents do not add up to 100% because more than one cause may impair a waterbody.

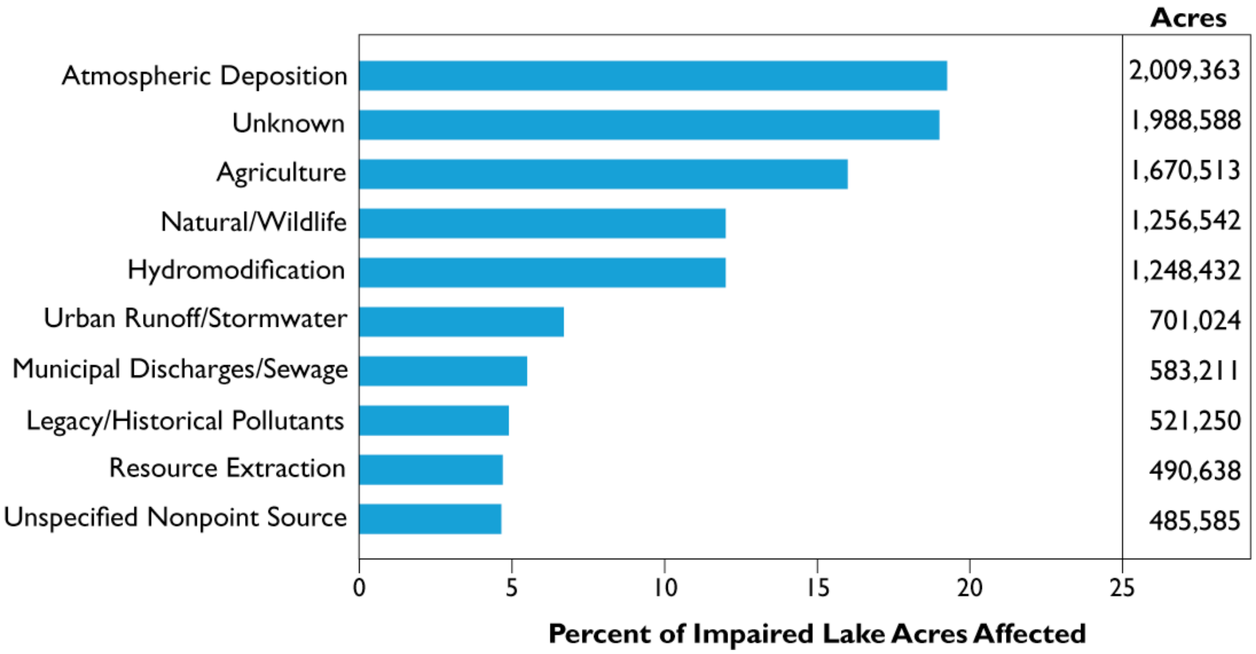
Figure 5. Top 10 causes of impairment in assessed lakes, ponds, and reservoirs.

Heightened reporting of mercury, PCBs, and metals is largely the result of the reporting of broad-based fish consumption advisories due to these substances in fish tissue; some states have begun reporting the extent of waters affected by such advisories and bans. For example, Minnesota reported 3.7 million acres impaired by mercury (representing 63% of the lake acres impaired by mercury in the United States) and 1.6 million acres impaired by PCBs (representing 70% of the lake acres impaired by PCBs in the United States). Other leading causes of impairments in lakes include organic enrichment/low dissolved oxygen, fish consumption advisory/pollutant unspecified, nuisance exotic species, sediment, turbidity, and pathogens.

More information on state-reported causes and sources of impairment is available from the ATTAINS Water Quality Assessment and TMDL Information database at http://www.epa.gov/waters/ir.

Figure 6 shows the top sources of impairment in assessed lakes, ponds, and reservoirs. According to the states, the top sources of lake impairment were the following:

- **Atmospheric (or air) deposition,** primarily of toxic substances such as mercury, PCBs, and other metals, from both local and long-range sources;
- **Unknown or unspecified sources** (i.e., the states could not identify specific sources); and
- **Agricultural activities**, such as crop production and grazing.



Note: Percents do not add up to 100% because more than one source may impair a waterbody.

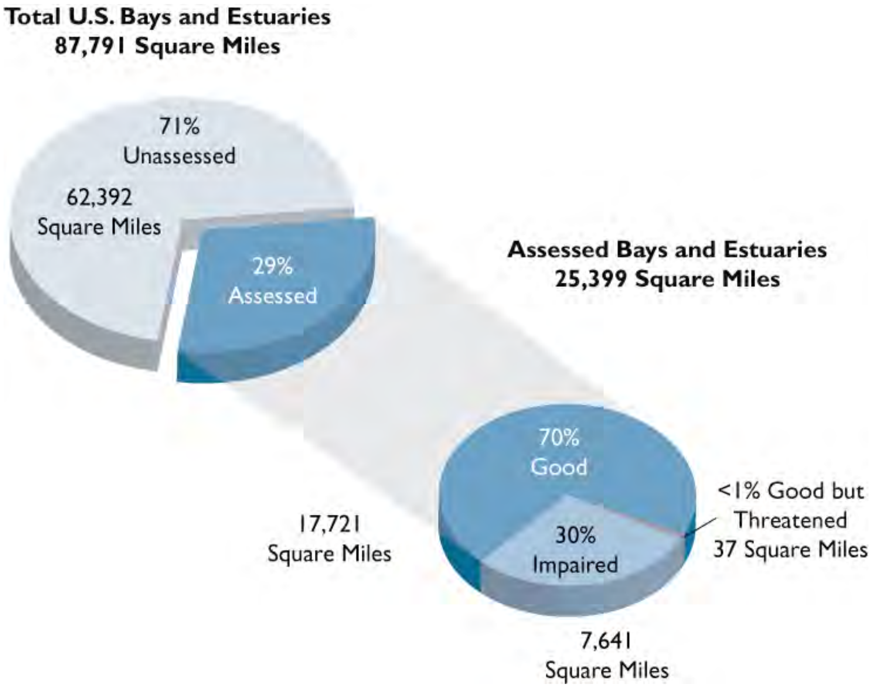
Figure 6. Top 10 sources of impairment in assessed lakes, ponds, and reservoirs.

It should be noted that about one fourth (485,376 acres) of lake acres impaired by atmospheric deposition were reported by one state, Wisconsin. This is because Wisconsin reported that all its lake acres are under a fish consumption advisory due to mercury from atmospheric deposition sources. However, the total does not include lake acres that may be impaired by atmospheric deposition in Minnesota, which reported the largest number of impaired lake acres for mercury and PCBs, because Minnesota did not identify the source of these impairments. It is likely that the majority of impairment by mercury and PCBs in Minnesota is from atmospheric deposition. Other leading sources of impairment include natural/wildlife sources (e.g., droughts, flooding, waterfowl), hydromodification, urban-related runoff/stormwater, municipal discharges/sewage, and legacy/historical pollutants (primarily in sediments).

Bays and Estuaries

The ATTAINS database summarizes state-reported designated use support information for bays and estuaries by overall use support and by individual categories of uses.

This report includes states' assessments of 25,399 square miles of bays and estuaries, or 29% of the nation's total estimated 87,791 square miles, for the 2004 reporting cycle (Figure 7). About 5,000 fewer estuarine square miles were assessed in 2004 than in 2002, at least in part because several coastal states did not provide electronic data in 2004. States identified 30% of assessed square miles as impaired, or not supporting one or more of their designated uses (e.g., swimming, fishing, shellfishing). The remaining 70% of assessed estuarine square miles were fully supporting all uses.



*Total U.S. estuarine square miles estimate based on 2004 state Integrated Reports.

Figure 7. Water quality in assessed bay and estuary square miles

Individual use support assessments provide important details about the nature of water quality problems in bays and estuaries. Table 5 shows the top three uses assessed in bays and estuaries. States assessed 24,338 estuarine square miles for support of the Fish, Shellfish, and Wildlife Protection and Propagation use and found that 27% were impaired; the Aquatic Life Harvesting use was assessed in 11,004 square miles and found to be impaired in 19% of assessed waters; and 13% of the 9,322 square miles assessed for Recreation uses (e.g., swimming, boating) were reported as impaired.

Table 5. Individual Use Support in Assessed Bay and Estuary Square Miles [a]

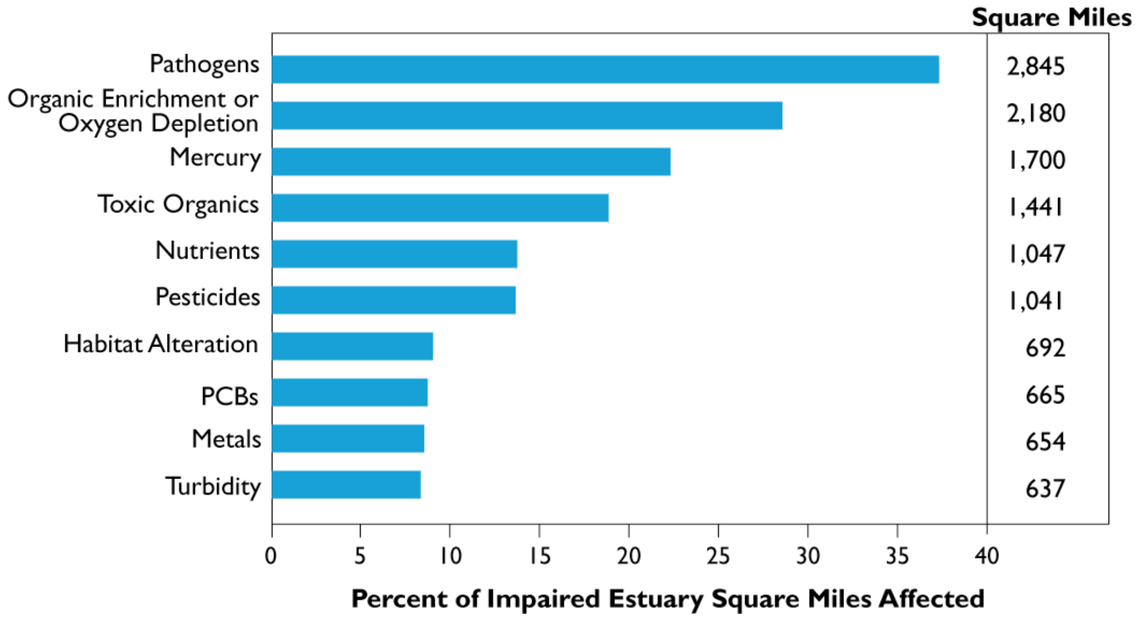
Designated Use	Square Miles Assessed	Percentage of Total U.S. Estuarine Miles	Percentage of Waters Assessed		
			Good	Threatened	Impaired
Fish, Shellfish, and Wildlife Protection/Propagation	24,338	28%	73%	<1%	27%
Aquatic Life Harvesting	11,004	13%	81%	<1%	19%
Recreation	9,322	11%	87%	<1%	13%

[a] Waterbodies can have multiple designated uses, resulting in an overlap of square miles assessed.

State-reported information about specific sources and causes of impairment may be incomplete because the states do not always report the pollutant or source of pollutants affecting every impaired bay and estuary. In some cases, states may recognize that water quality does not fully support a designated use; however, they may not have adequate data to document the specific pollutant or source responsible for the impairment and report the cause or source as "unknown."

Figure 8 shows the top causes of impairment in assessed bays and estuaries. According to the states, the top causes of estuarine impairment were the following:

- **Pathogens**, i.e., bacteria used as indicators of possible contamination by sewage, livestock runoff, and other sources;
- **Organic enrichment/oxygen depletion**, i.e., low levels of dissolved oxygen and/or high levels of oxygen-demanding substances such as organic waste; and
- **Mercury,** a toxic metal found in fish tissue, and, to a lesser extent, in the water column, often entering the aquatic environment via atmospheric deposition.



Note: Percents do not add up to 100% because more than one cause may affect a waterbody.

Figure 8. Top 10 causes of impairment in assessed bays and estuaries.

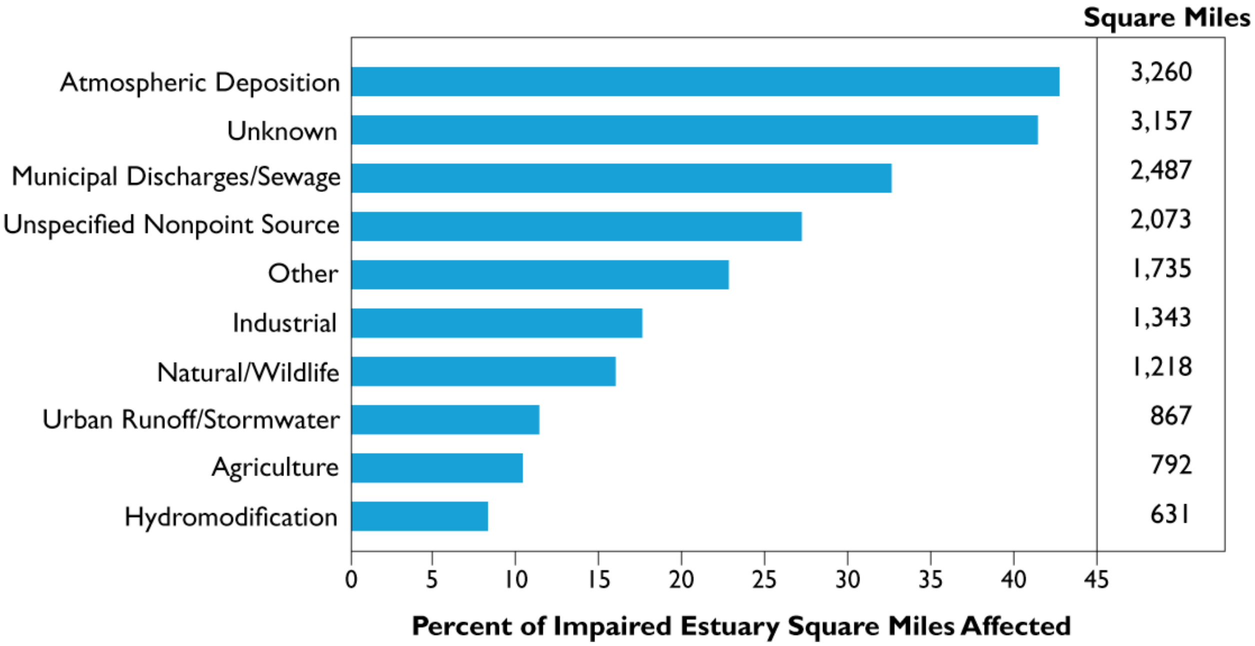
Toxic organics, nutrients, pesticides, and metals are also reported as top causes of impairment for estuarine waters.

Figure 9 shows the top sources of impairment in assessed bays and estuaries. According to the states, the top sources of estuarine impairment included the following:

- **Atmospheric (or air) deposition,** which can bring pollutants such as mercury from distant locations such as industrial centers;
- **Unknown/unspecified sources,** or sources that cannot be further identified by the states; and
- **Municipal discharges/sewage,** which includes septic systems, sewage treatment plants, and sanitary and combined sewer overflows.

More information on state-reported causes and sources of impairment is available from the ATTAINS Water Quality Assessment and TMDL Information database at http://www.epa.gov/waters/ir.

Other leading sources of impairment in bays and estuaries were unspecified nonpoint sources, other sources (such as sources outside state waters), and industrial sources.



Note: Percents do not add up to 100% because more than one source may impair a waterbody.

Figure 9. Top 10 sources of impairment in assessed bays and estuaries.

Other Waters

The 2004 ATTAINS database also contains state-reported information on conditions in coastal shoreline waters, ocean waters, Great Lakes, and wetlands, although, in some cases, only a small percentage of these resources were assessed in the 2004 reporting cycle. These waters are discussed below.

Coastal Resources

Coastal resources are identified in the ATTAINS database in two categories: coastal shorelines (the water immediately offshore, reported in miles) and ocean/near-coastal waters (i.e., the area of water extending into the ocean or gulf, range not specified, in square miles). Eight states assessed 1,859 miles of coastal shorelines, or about 3% of the nation's total 58,618 shoreline miles. The majority of assessed shoreline miles (68%) fully support their designated uses, with 12% of these miles classified as supporting uses, but threatened (i.e., water quality is deteriorating). In the 32% of shoreline miles not fully supporting their uses, metals (which could in some cases include mercury) and pathogens were the leading causes of impairment, and municipal discharges/sewage and industrial sources were listed as top sources of impairment.

To help protect the public at coastal recreation waters, Congress passed the Beaches Environmental Assessment and Coastal Health Act of 2000 (BEACH Act), requiring that coastal and Great Lakes states and territories report to EPA on beach monitoring and notifications to the public of potential health risks. Public notification may include issuing a beach advisory, warning people of possible risks of swimming due to water quality problems, or closing a beach to the public. The BEACH Act also requires EPA to maintain an electronic monitoring and notification database of those data.

For the 2004 swimming season, 28 of 30 coastal states and Puerto Rico reported public notification actions to EPA. Of the 3,574 beaches that were monitored in 2004, 942 (26%) had at least one advisory or closing. A total of 4,907 beach notification actions were reported. EPA calculates "beach days" (number of beaches multiplied by number of days in the swimming season) to get a better sense of the extent of the advisory and closure information. For the 2004 season, EPA determined that there were 584,150 beach days for all of the monitored beaches, and actions were reported about 4% of the time. EPA is continuing to work to improve the delivery of its beach advisory information to the public. Visit http://www.epa.gov/beaches/ for more information on beach monitoring and notification.

A total of 5,544 square miles of oceans and near-coastal waters, or 10% of approximately 54,120 square miles of oceans and near-coastal waters in the United States, were assessed by 5 states in 2004. Of the assessed square miles, 88% were identified as impaired. Mercury was by far the most commonly reported cause of impairment, followed by organic enrichment/oxygen depletion. Atmospheric deposition was the predominant reported source of impairment in oceans and near-coastal waters. (It is important to note that Texas alone assessed nearly 3,879 square miles of oceans and near-coastal waters and reported that 100% of its assessed square miles are impaired due to mercury in fish tissue from atmospheric deposition.)

More information on state-reported causes and sources of impairment is available from the ATTAINS database information website at http://www.epa.gov/waters/ir..

Detailed information on U.S. coastal condition trends is available in the EPA's *National Coastal Condition Report* series, which presents the findings of a collaborative effort between the states, EPA, and other federal agencies to characterize the condition of 100% of the nation's coastal resources. Section III of this report summarizes key findings of the draft *National Coastal Condition Report III.*

Great Lakes

The Great Lakes—Superior, Michigan, Huron, Erie, and Ontario—are freshwater inland seas of vast importance for water consumption, recreation, fisheries, power, transportation, and many other uses. Of the eight states bordering the Great Lakes, six reported on the condition of their Great Lakes shoreline miles.

About 1,070 of 5,521 total Great Lakes shoreline miles were assessed in 2004, and of these, 93% were reported as impaired. The leading causes of impairment included PCBs, toxic organics, pesticides, and dioxins. Legacy or historical pollution—primarily contaminated sediment—were the leading source of shoreline impairment reported by the states, followed by municipal discharges/sewage.

Wetlands

Wetlands occur where water and land come together for a prolonged period of time and where saturation of the land with water is the dominant factor determining soil types and the plant and animal communities living in the soil and on the surface. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Included among the many types of U.S. wetlands are marshes, bogs, swamps, wet meadows, vernal pools, playas, pocosins, sloughs, peat lands, prairie potholes, and fens.

Wetlands are a critically important resource due to the many benefits they provide to humans, aquatic life, wildlife, and the environment. Wetlands produce great quantities of food that attract a huge variety of animal species. They serve as nurseries and habitat for many game and commercial fish and wildlife species, and they help improve water quality by intercepting surface runoff and removing, retaining, or filtering out a broad range of substances (e.g., nutrients, sediments, organic wastes). By storing and slowly releasing water, wetlands help reduce the impacts of floods and erosion, as well as help replenish groundwater and stream flow during dry periods. Wetlands are also of great recreational value to bird watchers, hunters, fishermen, and nature lovers.

Only 10 states provided information on the support of designated uses for 1.8 million acres of wetlands assessed in their 2004 reports—a tiny portion of the nation's estimated 107 million acres. States identified 30% of these assessed acres as impaired. Organic enrichment/oxygen depletion, sediment, and turbidity were the leading causes of wetland degradation in these six states. Agriculture, unknown/unspecified sources, and atmospheric deposition were listed by the states as top contributors to impairment.

Section III of this report discusses plans for an upcoming National Wetland Condition Assessment.

III. Probability Surveys of Water Quality

EPA, other federal agencies, and the states have embarked on a cost-effective approach to assess status and track trends in the quality of the nation's waters: probability-based surveys that complement existing monitoring and assessment programs and add to our understanding of national, regional, and local water quality conditions. Probability surveys are designed to yield unbiased estimates of the condition of a whole resource (such as lakes or rivers and streams) based on a representative sample of waters. These surveys are designed to answer key questions asked by Congress, the public, and decision makers, such as

- Is water quality improving?
- What is the extent of waters that support healthy ecosystems, recreation, and fish consumption?
- How widespread are the most significant water quality problems?
- Are we investing in restoration and protection wisely?

Several national probability-based studies have already been completed, and several more are underway.

Understanding the Value of Probability-based Surveys and the National 305(b) Report

Although some of the findings of the national 305(b) report appear similar to the findings of the national, probability-based coastal and streams surveys, there are many differences in the scope of these reports and how they are best used to inform water quality management.

Probability surveys provide consistent environmental indicators of the condition of the nation's water resources, much as economic indicators report on the health of the nation's economy. Their design ensures that results represent the population of all waters of a certain type across the United States, and their consistent sampling methods ensure that results can be aggregated into regional and national indicators of the health of the resource. The survey results quantify, with documented confidence, how widespread water quality problems are across the country and estimate the extent of waters affected by key stressors. This helps set priorities for water resource protection and restoration. Nationally consistent surveys provide a standardized measure for tracking changes in the condition of the nation's waters over time and for evaluating, at a broad scale, progress in investments to protect and restore water quality.

In contrast to the probability surveys, this national 305(b) report summarizes information reported by states for only a portion of waters (approximately 16% of U.S. river and stream miles, 39% of lake acres, and 29% of bay and estuarine square miles). It tallies state findings based on data collected using a variety of sampling methods and parameters; water quality standards and interpretation methods; extrapolation methods; and time periods. The strength of the 305(b) report is that it provides useful information on the nature of water quality problems identified by state monitoring programs; documents the amount of waters assessed and unassessed; and supports the identification of specific waters not meeting water quality standards; therefore, it helps states set priorities for these waters.

National Coastal Assessment

The National Coastal Assessment surveys the condition of the nation's coastal resources. The results of these surveys have been compiled into the *National Coastal Condition Report* series. The states, EPA, and partner agencies — NOAA, USGS, and the U.S. Fish and Wildlife Service (FWS) — issued the first three reports of the *National Coastal Condition Report* series in 2001, 2005, and 2008. These reports include evaluations of 100% of the nation's estuaries in the contiguous 48 states and Puerto Rico. Federal, state, and local agencies collected samples using nationally consistent methods and a probability-based design to assess five key indices of coastal water health.

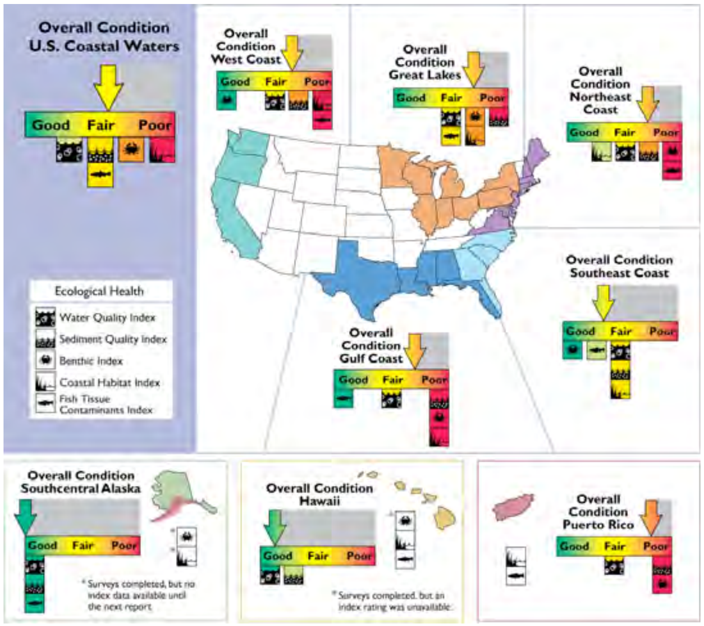


Figure 10. Findings of the *National Coastal Condition Report III* (U.S. EPA, 2008).

The *National Coastal Condition Report III* finds that the overall condition of the nation's coastal waters is generally fair and has improved slightly since the 1990s. This rating is based on five indices of ecological condition: a water quality index (calculated based on ratings for dissolved oxygen, chlorophyll *a*, dissolved inorganic nitrogen, dissolved inorganic phosphorus, and water clarity), a sediment quality index (calculated based on ratings for sediment toxicity, sediment contaminants, and sediment total organic carbon), a benthic index, a coastal habitat index, and a fish tissue contaminants index. For each of these indicators, a score of good, fair, or poor was assigned to each coastal region of the United States. Ratings were then averaged to create the overall regional and national scores illustrated in Figure 10, which uses "traffic light" color scoring. Based on the findings of this survey, fifty-seven percent of the area of the nation's estuaries and coastal embayments are in good condition for the water quality index, 6% are in poor condition, and 35% are in fair condition.

The indices that show the poorest condition are coastal habitat and benthic condition. Two of the individual component indicators of the water quality index generally show the best condition —dissolved oxygen and dissolved inorganic nitrogen.

In 2010, EPA and its partners expect to undertake a new survey of coastal waters and expect to report survey results in 2012. For more information on the *National Coastal Condition Report* series, go to http://www.epa.gov/nccr/.

The Wadeable Streams Assessment

The Wadeable Streams Assessment, a survey of the biological health of the nation's wadeable streams, was launched by EPA and the states to provide a national baseline of stream water quality based on conditions at approximately 1,300 randomly selected sites across the conterminous United States. With support from EPA, state water quality agencies sampled streams using the same methods at all sites. Crews collected macroinvertebrates to determine the biological condition of streams. They also measured key chemical and physical indicators that reveal stress or degradation of streams. The Wadeable Streams Assessment reports on four chemical indicators (i.e., phosphorus, nitrogen, salinity, and acidity) and four physical condition indicators (i.e., streambed sediments, in-stream fish habitat, riparian vegetative cover, and riparian disturbance).

The Wadeable Streams Assessment found that 42% of U.S. stream miles are in poor biological condition compared to best-available reference sites in their ecological regions, 25% are in fair condition, and 28% are in good condition (Figure 11). The confidence level for these key findings of biological quality is ±2.8%. Five percent of U.S. stream miles were not assessed because the New England states did not include first order streams in the sample design.

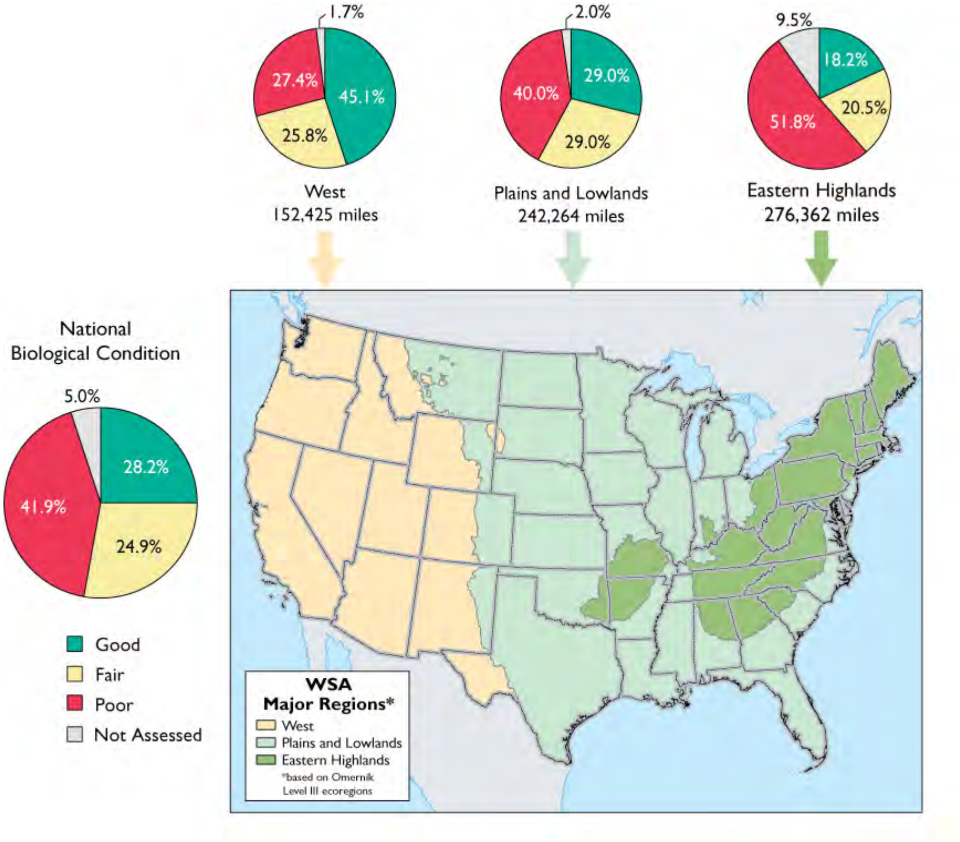


Figure 11. Biological quality of the nation's streams (U.S. EPA, 2006).

The study was designed to examine eight key stressors. The most widespread stressors observed across the country and in each of the three major regions are nitrogen, phosphorus, riparian disturbance, and streambed sediments (Figure 12).

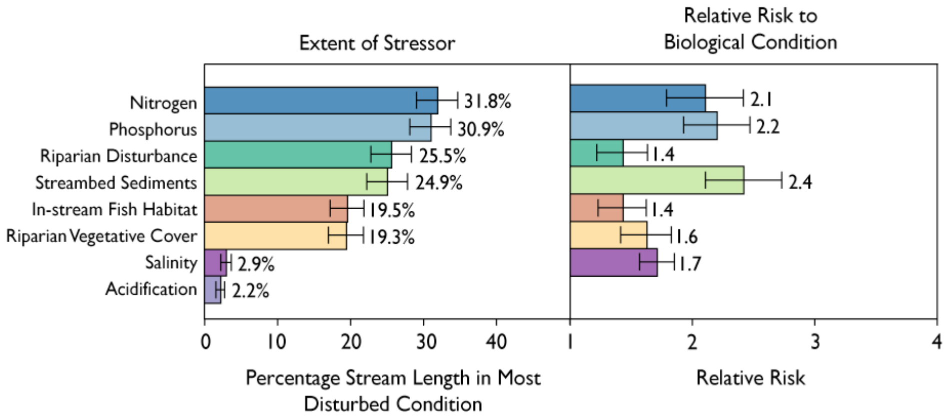


Figure 12. Extent of streams rated poor for aquatic stressors, and increase in risk of poor biology in streams rated poor over streams rated good for each stressor (U.S. EPA, 2006).

These stressors can degrade stream conditions for fish and other aquatic life. Nitrogen and phosphorus are nutrients that, when present in excess amounts, can increase the growth of algae, decrease levels of dissolved oxygen and water clarity, and degrade stream habitat. Excess streambed sediments can smother habitat for aquatic organisms. Riparian disturbance is evidence of human activity alongside streams, such as pipes, pavement, and pastures. The survey found that increases in nutrients and streambed sediments have the highest impact on biological condition, i.e., streams scoring poor for these stressors are twice as likely to have poor biological condition as streams that score in the good range for the same stressors. For more information on the Wadeable Streams Assessment, go to http://www.epa.gov/owow/streamsurvey.

Survey of the Nation's Lakes

In 2007, EPA and its state partners completed the field sampling season for the Survey of the Nation's Lakes, a baseline assessment of the condition of the nation's lakes, ponds, and reservoirs. More than 900 lakes were sampled over the course of a summer for this survey (see Figure 13). The population of lakes to be sampled was comprised of natural and man-made freshwater lakes, ponds, and reservoirs that were greater than 10 acres, at least one meter in depth, and located in the conterminous United States. The survey does not include the Great Lakes, the Great Salt Lake, natural saline systems, or treatment and disposal ponds. In order to examine potential trends in water quality, a representative subset of lakes from EPA's 1972 National Eutrophication Survey was included.

Figure 13. Sampling locations for the survey of the nation's lakes.

Key indicators sampled for the Survey of the Nation's Lakes included the following:

- Trophic indicators, such as *in situ* temperature and dissolved oxygen profiles, water chemical quality, nutrient concentrations, chlorophyll *a* levels, transparency measured by Secchi disk, turbidity, and color
- Ecological integrity indicators, such as sediment diatom abundance, diversity, and trends; phytoplankton abundance and diversity; zooplankton abundance and diversity; shoreline physical habitat conditions; and benthic macroinvertebrate abundance and diversity

- Recreational indicators, such as pathogen (*Enterococci*) concentrations, algal toxin (microcystins) levels, and sediment mercury concentrations.

Analysis of the survey's data is underway in 2008, and a report on the condition of the nation's lakes is planned for 2009.

National Rivers and Streams Assessment

EPA is undertaking a survey of the nation's rivers—including the "Great Rivers" of the United States—and intends to combine it with a second Wadeable Streams Assessment.

In 2008 and 2009, field crews expect to collect data on indicators of the following:

- Ecological condition, such as the abundance and diversity of periphyton, phytoplankton, benthic macroinvertebrates, and fish
- Recreational value, such, as fecal contaminant concentrations in water and contaminant residue in fish tissue
- Physical habitat condition, such as bank stability, channel alterations, and invasive species
- Water quality, such as basic water chemistry.

The focus will be on wadeable streams in the first year of monitoring and non-wadeable systems (e.g., rivers) in the second. Figure 14 shows the locations of the 1,350 new sites that will be sampled and the 450 sites from the 2006 Wadeable Streams Assessment will be re-sampled for this survey. A national report on rivers and streams is scheduled for 2011. For more information on the National River and Streams Assessment, visit http://www.epa.gov/owow/riverssurvey/index.html.

Figure 14. Sampling locations for the national rivers and streams assessment.

National Wetland Condition Assessment

In 2011, EPA and the states plan to conduct a survey (National Wetlands Condition Assessment) of the condition of the nation's wetlands, with a report planned for 2013. EPA and the states are working with the FWS to design the wetland assessment to ensure that it effectively complements the FWS *Status and Trends* reports, which focus on the distribution of wetlands rather than their condition.

EPA is currently in the research phase of the National Wetland Condition Assessment and has identified several significant challenges to designing and implementing a wetland assessment on a national scale. These include designing the best sample frame and methods to support a national report; selecting efficient, scientifically valid indicators; ensuring that adequate resources are available; maintaining the resultant data; and building partnerships to most effectively use the information gleaned from the National Wetlands Condition Assessment.

EPA is coordinating a number of regional pilot projects with states, academics, and other federal agencies to test design approaches, field protocols, and indicators. EPA anticipates that in 2009, the project team will be making initial decisions on condition indicators and assessment methods that can apply across the nation's wide range of wetland types. For more information on the National Wetland Condition Assessment, visit http://www.epa.gov/owow/wetlands/survey.

Through the institution of regular probability surveys of all waterbody types, EPA and its partners in the states and other federal agencies expect to be able to cost-effectively assess 100% of the water resources of the United States and track trends in water quality over time. This scientifically based data will assist in the evaluation of the effectiveness of pollution-control activities and will greatly improve our ability to manage the nation's water resources.

State-Scale Statistical Surveys

More than half of the states have begun to implement state-scale statistical or probabilistic surveys to characterize the full population of a water resource type (e.g., streams, lakes). The majority of these surveys are of streams and rivers, although lakes, coastal waters, and wetlands are also surveyed.

States use probabilistic monitoring designs to develop estimates of water quality across the entire state, based on a representative sample, and to examine trends in water quality over time statewide. Probability surveys can eliminate the risk of generating a biased picture of water quality conditions; they provide information on changes in water quality over time statewide, and serve as a cost-effective benchmark of the effectiveness of the state's water quality program. Also as part of the probability assessment, a state can produce an estimate of the accuracy of its assessment results. The results also provide information on whether it would be useful to target certain waters for further assessment, or if limited resources for water quality assessment can be used more effectively in other ways.

States use targeted monitoring, on the other hand, to meet state management objectives such as identifying specific waters that are not meeting water quality standards, setting priorities for impaired waters, and tracking the restoration of individual waters. The two approaches are not expected to provide the same results because they are designed to achieve different objectives.

Comparing the results of the two monitoring designs is a useful evaluation tool for the state. For example, the statistical survey's overall description of the full population of waters provides a useful benchmark for comparing the results of targeted monitoring activities and can help the state identify potential gaps in its targeted monitoring program.

The following are examples of how some states use probability assessments for water quality assessment reporting in 2004. It is important to note that for the 2004 reporting cycle, statewide probability assessments are still a fairly new development, and most states are only beginning to report their findings.

South Carolina

South Carolina's monitoring program includes a probability-based component to complement its targeted monitoring activities. Probability-based monitoring is conducted for streams, lakes/reservoirs, and estuaries. Each year, a new statewide set of probability-based random sites is selected for each waterbody type. These random sites are sampled on a monthly basis for one year. South Carolina's *2004 Integrated Report* (South Carolina DHEC, 2004) includes details on site selection.

South Carolina provides tables comparing assessment results from its traditional monitoring program and its probability-based assessment results for rivers and streams and for estuaries, including a discussion of the findings.

For rivers and streams, the traditional approach included data from 630 monitoring stations strategically located around the state, many of which include biological (macroinvertebrate) and chemistry data. Approximately 15,300 stream miles—or about half the state's total 29,794 stream miles—were assessed using the traditional 305(b) assessment approach.

South Carolina summarized data from a total of 58 randomly located stream sites for the probability-based assessment conclusions, 29 of which were sampled in 2001 and 29 of which were sampled in 2002 (Table 6). These sites represent the total stream miles in the state, weighted by stream size (i.e., based on the relative proportion of small headwater streams, second order or intermediate streams, and larger streams to the stream resource as a whole).

Table 6. Traditional vs. Probability-based Assessment Results for Rivers and Streams in South Carolina (South Carolina DHEC, 2004)

Use Support Category	Degree of Use Support	Percent of assessed miles in category -- traditional 305(b) approach	Estimated percent of total resource in category -- probability-based approach
Aquatic Life Use	Fully supporting	65.3%	79.0%
	Partially supporting	12.1%	5.9%
	Not supporting	22.5%	15.0%
Recreational Use	Fully supporting	59.3%	49.9%
	Partially supporting	21.5%	14.6%
	Not supporting	19.2%	35.5%

For its probability-based estuarine condition conclusions, the State summarized data from 60 randomly located estuary sites—30 sampled in 2001 and 30 sampled in 2002. These sites represent the total estuarine area in the state. Probability-based approach results were compared to the traditional approach, under which 221 square miles of South Carolina's total 401 square miles of estuaries were assessed (Table 7).

Table 7. Traditional vs. Probability-based Assessment Results for Estuaries in South Carolina (South Carolina DHEC, 2004)

Use Support Catgory	Degree of Use Support	Percent of assessed square miles in category -- traditional 305(b) approach	Estimated percent of total resource in category -- probability-based approach
Aquatic Life Use	Fully supporting	68.0%	75.3%
	Partially supporting	14.4%	3.0%
	Not supporting	17.6%	21.7%
Recreational Use	Fully supporting	94.1%	100%
	Partially supporting	4.5%	--
	Not supporting	1.4%	--

Indiana

In Indiana, probability-based representative samples are used to determine overall aquatic life use support, as part of the state's rotating basin approach (i.e., a plan for monitoring a subset of the state's watersheds on a rotating 5-year cycle, such that in 5 years, all watersheds have been cumulatively monitored). A stratified random sampling design is used to generate sampling sites and provide a representative sample set for each basin. A fish community Index of Biotic Integrity (IBI) is determined for each sampling location, and the results of each year's sample data are analyzed to estimate the percentage of stream miles supporting aquatic life use for each basin. This approach allows the state to make statistically valid estimates of aquatic life use support for a large geographic area (e.g., a basin) with a relatively small number of representative samples. For its *2004 Integrated Report* (Indiana DEM, 2004), Indiana's probability-based program found that 22,157 stream miles in the state's major river basins supported aquatic life and 13,168 miles did not support uses, for a total of 35,325 river and stream miles covered by the probabilistic assessment.

Indiana's probability-based sampling design, known as the Watershed Monitoring Program, allows the state to predict with reasonable certainty what percentage of its rivers and streams are impaired. An individual stream or stream reach is considered assessed only when sufficiently detailed monitoring data representative of that stream are available. According to the state, the principal advantage of the probabilistic monitoring approach is that it allows the agency to meet the goals of assessing all the waters of the state (in terms of the overall quality of each basin) while providing data that can also be used to make waterbody-specific assessments.

Florida

Florida uses a three-tiered approach to monitor surface water quality, ranging from the general to the specific. Tier 1, or probability monitoring, addresses statewide and regional questions and is used to develop statistical estimates of statewide water quality based on a representative sample. It allows the state to assess 100% of the waters of the state over a 5-year period. Tier 2 addresses basin-specific and stream-specific questions (e.g., to verify waterbody impairment), and Tier 3 addresses site-specific questions, such as those associated with permits and the development of TMDLs.

The first cycle of the statewide probability assessment through the Integrated Water Resource Monitoring Network began in 2000 and was completed in 2003. The results for each basin are aggregated by waterbody type and assessed against water quality targets to assess the overall health of that type of water in the basin. Florida assessed rivers and streams, large lakes, and small lakes using this approach (see Figure 15).

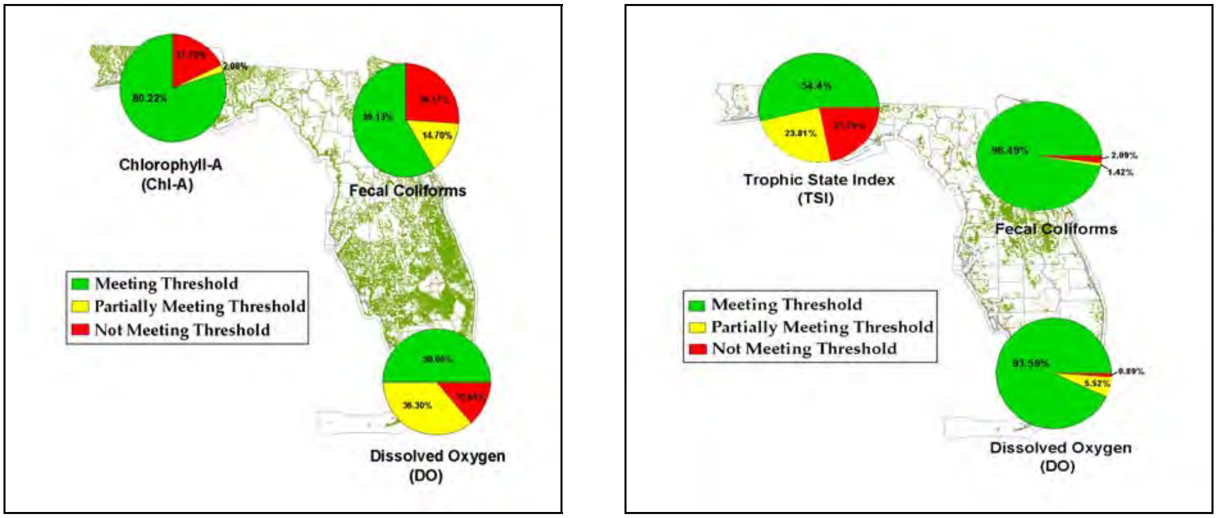


Figure 15. Summary of statewide condition for Florida rivers and streams (left) and large lakes (right) (Florida DEP, 2004).

Although the report (Florida DEP, 2004) presents preliminary results for the statewide probability assessment, it also notes the fundamental differences between this approach and the basin and stream assessments of Tier 2. Assessment targets, parameters monitored, and sample sizes are different between the two types of assessments. The results of the probability network should be more representative of statewide conditions and may be able to shed light on any biases in the basin and stream assessments due to, for example, the location of monitoring stations. The State plans to make comparisons between both types of monitoring approaches as its probability network continues to evolve.

IV. Future Reporting

In March 2003, EPA issued guidance describing the basic elements of a state monitoring and assessment program. In response to this guidance, states have prepared long-term strategies that address comprehensive monitoring of all water types, including those for which little data currently exist. Along with the traditional, targeted monitoring approach, which describes the condition of individual waters of concern, probability surveys are an important component of comprehensive water monitoring programs, providing a cost-effective means of assessing and reporting on status and trends in overall populations of waters (e.g., streams and rivers, lakes). In the future, 305(b) reports will be able to provide statistically valid water quality data that is comparable across states.

The states and EPA are taking steps toward streamlining and improving water quality monitoring and assessment by integrating monitoring and reporting requirements under sections 305(b) and 303(d) of the Clean Water Act (see the section *Background, Integrated Water Quality Reporting* of this report*)*. EPA has issued guidance to the states to clarify reporting requirements for the 2008 reporting cycle and has established a goal that all 50 states and 6 territories and jurisdictions use the integrated reporting format by 2008. EPA continues to promote this comprehensive assessment approach to improve the states' ability to track both programmatic and environmental goals of the Clean Water Act, and ideally, to increase the pace of achieving these important environmental goals. (See http://www.epa.gov/owow/tmdl/ for more information on EPA's national water quality reporting guidance.)

Electronic reporting of water quality information is a continuing EPA priority and involves a significant commitment at the state and national levels. EPA and the states are working to ensure that each assessed watershed and waterbody is identified using a consistent national surface water locational system, the National Hydrography Dataset (see http://nhd.usgs.gov/ for more information), and that electronic reporting continues to improve. EPA intends to continually adapt and improve the ATTAINS database to reflect new reporting requirements and the full range of state monitoring activities, including state-scale probability-based surveys, and will continue to fully support state efforts to adopt electronic reporting. This commitment to providing more comprehensive, easily shared water quality information will help managers and the public make more informed decisions about the future of our waters.

V. References

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Chapter 2
THE CAUSES OF URBAN STORMWATER POLLUTION

Runoff pollution occurs every time rain or snowmelt flows across the ground and picks up contaminants. It occurs on farms or other agricult water carries away fertilizers, pesticides, and sediment from cropland or pastureland. It occurs during forestry operations (particularly alon the water carries away sediment, and the nutrients and other materials associated with that sediment, from land which no longer has enoug hold soil in place.

This report, however, focuses on runoff pollution from developed areas, which occurs when stormwater carries away a wide variety of cont across rooftops, roads, parking lots, baseball diamonds, construction sites, golf courses, lawns, and other surfaces in our cities and suburb rainwater in roadside gutters is but one common example of urban runoff pollution.

This chapter discusses some of the causes of stormwater runoff and pollution, which are important to understand before adopting managen

The United States Environmental Protection Agency (EPA) now considers pollution from all diffuse sources, including urban stormwater poll important source of contamination in our nation's waters. [1] While polluted runoff from agricultural sources may be an even more important s than urban runoff, urban runoff is still a critical source of contamination, particularly for waters near cities -- and thus near most people. EP storm-sewer discharges as the second most prevalent source of water quality impairment in our nation's estuaries, and the fourth most pre impairment of our lakes. [2] Most of the U.S. population lives in urban and coastal areas where the water resources are highly vulnerable to degraded by urban runoff.

Urban stormwater continues to impair the nation's waterways, 29 years after passage in 1972 of the law now known as the Clean Water A why urban stormwater remains such an important contributor to water pollution is the fact that in most areas, stormwater receives no treatn waterbodies. The storm-sewer system merely collects the urban runoff and discharges it directly to the nearest river, lake, or bay.

Over the past 29 years, water pollution control efforts have focused primarily on certain process water discharges from facilities such as fa treatment plants, with less emphasis on diffuse sources. While these efforts have led to many water quality improvements, new efforts are the remaining sources of water pollution, including urban runoff pollution.

Comprehensive stormwater regulation has been slow to develop (see box: "History of Stormwater Regulation in the United States"). Since 1 population over 100,000, certain industries, and construction sites over 5 acres have had to develop and implement stormwater plans under Pollutant Discharge Elimination System (NPDES) stormwater regulations. As of May 1999, states and the EPA have issued more than 260 850 operators, including larger cities operating separate storm sewer systems, which requires them to develop stormwater management pl stormwater discharges from industrial activities are also subject to NPDES stormwater permit requirements.

On December 8, 1999, EPA promulgated a rule requiring smaller municipalities, those with populations of fewer than 100,000 people locate (where population density is greater than 1,000 persons per square mile) to develop stormwater plans. Municipalities not in urbanized areas 10,000 residents and a population density greater than 1,000 persons per square mile will also have to develop stormwater plans if the stat this so-called "Phase II" rule, the EPA and states will develop "tool boxes" from which the smaller local governments can choose particular including the strategies presented in this report, to develop their stormwater plans.

Stormwater must be distinguished from other urban sources of pollution largely caused by wet weather since each separate source is regul addition to stormwater runoff, which is the focus of this study, there are two other significant sources of urban wet weather pollution: sanita (SSOs) and combined sewer overflows (CSOs). SSOs occur when sanitary sewers, often because of leaks and cracks, become surcharge overflow, often through manholes or into basements. CSOs occur when flows into combined sewer system (systems that receive stormwat discharges from residences and businesses, and wastewater discharges from industrial facilities and transport it all through a single pipe) e and storage capacity of the sewer system and waste treatment facility. At that point, this combined waste stream overflows into creeks, riv through designated outfalls usually without treatment. CSOs and SSOs are more of a problem with older systems while stormwater is an is areas, especially growing areas. Moreover, while prevention programs can be very important to efforts to reduce CSOs and SSOs, structu necessary. By contrast, much stormwater pollution can be *prevented* with proper planning in growing or redevelopment areas.

Remarkably, studies have shown that stormwater alone can be almost as contaminated as these sewage/stormwater mixtures.[3] Yet storm be regulated in most of the nation's populated areas. While many CSO and SSO control measures may overlap with stormwater pollution c strategies that deal with stormwater specifically must be implemented if the quality of America's waterbodies is to improve. These strategie the hands of states and local governments.

1972: EPA issues exemptions from the federal Clean Water Act NPDES permit program for most sources of stormwa sues EPA to require permits for all point sources, including urban storm sewers (applications by 1973 and permits by 1

1975–1977: The U.S. District Court finds that EPA exemptions are contrary to the Clean Water Act (NRDC v. Train).[a decision is upheld by U.S. Court of Appeals in 1977 (NRDC v. Costle).[b]

1980: EPA issues rules responding to the court's decision that exempt cities outside "urbanized areas from needing NI permits for their storm sewers." NRDC and industry sue EPA over the rules (NRDC v. EPA).[c]

1980–1990: During this period, EPA struggled with developing stormwater rules, and extends the stormwater permit de large cities until 1987 and 1989. EPA also issues "nonenforcement letters" informing cities that EPA would not take enf actions against cities with permit applications and proposes narrowing the definition of stormwater discharges. In 1983 issues a final report on the Nationwide Urban Runoff Program. In 1984, NRDC and the states negotiated with EPA to r narrowing coverage and revoke letters.

1987: In Clean Water Act amendments, Congress requires EPA to issue by 1989 "Phase I" rules addressing stormwat cities with a population over 100,000 and from industrial sites, and to issue by 1992 "Phase II" rules for other significar of stormwater pollution.

1990: EPA promulgates "Phase I" NPDES stormwater regulations and extends compliance beyond those dates in the NRDC sues EPA for illegally extending deadlines and excluding certain sources from regulations (NRDC v. EPA).[d]

1992: A U.S. Court of Appeals ruling prohibits further stormwater dead-line extensions (NRDC v. EPA)[e] and invalidat provisions of the Phase I rule. EPA and the states issued initial general permits for storm-water discharges.

1992: Congress provides an additional extension to small cities for storm-water permit applications.

1995: EPA is sued for its failure to conduct study, file report, and issue regulations concerning Phase II stormwater pol sources (NRDC v. Browner).[f] EPA issues Report to Congress on "Storm Water Discharges Poten-tially Addressed b of the NPDES Storm Water Program." NRDC and EPA enter into consent decree requiring EPA to issue a final rule by 1999 (later extended to October 1999) addressing both Phase II stormwater and Phase I issues remanded by the court EPA convenes a federal advisory committee.

1997: EPA issues draft Phase II stormwater rules.

a 396 F.Supp. 1393 (D.D.C. 1975), aff'd by NRDC v. Costle, 568 F.2d 1369 (D.C. Cir. 1972).

b 568 F.2d 1369 (D.C. Cir. 1972).

c 673 F.2d 392 (D.C. Cir. 1980) (per curiam).

d 915 F.2d 1314 (9th Cir. 1990).

e 966 F.2d 1292 (9th Cir. 1992).

f No. 95-634 PLF (D.D.C.) (consent order signed April 6, 1995).

The Water Cycle

To fully understand the stormwater pollution problem, it is helpful to step back and review the water cycle, also known as the hydrologic cyc simply the constant movement of water from the sky to the ground and back again. The main components of the water cycle are precipitatic evapotranspiration (evaporation and transpiration, the process by which plants release water they have absorbed into the atmosphere), sur storage, and groundwater storage. As part of that cycle, when rainwater falls to the ground, or when snow or hail on the ground melt, that v paths, as illustrated in Figure 2-1 (print report only).

While the magnitude of these effects varies across the country depending on the precipitation patterns, soil types and other factors, the und remain the same. [4] In a typical Midwestern undeveloped area, for example, with natural ground cover such as forests or meadows, a large percent -- of the water infiltrates the soil. Much of this water may remain near the surface from which it often resurfaces into lakes or strear water descends to a deeper level, perhaps recharging an underground aquifer used for drinking water. A significant share -- 40 percent in tl water returns to the atmosphere through evapotranspiration. Only a small amount of the water -- the remaining 10 percent, in this example - the surface of undeveloped land to run off into streams and other waterbodies.

Urbanization can dramatically alter this water cycle, increasing runoff and reducing, at times to almost zero, infiltration. This can completely chemical character of the receiving waterbody.

The Causes of Stormwater Pollution

The stormwater pollution problem has two main components: the increased volume and velocity of surface runoff and the concentration of p Both components are directly related to development in urban and urbanizing areas. Together, these components cause changes in hydrolo that result in a variety of problems including habitat loss, increased flooding, decreased aquatic biological diversity, and increased sediment well as affects on our health, economy, and social well-being. These consequences will be discussed in Chapter 3; the following is a discuss these problems.

Table 2-1
Impacts from Increases in Impervious Surfaces

	Resulting Impacts				
Increased Imperviousness Leads to:	**Flooding**	**Habitat Loss (e.g., inadequate substrate, loss of riparian areas, etc.)**	**Erosion**	**Channel Widening**	**Strea Alter**
Increased Volume	•	•	•	•	
Increased Peak Flow	•	•	•	•	
Increased Peak Flow Duration	•	•	•	•	
Increased Stream Temperature		•			
Decreased Base Flow		•			
Changes in Sediment Loadings	•	•	•	•	

Source: *Urbanization of Streams: Studies of Hydrologic Impacts,* EPA 841-R-97-009, 1997

INCREASED VOLUME AND VELOCITY: THE IMPERVIOUS COVER FACTOR

Types of Impervious Cover

Some impervious cover, such as exposed rock or hardpan soil, is natural. Land development, however, greatly increases it. Human-made in in three varieties: rooftop imperviousness from buildings and other structures; transport imperviousness from roadways, parking lots, and ot related facilities; and impaired pervious surfaces, also known as urban soils, which are natural surfaces that become compacted or otherwis pervious through human action. Examples of the hard soils include the base paths on a baseball diamond or a typical suburban lawn.

Transport imperviousness generally exceeds rooftop imperviousness in urban areas of the United States.[5] "Cumulative figures show that, w third of all developed urban land is devoted to roads, parking lots, and other motor vehicle infrastructure. In the urban United States, the aut close to half the land area of cities; in Los Angeles the figure approaches two thirds."[6] The city of Olympia, Washington, also found that tra constituted approximately two-thirds of total imperviousness in several residential and commercial areas.[7] This distinction is important beca transportation surfaces drains directly to a stream or stormwater collection system that discharges to a waterbody usually without treatmer drain into seepage pits or other infiltration devices. Research has also found a strong relationship between curb density and overall impervic areas suggesting that roads lead to the creation of other impervious surfaces.[8]

The creation of additional impervious cover also reduces vegetation, which magnifies the effect of the reduced infiltration. Trees, shrubs, me like most soil, intercept and store significant amounts of precipitation. Vegetation is also important in reducing the erosional forces of rain ar conversion of forest to impervious cover resulted in an estimated 29 percent increase in runoff during a peak storm event.[9]

Imperviousness Thresholds

Research has shown that when impervious cover reaches between 10 and 20 percent of the area of a watershed, ecological stress becom After this point, stream stability is reduced, habitat is lost, water quality becomes degraded, and biological diversity decreases. Figure 2-3 (

shows that as the amount of impervious surface in a watershed increases infiltration and evapotranspiration both drop substantially. As a re
having nowhere else to go, runs off the surface picking up pollutants from activities occurring on the impervious surfaces.

To put these numbers into perspective, typical total imperviousness in medium-density, single-family home residential areas ranges from 25
percent.[11] Total imperviousness at strip malls or other commercial sites can approach 100 percent.

Increased Volume of Runoff

The effect of impervious surfaces on the volume of stormwater runoff can be dramatic. For example, a 1-inch rainstorm on a 1-acre natural
typically produce 218 cubic feet of runoff, enough to fill a standard size office to a depth of about 2 feet. The same storm over a 1-acre pav
produce 3,450 cubic feet of runoff, nearly 16 times more than the natural meadow, and enough to fill three standard size offices completely

On a larger scale, the effect is even greater. In a 620-square-mile portion of the watershed of the Des Plaines River in Illinois, in 1886, whe
development covered 10 percent of the land area, the river's median annual discharge was 4 cubic feet per second. Today, when developm
approximately 70 to 80 percent of that same area, the median annual discharge has been 700 to 800 cubic feet per second, 175 to 200 tim
level.[13]

Greater Stream and Runoff Velocity During Storm Events

Impervious surfaces increase the speed of runoff as it drains off the land. Unlike grassy meadows or forests, hard, impervious cover, such
rooftops, offers little resistance to water flowing downhill, allowing it to travel faster across these surfaces.[14] In addition, the faster rate of
water in a shorter time to receiving waters than would occur under natural conditions. The increased velocity and delivery rate greatly magn
of water as it flows across the land surface and once it enters a stream.

Increased Peak Discharges

Increased imperviousness not only changes the volume of stormwater flows, but also the distribution of flows over time. When land is undev
stormwater flow following a rain event is relatively small, since the land absorbs and infiltrates much of the water. However, impervious cove
snowmelt to run off the land immediately, causing a sharp peak in runoff immediately following the rain event, as illustrated in Figure 1-5 (pri
Impervious cover can double, triple, quadruple or even quintuple peak discharge.[15] Streams receiving these increased urban peak flows ar
meaning that they are prone to sporadic and unstable discharges including flash floods or sudden high pulses of storm flows. An increase in
significant impacts on the human and natural environment. Greater peak flows lead to increased flooding, channel erosion and widening, se
cutting, and general habitat loss as discussed in Chapter 3.

Reduced Stream Base Flow

Because impervious cover reduces infiltration and forces stormwater to run off the land immediately, it also typically reduces the amount of
to recharge streams when there is no rain.[16] Hydrologists often refer to groundwater zones under urban areas as "starved" since they are
groundwater-charged stream flow, known as base flow, can fall to 10 percent of the regional average when the level of imperviousness in t
reaches 65 percent.[17] Prolonged low flow can have a significant impact on aquatic life and, in some cases, a greater impact than extreme
infiltration can also lead to shortages of drinking water supplies.

Decreased Natural Stormwater Purification Functions

Government flood control agencies often replace the beds of creeks, streams, and other drainage ways with concrete open channels, or c
drainage ways with subsurface concrete storm drain lines. These changes degrade or eliminate habitat and dramatically alter hydrology. C
levying disconnects a river from its floodplain and reduces its ability to modify floods naturally. Similarly, this and other development fills, co
eliminates swamps, marshes and other wetlands. Eliminating these natural drainage ways reduces flow storage and detention and soil mois
can increase overall flooding and erosion. In addition, natural streambeds and floodplains provide a hydrologic link between groundwater an
can naturally clean waters. By capturing and slowing stormwater, these areas trap sediment, trace metals, and soluble forms of nutrients.[1
that wetlands can retain up to 100 percent of the metals present in water.[20] Wetlands reduce nitrogen discharges, both through the proces
denitrification and through plant uptake, but less effectively reduce phosphorous when soils are saturated.

Similarly, other natural areas can reduce pollutant loads. One riparian forest in the Chesapeake Bay region removed 89 percent of the nitro
the phosphorus from runoff.[21] Forests also typically absorb 70 to 80 percent of atmospherically deposited nitrogen.[22] Trees and other pla
giving it structure that prevents erosion, and reduce runoff by intercepting and storing precipitation. When rapid stormwater flows have alre
bare soils, plants on downhill slopes slow those flows and allow sediment, as well as other pollutants, to settle onto the land rather than in

However, use of wetlands, streams, and other natural systems is not desirable unless stormwater is delivered at a rate at which pollutants
Natural wetlands, while playing an important role in managing the quality and quantity of runoff, should not be viewed as a sink for polluted
help remove pollutants from runoff, some pollutants can accumulate in wetlands or be converted to more potent forms, thereby degrading t

functions and values of these systems and impact the organisms living there.[23] Furthermore, the US EPA recommends protection for any w
which removes pollutants from runoff to coastal waters.[24] Therefore, use of these systems for stormwater management should be carefull
that these systems need quality water delivered at an appropriate rate to function properly.

INCREASED DEPOSITION OF POLLUTANTS

The second aspect of urbanization that contributes to urban stormwater pollution is the increased discharge of pollutants. As human activity
area, the amount of waste material deposited on the land and in drainage systems increases. The principal contaminants of concern for sto
categories. The following table lists these categories and provides examples.

While all activities can be a source of some contaminants, certain activities are particularly large contributors. Industrial sites can be major s
organic chemicals. Feedlots are a large source of pathogens, nutrients, and BOD. Agricultural and timber operations discharge high quantiti
report focuses on those activities in urbanized and urbanizing areas, practices of homeowners, businesses, and government agencies that a
these contaminants.

TABLE 2-2
Categories of Principal Contaminants in Stormwater

Category	Examples
Metals	zinc, cadmium, copper, chromium, arsenic, lead
Organic chemicals	pesticides, oil, gasoline, grease
Pathogens	viruses, bacteria, protozoa
Nutrients	nitrogen, phosphorus
Biochemical oxygen demand (BOD)	grass clippings, fallen leaves, hydrocarbons, human, and animal waste
Sediment	sand, soil, and silt
Salts	sodium chloride, calcium chloride

Vehicle Use

Driving a car or truck contributes a number of different types of pollutants to urban runoff. Pollutants are derived from automotive fluids, det
vehicle exhaust. Once these pollutants are deposited onto road and parking surfaces, they are available for transport in runoff to receiving v
events. One landmark study estimated that cars and other vehicles contributed 75 percent of the total copper load to the lower San Francis
runoff.[25] Brake pad wear contributed 50 percent of the total load, and 25 percent came from atmospheric deposition -- the eventual settlin
emissions onto the ground. Other car- and truck-related sources of metals include tire wear, used motor oil and grease, diesel oil, and vehi
a substantial source of cadmium and zinc; concentrations at outfalls often exceed acute toxicity levels. Engine coolants and antifreeze conta
and propylene glycol can be toxic and contribute high BOD to receiving waters.

Vehicle exhaust contributes the nutrient nitrogen to our nation's waters. Studies estimate that deposition of nitrogen from power plant and ve
contributes 17 pounds per year of nitrogen and 0.7 pounds per year of phosphorus to a typical acre of land in the metropolitan Washington,
general, fossil fuel combustion is the largest contributor of nitrogen to the waters of the northeastern United States, and is a very large cont

Oil, grease, and other hydrocarbons related to vehicle use and maintenance also contaminate our waters. These come from disposal of use
the ground or into storm drains, spills of gasoline or oil, and leaks from transmissions or other parts of automobiles and trucks. The stormw
square mile of roads and parking lots can yield approximately 20,000 gallons of residual oil per year.[29] Runoff from residential car washing
grease, grit, and detergents to the stormwater system. Even gas vapor emitted when filling tanks can subsequently mix with rain, contributi
polluted runoff.[30]

Roads and Parking Lots

In many communities, most impervious cover is related to the transportation system.[31] Material accumulates on these surfaces during dry
to form a highly concentrated first flush during storm events. One study found streets to be the impervious surface with the highest pollutant
categories.[32] Another found that transportation related land uses have the second highest level of pollutant concentrations; only piped indus
higher.[33]

Table 2-3
Sources of Heavy Metals from Transportation

Source	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb
Gasoline	•			•				•
Exhaust							•	•
Motor Oil & Grease		•			•		•	•
Antifreeze					•			
Undercoating								•
Brake Linings				•	•		•	•
Rubber	•			•				•
Asphalt				•			•	
Concrete				•			•	
Diesel Oil	•							
Engine Wear					•	•	•	•

Source: Local Ordinances: A Users Guide, Terrene Institute and EPA, Region 5, 1995.

Home Landscaping and Public Grounds Maintenance

Landscaping practices are another potential source of pollutants in urban runoff. Turf management chemicals including fertilizers used at hor cemeteries, and public parks can add nutrients to runoff.[34] Monitoring has shown a direct link between the chemicals found in lawn care pr quality.[35] While there remain questions on some details of the contribution of turf management to receiving water quality, it is clear that the timing of materials used make a significant difference.

One important variable is the quantity of chemicals being applied. Over or improper application at homes and other places is far too commo that residential fertilizer use accounts for one-third of the excess nitrogen entering the Sarasota Bay watershed in southwest Florida.[37] Of application of fertilizers and pesticides just before an intense storm event, since they may not have had time to become fixed in the soil and

Similarly, harmful pesticides found in stormwater, such as chloropyrifos, 2,4-D, and diazinon come from golf courses, municipal parks, highw roadsides, and residential lawns and gardens.[38] The percentage of pesticide lost in runoff can be large; one study found up to 90 percent was lost in runoff after being applied a few hours before a storm event.[39]

Since organic matter contains nutrients, raking autumn leaves or grass clippings into gutters or streets for municipal collection or otherwise these materials into the storm-sewer system also adds nutrient loads and oxygen-demanding substances to stormwater. Poorly maintained can be a source of sediment as well.

Table 2-4
Six Pesticides Found Frequently in Stormwater Samples

Pesticide Name	Human Health and/or Environmental Effects
2,4-D	Associated with lymphoma in humans; testicular toxicant in animals.
Chlorpyrifos	Moderately toxic to humans; neurotoxicant; can be highly toxic to birds, aquatic organisms, and wildlife.
Diazinon	Moderately toxic to humans; neurotoxicant; can be highly toxic to birds, aquatic organisms, and wildlife.
Dicamba	Neurotoxicant; reproductive toxicity in animals; association with lymphoma in some human studies.
MCPA (Methoxane)	Low toxicity to non-toxic in test animals, birds, and fish; suspected gastrointestinal, liver, and kidney toxi

MCPP (Mecoprop)	Slightly to moderately toxic; some reproductive effects in dogs; suspected cardiovascular, blood, gastro liver, kidney, and neurotoxicant.

Sources: T.R. Schueler, quot;Urban Pesticides: From the Lawn to the Stream,quot; Watershed Protection Techniques, vol. 2, no. pp. 247, 250 and Extoxnet: Extension Toxicology Network Pesticide Information Profiles, http://ace/orst.edu/info/extoxnet, and En Defense Fund, Scorecard Chemical Profiles, http://www.scorecard.org/chemical-profiles.

Construction Sites

Construction activity is the largest direct source of human-made sediment loads.[40] quot;Results from both field studies and erosion models rates from construction sites are typically an order of magnitude larger than row crops and several orders of magnitude greater than rates areas, such as forest or pastures.quot;[41] Since erosion rates are much higher for construction sites relative to other land uses, the total yi nutrients is higher.[42] Studies indicate that poorly managed construction sites can release 7 to 1,000 tons of sediment per acre during a yea less from undeveloped forest or prairie land.[43] Construction activity can also result in soil compaction and increased runoff.

Like nutrients, soil and sediment are, to a certain degree, a naturally occurring and functional component of all waterbodies. Yet human act the amount of sediment entering our waterbodies to such an extent as to turn sediment into a water quality problem.

Illicit Sanitary Connections to Storm Sewers From Homes and Businesses

Illicit connections from toilets to storm sewer pipes can add pathogens to stormwater.[44] [45] Pathogens are viruses, bacteria, and protozoa health. Coliform bacteria, which come from human waste, is commonly used as an indicator that harmful pathogens may be present in the w found high levels of coliform bacterial in stormwater.[47]

Illicit sanitary connections can also add nutrients such as nitrogen and phosphorus to stormwater. Human waste also contributes to bod. Le lines located near storm sewer lines can pose the same problems as illicit connections.[48]

Septic Systems

Effluent from poorly maintained or failing septic systems can rise to the surface and contaminate stormwater.[49] Septic systems can be imp pathogens and nutrients, especially nitrogen, that are not effectively removed from the waste stream. Bathing beach and shellfish bed closu result of septic system effluent. One study found that 74 percent of the nitrogen entering the Buttermilk Bay estuary in Massachusetts origi systems.[50] Fecal coliform and BOD can be present in stormwater if the system is improperly sited, designed, installed, or maintained.

Illicit Industrial Connections to Storm Sewers

Businesses that illicitly connect pipes containing wastewater from industrial processes to the storm sewer system rather than to the sanitar metals, solvents or other contaminants to stormwater. In Seattle, one industrial facility's discharge of lead to the storm sewer system result contaminated that it could be sent to a smelter to be refined.[51] Floor drains, dry wells, and cesspools are also frequent sources of illicit ind connections.

Uncovered Materials Stored Outside

Rain or melting snow can erode piles of bulk material, such as sand, loose topsoil, or road salt if left uncovered, adding sediment, salts or c nearby waterbodies. Likewise, precipitation can wash contaminants off leaking or dirty objects left outdoors. For example, water quality mo untreated runoff collected from auto recycling facilities near Los Angeles frequently exceeded EPA benchmark figures, for biochemical oxyg oil and grease, phosphorus, and sediment.[52]

Street, Sidewalk, and Airport De-icing

In colder parts of the country, salts used to keep roads, parking lots and sidewalks free of ice often drain into our waterbodies as snow an rain falls. While some salt and ice treatment is necessary to keep roads safe in winter, measures can be taken to reduce or prevent the im principal salts used are sodium chloride and calcium chloride, although materials such as calcium magnesium acetate and other commercial used.[53] Some municipalities spread sand to maintain road traction on snow and ice, and this sand eventually may increase sediment loads. runways and planes, usually with glycol mixtures that can be both toxic to fish, wildlife, and humans and exert high BOD on receiving stream

Landfills

Because the soil cover on landfills is not stabilized with vegetation or other retaining cover while the landfill is operational, soil can erode fro
from construction sites. Additionally, improperly maintained hazardous-waste landfills can allow toxic contaminants to reach or stay on the s
allowing stormwater to carry these pollutants to nearby waterbodies.

Pets and Wild Animals

Waste from domestic and wild animals is a source of pathogens, nutrients and BOD in stormwater.[54] The Northern Virginia Soil and Water
estimates that each day, dogs leave 180,000 pounds of waste on the ground in Fairfax County, Virginia, alone.[55] Waste from birds such a
gulls that are attracted to human activity can also be a problem. Wild geese that congregate in large numbers on cultivated turf adjacent to
contribute to pathogen, nutrient and BOD loadings.[56]

Littering

Not only does stormwater frequently receive no treatment, it also often does not even have the benefit of simple filtering or screening for vis
result, paper cups, cigarette butts, virtually anything made of styrofoam, newspaper, and other materials that people toss on the ground ar
sewer systems -- and eventually into lakes, streams, and oceans.

This list, exhaustive as it is, is incomplete. Galvanized roofs, unpaved roads, the dust that collects on paved streets, and countless other as
urban areas contribute to polluted runoff. The first step in stormwater management is not to memorize any particular list, but rather to recog
opportunities for pollution prevention and the need to think holistically about the entire chain of human activities that affect runoff quantity an
studies presented in this report demonstrate a wide variety of effective and efficient strategies for addressing stormwater runoff at the sour

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science for a changing world

Selected Findings and Current Perspectives on Urban and Agricultural Water Quality by the National Water-Quality Assessment Program

Studies by the USGS National Water-Quality Assessment (NAWQA) program in the last decade describe water-quality conditions in nearly 120 agricultural and 35 urban watersheds ("urban" primarily refers to residential and commercial development over the last 50 years). The findings show that for both urban and agricultural areas, nonpoint chemical contamination is an issue. Much work still needs to be done in urban areas with point source contamination as well, including infrastructure improvements. Appreciable improvements in overall water quality, however, will depend upon effective management of point and nonpoint sources. The findings also show that water-quality conditions and aquatic health reflect a complex combination of land and chemical use, land-management practices, population density and watershed development, and natural features, such as soils, geology, hydrology, and climate. Contaminant concentrations vary from season to season and from watershed to watershed. Even among seemingly similar land uses and sources of contamination, different areas can have very different degrees of vulnerability and, therefore, have different rates at which improved treatment or management can lead to water-quality improvements.

Water Quality in Agricultural Watersheds

- Nitrogen and phosphorus in surface water commonly exceed levels that contribute to excessive algae. For example, average annual concentrations of phosphorus in nearly 80 percent of streams sampled in agricultural areas were greater than the U. S. Environmental Protection Agency (USEPA) desired goal for preventing nuisance plant growth in streams. Excessive plant growth can lead to low dissolved oxygen, which can be harmful to fish and other aquatic life.
- Nitrate is often elevated above background levels in shallow ground water underlying farmland. Concentrations in about 20 percent of shallow wells sampled in agricultural areas exceeded the USEPA drinking water standard. This result is a concern in rural areas where shallow ground water is used for domestic supply; these domestic wells are not regulated and owners often do not know the quality of their well water or whether their wells are vulnerable to contamination. Nitrate is most often elevated in karst (carbonate) areas or where soils and aquifers consist of sand and gravel. These natural features enable rapid infiltration and downward movement of water and chemicals. Some of the more vulnerable areas are the Central Valley of California, and parts of the Pacific Northwest, the Great Plains, and the Mid-Atlantic region. In contrast, ground-water contaminants underlying farmland in parts of the upper Midwest are barely detectable, despite similar high rates of chemical use. In these areas ground-water contamination may be limited because of relatively impermeable, poorly drained soils and glacial till that cover much of the region, and because tile drains provide quick pathways for runoff to streams.
- Pesticides are widespread. At least one pesticide was detected in more than 95 percent of stream samples. Pesticides were detected in more than 60 percent of shallow wells sampled in agricultural areas.
- Pesticides commonly occur in mixtures. Two-thirds of stream samples collected in agricultural areas contained 5 or more pesticides, and more than one-quarter of the samples contained 10 or more. Ground water contained fewer pesticides; about 30 percent of the wells sampled contained 2 or more.
- Concentrations of pesticides generally are low and below drinking-water standards. However, the risk to humans and the environment from present-day low levels of contaminant exposure remains unclear. For example, current standards and guidelines do not yet account for exposure to mixtures, and many pesticides and their breakdown products do not have standards or guidelines.
- Herbicides—most commonly atrazine and its breakdown product desethylatrazine, and metolachlor, cyanazine, and alachlor—occur more frequently and usually at higher concentrations in agricultural streams and ground water than in urban waters. Their occurrence is linked to their use; they rank in the top five in national herbicide use for agriculture.
- Insecticides that were used in the past still persist in agricultural streams and sediment. DDT was the most commonly detected organochlorine compound, followed by dieldrin and chlordane. Their uses were restricted in the 1970s and 1980s and, yet, more than 20 years later, one or more sediment-quality guidelines were exceeded at more than 20 percent of agricultural sites.

Water Quality in Urban Watersheds

- Concentrations of fecal coliform bacteria commonly exceed recommended standards for water-contact recreation.
- Concentrations of total phosphorus are generally as high in urban streams as in agricultural streams. More than 70 percent of sampled urban streams exceeded the USEPA desired goal for preventing nuisance plant growth.
- Insecticides, such as diazinon, carbaryl, chlorpyrifos, and malathion, occur more frequently, and usually at higher concentrations in urban streams than in agricultural streams. Concentrations are low in urban streams, rarely exceeding USEPA drinking-water standards. However, effects on aquatic life may be more of a concern. Concentrations of insecticides exceeded at least one guideline established to protect aquatic life in every sampled urban stream.
- Herbicides are widespread in surface water (detected in 99 percent of urban stream samples) and ground water (detected in more than 50 percent of sampled wells). Most common are those applied to lawns, golf courses, and road right-of-ways, such as atrazine, simazine, and prometon.
- Similar to agricultural areas, pesticides in urban waters commonly occur in mixtures; nearly 80 percent of stream samples contained 5 or more pesticides. Two of the most commonly detected insecticides in mixtures were diazinon and chlorpyrifos; common herbicides detected were simazine and prometon.
- Sediment in urban streams is associated with higher frequencies of occurrence of DDT, chlordane, and dieldrin and higher concentrations of chlordane and dieldrin than sediment in agricultural streams. Sediment-quality guidelines for organochlorine pesticides were exceeded at 36 percent of sampled urban sites.
- Volatile organic compounds, which are used in plastics, cleaning solvents, gasoline, and industrial operations, occur widely in shallow urban ground water. Some of the most frequently detected of the 60 analyzed compounds were the commercial and industrial solvents trichloroethene (TCE), tetrachloroethene (PCE), and methylene chloride; the gasoline additive methyl tert-butyl ether (MTBE); and the solvent and disinfection by-product of water treatment, trichloromethane (also known as chloroform).
- Concentrations of selected trace elements, such as cadmium, lead, zinc, and mercury, are elevated above background levels in populated urban settings, most likely caused by emissions from industrial and municipal activities and motor vehicles. Sediment cores from streambeds and reservoirs, which can be used to track changes over long time periods, indicate that lead increased from 1940s to the 1970s, and began to decrease after it was removed from gasoline. Concentrations are not yet down to background levels. Decreases also are noted for DDT and chlordane.
- In contrast to lead, DDT, and chlordane, sediment cores indicate that zinc and polycyclic aromatic hydrocarbons (PAHs, which result from fossil fuel combustion) are increasing. These increases most likely relate to increasing motor vehicle traffic in watersheds. Sediment-quality guidelines for PAHs were exceeded at more than 40 percent of urban sites.
- Toxic compounds in streambed sediment in urban areas, such as DDT, chlordane, dieldrin, and PCBs, also were found in fish tissue, often at higher concentrations than in the sediment. One or more organochlorine compounds were detected in 97 percent of whole fish samples collected at urban sites, and PCBs were detected in more than 80 percent of whole fish samples. Concentrations of organochlorine compounds exceeded guidelines to protect wildlife at more than 10 percent of urban sites; wildlife guidelines for PCBs were exceeded at nearly 70 percent of urban sites. These findings have contributed to decisions by some states to issue fish-consumption advisories.
- Deteriorated water quality and sediment, as well as habitat disturbances, contribute to degraded biological communities in urban streams. The greatest effects are seen in areas with the highest human population densities and watershed development. Pollution-tolerant algae and aquatic invertebrates (such as worms and midges), as well as omnivorous fish communities, prevail at the affected sites.

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For Internet access to NAWQA publications, data, and maps:

http://water.usgs.gov/nawqa