STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2001 - 129

ACTION TO VACATE SITE-SPECIFIC VARIANCES ADOPTED AS PART OF THE CONSOLIDATED TOXIC HOT SPOTS CLEANUP PLAN
(STATE WATER RESOURCES CONTROL BOARD RESOLUTION NO. 99-065)

WHEREAS:

1. On June 17, 1999, the State Water Resources Control Board (SWRCB) adopted Resolution No. 99-065 adopting the Consolidated Toxic Hot Spots Cleanup Plan and approving three site-specific variances to allow the Central Valley Regional Water Quality Control Board to address pesticide regulation under the Clean Water Act Section 303(d) Total Maximum Daily Load process.

2. In 1999, a lawsuit was filed by the San Francisco Baykeeper and Bill Jennings challenging, among other things, the site-specific variances for pesticides.

3. On October 11, 2001, a Judgment was entered in favor of the petitioners.

4. The Judgment directed the SWRCB to vacate and set aside the site-specific variances for Toxic Hot Spot Sites 5.3, 5.4, and 5.5 in the Consolidated Toxic Hot Spots Cleanup Plan adopted by the SWRCB in 1999.

THEREFORE BE IT RESOLVED THAT:

The SWRCB:

1. Vacates and sets aside the site-specific variances for Toxic Hot Spot Sites 5.3, 5.4, and 5.5 in the Consolidated Toxic Hot Spots Cleanup Plan adopted by the SWRCB in 1999 (SWRCB Resolution No. 99-065) as shown in the attached the deleted sections of Volume II: Regional Cleanup Plans of the Consolidated Toxic Hot Spots Cleanup Plan; pages 5-40 through 5-61.

2. Vacates and sets aside its approval of the site-specific variances in SWRCB Resolution No. 99-065.

CERTIFICATION

The undersigned, Clerk to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on November 15, 2001.

/s/
Maureen Marché
Clerk to the Board

Pages 5-40 through 5-61

Site-Specific Variances are vacated and set aside as follows:

Deleted: ***Pesticide Variance From Regional Toxic Hot Spot Cleanup Plan*¶**
High Priority Candidate Toxic Hot Spot Characterization Variance for Diazinon Orchard Dormant Spray Cleanup Plan¶
Background ¶
"Diazinon in orchard dormant spray runoff" was identified in ¶
Part of the draft Central Valley Bay Protection Clean-up plan as constituting a candidate hot spot in the Sacramento-San Joaquin Delta Estuary (Ranking Matrix Table). Staff briefed the Central Valley Regional Board on 23 October 1998 on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program in order to be considered as a candidate high priority toxic hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act as the same pesticide excursions were also listed as a high priority 303(d) impairment. The Board unanimously determined that the pattern of pesticide detections observed in the Sacramento and San Joaquin Rivers and in the Bay-Delta were frequent and merited consideration as a high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and regulate pesticides under the Clean Water Act. Outlined below are all required elements of the Bay Protection Clean Up Plan except sections D through G which address the assessment of the necessary control actions and their associated cost. The activities covered by these latter sections will be addressed by the Regional Board as it develops a waste load allocation program under section 303(d) of the Clean Water Act.¶
¶
About a million pounds of insecticide active ingredient are applied each January and February in the Central Valley on about half a million acres of stonefruit and almond orchards to control boring insects (Foe and Sheipline, 1993). The organophosphate insecticide diazinon accounts for about half the application. Numerous bioassay and chemical studies have measured diazinon in surface water samples in the Central Valley during winter months at toxic concentration to sensitive invertebrates (Foe and Connor, 1991; Foe and Sheipline, 1993; Ross 1992;1993; Foe, 1995; Domagalski, 1995; Kratzer, 1997). The typical pattern is that the highest concentrations and longest exposures are in small water courses adjacent to high densities of orchards. However, after large storms in 1990 and 1992 diazinon was measured in the San Joaquin River at the entrai ... [1]

Pesticide Variance From Regional Toxic Hot Spot Cleanup Plan

High Priority Candidate Toxic Hot Spot Characterization Variance for Diazinon Orchard Dormant Spray Cleanup Plan

Background

"Diazinon in orchard dormant spray runoff" was identified in
Part of the draft Central Valley Bay Protection Clean-up plan as constituting a candidate hot spot in the Sacramento-San Joaquin Delta Estuary (Ranking Matrix Table). Staff briefed the Central Valley Regional Board on 23 October 1998 on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program in order to be considered as a candidate high priority toxic hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act as the same pesticide excursions were also listed as a high priority 303(d) impairment. The Board unanimously determined that the pattern of pesticide detections observed in the Sacramento and San Joaquin Rivers and in the Bay-Delta were frequent and merited consideration as a high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and regulate pesticides under the Clean Water Act. Outlined below are all required elements of the Bay Protection Clean Up Plan except sections D through G which address the assessment of the necessary control actions and their associated cost. The activities covered by these latter sections will be addressed by the Regional Board as it develops a waste load allocation program under section 303(d) of the Clean Water Act.

About a million pounds of insecticide active ingredient are applied each January and February in the Central Valley on about half a million acres of stonefruit and almond orchards to control boring insects (Foe and Sheipline, 1993). The organophosphate insecticide diazinon accounts for about half the application. Numerous bioassay and chemical studies have measured diazinon in surface water samples in the Central Valley during winter months at toxic concentration to sensitive invertebrates (Foe and Connor,

1991; Foe and Sheipline, 1993; Ross 1992;1993; Foe, 1995; Domagalski, 1995; Kratzer, 1997). The typical pattern is that the highest concentrations and longest exposures are in small water courses adjacent to high densities of orchards. However, after large storms in 1990 and 1992 diazinon was measured in the San Joaquin River at the entrance to the Delta at toxic concentrations to the cladoceran invertebrate *Ceriodaphia dubia* in U.S. EPA three species bioassays (Foe and Connor, 1991; Foe and Sheipline, 1993). Following up on these findings, the U.S. Geological Survey and Regional Board traced pulses of diazinon from both the Sacramento and San Joaquin Rivers across the Estuary in 1993 (Kuivila and Foe, 1995). Toxic concentrations to *Ceriodaphnia* were observed as far west in the Estuary as Chipps Island, some 60 miles downstream of the City of Sacramento and the entrance to the Delta.

Concern has been expressed that other contaminants might also be present in winter storm runoff from the Central Valley and contribute to invertebrate bioassay mortality. Therefore, in 1996 toxicity identification evaluations (TIEs) were conducted on three samples testing toxic in *Ceriodaphnia* bioassays from the San Joaquin River at Vernalis (Foe *et al*., 1998). The results confirm that diazinon was the primary contaminant although other unidentified chemicals may also have contributed a minor amount of toxicity. The study was repeated in 1997 with the exception that samples were taken further upstream in the Sacramento and San Joaquin watersheds in the hope of collecting water with greater concentrations of unknown toxicants thereby facilitating their identification. TIEs were conducted on samples from Orestimba Creek in the San Joaquin Basin on 23 and 25 January and from the Sutter Bypass on 23, 25, and 26 January. Again, diazinon was confirmed as the primary toxicant (Foe *et al*., 1998). No evidence was obtained suggesting a second contaminant.

No biological surveys have been undertaken to determine the ecological significance of toxic pulses of diazinon. However, Novartis, the Registrant for diazinon, has completed a diazinon probabilistic risk assessment for the Central Valley (Novartis Crop Protection, 1997). Little data were available for the Delta. The risk assessment, like chemical and bioassay studies, suggest that the greatest impacts are likely to occur in water courses adjacent to orchards. Lower concentrations are predicted in mainstem

Rivers. The report predicts that the Sacramento and San Joaquin Rivers will experience acutely toxic conditions to the 10% of most sensitive species 0.4 and 11.6% of the time in January and February, the period of most intensive diazinon off site movement. Novartis concludes that the risk of diazinon alone in the Sacramento-San Joaquin River basin is limited to the most sensitive invertebrates, primarily cladocerans. Furthermore, the report notes that cladocerans reproduce rapidly and their populations are therefore predicted to recover rapidly. Also, the report predicts that indirect effects on fish through reductions in their invertebrate prey are unlikely as the preferred food species are unaffected by the diazinon concentrations observed in the rivers. The study recommends though, that the population dynamics of susceptible invertebrate species in the basin be evaluated along with the feeding habits and nutritional requirements of common fish species.

In conclusion, the only major use of diazinon in the Central Valley in January and February is on stonefruit and almond orchards. In 1990, 1992, 1993, and 1996 diazinon was observed entering the Estuary from either the Sacramento or San Joaquin Rivers at toxic concentration in *Ceriodaphnia* bioassays. In 1993 the chemical was followed at toxic concentrations across the Estuary. On each occasions diazinon was confirmed as being present in toxic water samples by GC/MS analysis. In 1996 and 1997 TIEs implicated diazinon as the primary contaminant responsible for the toxicity. Finally, sensitive organisms like *Ceriodaphnia* are predicted to experience acutely toxic conditions in the Sacramento and San Joaquin Rivers about 0.5 and 12 percent of the time in January and February of each year. These frequencies translate to about 1 day every four years in the Sacramento River and 7-8 days per year in the San Joaquin River.

Bay Protection Toxic Cleanup Program guidance recommends that a site or situation be considered a candidate toxic hot spot for pesticides if toxicity in bioassays can be demonstrated, bioassay results are collaborated by both chemical analysis and TIEs, and the pesticide residues reoccur in a pattern of frequent pulses. On 23 October 1998 the Central Valley Regional Board reviewed the dormant spray data and unanimously concluded that the Sacramento and San Joaquin Rivers and Delta-Estuary fit the recommend criteria for listing as a

high priority candidate toxic hot spot.

A. Areal Extent

Studies demonstrate that the potential areal extent of diazinon water column contamination from orchard runoff is variable by year but may include in some years the entire Sacramento San Joaquin Delta Estuary. The Delta Estuary is a maze of river channels and diked islands covering some 78 square miles of water area and 1,000 linear miles of waterway.

B. Sources

The only major use of diazinon in agricultural areas in the Central Valley in winter is as a dormant orchard spray. Virtually every study investigating off site movement into the Rivers and Estuary have concluded that the primary source of the chemical is from agriculture (Foe and Connor, 1991; Foe and Sheipline, 1993; Ross, 1992;1993; Domagalski, 1995; Kratzer, 1997).

Farmers must obtain a permit to apply diazinon as a dormant spray and their names and addresses are available through the County Agricultural Commissioner's Office. However, not known at this time is the relative contribution of each application to total offsite movement. More information is needed on the primary factors influencing off site movement and the relative contribution of different portions of the Central Valley watershed. Such information is essential not only for assessing responsibility but also for successful development and implementation of agricultural Best Management Practices (BMPs).

C. Summary of Actions

The Department of Pesticide Regulation (DPR) and the State Water Resources Control Board (SWRCB) both have statutory responsibilities for protecting water quality from adverse effects of pesticides. In 1997, DPR and the SWRCB signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of

surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicative pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the SWRCB and RWQCB water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses.

Currently, DPR is coordinating a stage 2 effort to address effects of dormant sprays on surface water. DPR's stated goal is to eliminate toxicity associated with dormant spray insecticides (i.e., chlorpyrifos, diazinon, and methidathion) in the Sacramento and San Joaquin River Basins and Delta. As long as progress continues toward compliance with appropriate water quality objectives, stage 3 activities will be unnecessary.

The U.S. EPA requires Regional Boards under the Clean Water Act to maintain 303(d) lists of impaired water bodies. In January 1998 the Central Valley Regional Board approved a revised 303(d) list of impaired water bodies and provided a schedule for the development of Total Maximum Daily Loads. The Sacramento and San Joaquin Rivers and Delta-Estuary were listed, in part, because of diazinon impairments from orchards to water quality. The Regional Board ranked the impairment in all three locations as a high priority and committed to the development of a TMDL by the year 2005. Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation. If compliance monitoring demonstrates that the problem has not been corrected by 2005, then a TMDL waste

load allocation, including an implementation schedule, must be adopted as a Basin Plan amendment by the Regional Board.

Several activities are underway in the Basin to develop agricultural BMPs to control orchard dormant spray runoff. These are summarized below by the Agency conducting the study.

Department of Pesticide Regulation. In addition to the activities already discussed, DPR is investigating orchard floor management as a means to reduce discharges of dormant sprays into surface waterways (Ross *et al*., 1997). At an experimental plot at UCD, DPR staff measured discharges of chlorpyrifos, diazinon, and methidathion from a peach orchard with three orchard floor treatments. Investigations are continuing in a commercial orchard. At California State University at Fresno, DPR is investigating the effects of microbial augmentation and postapplication tillage on runoff of dormant sprays. Results will be highlighted in DPR's own outreach activities and will be made available to other groups interested in the identification and promotion of reduced-risk management practices.

DPR is also monitoring water quality at four sites--two each within the Sacramento and San Joaquin river watersheds. During the dormant spray use season, approximately January through mid-March, water samples will be collected five times each week from each site. Chemical analyses are performed on each sample; one chronic and two acute toxicity tests, using *Ceriodaphnia dubia*, are performed each week.

Novartis. The Registrant of diazinon distributed over ten thousand brochures last winter through U.C. Extension, County Agricultural Commissioner's Offices, and Pesticide distributors. The brochure described the water quality problems associated with dormant spray insecticides and recommended a voluntary set of BMPs to help protect surface waters. Novartis intends to repeat the education and outreach program this winter.

DowElanco and Novartis. The Registrants of

chlorpyrifos and diazinon have undertaken a multiyear study in Orestimba Creek in the San Joaquin Basin with the primary objective of identifying specific agricultural use patterns and practices which contribute the bulk of the off-site chemical movement into surface water. The study involves an evaluation of pesticide movement in both winter storms and in summer irrigation return flows. Objectives in subsequent years are to use the data to develop and field test BMPs to reduce off site chemical movement. The first year of work is complete and a report may be released soon.

Biologically Integrated Prune Systems (BIPS). The BIPS program is a community-based project that supports implementation of reduced-risk pest management strategies in prune orchards. The reduction or elimination of organophosphate dormant sprays is a goal. The project has a strong outreach component that includes demonstration sites and "hands-on" training for growers and pest control advisors (PCAs). BIPS is a recipient of one of DPR's pest management grants.

Biologically Integrated Orchard Systems (BIOS). The BIOS program pioneered community-based efforts to implement economically viable, nonconventional, pest management practices. It emphasizes management of almond orchards in Merced and Stanislaus counties in ways that minimize or eliminate the use of dormant spray insecticides. BIOS was a recipient of a DPR pest management grant and a federal Clean Water Act (CWA) section 319(h) nonpoint source implementation grant.

Biorational Cling Peach Orchard Systems (BCPOS). This project has the same goals as the BIPS program, except that it focuses on primary pests in cling peach orchards. The University of California Cooperative Extension is acting as project leader, with Sacramento and San Joaquin valley coordinators. BCPOS is another recipient of a DPR pest management grant.

Colusa County Resource Conservation District. The Colusa County Resource Conservation District (RCD) is leading a runoff management project within the watershed of Hahn Creek. Project participants are

trying to identify management practices that reduce runoff from almond orchards within the watershed, thereby reducing pesticide loads in the creek. Outreach and demonstration sites are part of this project. This project was the recipient of a CWA section 319(h) grant.

Glenn County Department of Agriculture. The Glenn County Department of Agriculture is organizing local growers and PCAs to address the use of dormant spray insecticides in the county. The local RCD is also involved; they are applying for grants to facilitate the implementation of reduced-risk pest management practices.

Natural Resources Conservation Service-Colusa Office. The Colusa County office of the Natural Resources Conservation Service (NRCS) was recently awarded over $100,000 from the Environmental Quality Incentives Program (EQIP), one of the conservation programs administered by the U.S. Department of Agriculture. EQIP offers contracts that provide incentive payments and cost sharing for conservation practices needed at each site. Most of these funds should be available to help implement reduced-risk pest management practices in almond orchards in the area.

Natural Resources Conservation Service--Stanislaus Office. The Stanislaus County office of NRCS was recently awarded $700,000 from EQIP. Half of the funds are allocated to address livestock production practices, but most of the remaining funds should be available to address dormant sprays and the implementation of reduced-risk pest management practices. Local work groups, comprised of Reds, NRCS, the Farm Services Agency, county agricultural commissioners, Farm Bureau, and others will determine how EQIP funds will be distributed. Applicants for EQIP funds will be evaluated on their ability to provide the most environmental benefits.

Nature Conservancy. The Nature Conservancy is enrolling more prune growers in the BIPS project as it proceeds with its Felon Island restoration project in the Sacramento Valley. This project is supported by a CWA section 319(h) grant.

U.C. Statewide Integrated Pest Management Project. In late 1997 the U.C. Statewide Integrated Pest Management Project was awarded a two year grant by the State Water Resource Control Board to: (1) identify alternate orchard management practices to prevent or reduce off site movement of dormant sprays, (2) provide outreach and education on these new practices to the agricultural community, and (3) design and initiate a monitoring program to assess the success of the new practices. A Steering Committee composed of representatives from Commodity groups, State Agencies including Regional Board staff, and U.C. Academics was formed to serve as a peer review body for the study.

Page Break

D. Assessment of Actions Required.

In January 1998 the Central Valley Regional Water Quality Control Board adopted a revised 303(d) list, ranked diazinon impairments in the Sacramento and San Joaquin Rivers and in the Delta Estuary as high priority and committed to the development of a load reduction program by the year 2005. In October 1998 staff briefed the Regional Board on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program in order to be considered as a candidate high priority hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act. The Board unanimously decided that the pattern of pesticide detections observed in the Sacramento and San Joaquin Rivers and in the Bay-Delta from dormant spray applications was frequent and merited consideration as a high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and begin pesticide regulation under section 303(d) of the Clean Water Act.

E. An estimate of the total costs to develop the plan.

Not Applicable.

F. An estimate of recoverable costs from potential discharges.

Not Applicable.

G. Two year expenditure schedule identifying funds to implement the plan that are not recoverable from potential dischargers.

Not Applicable.

Urban Stormwater Pesticide Cleanup Plan

Background

"Diazinon and chlorpyrifos in urban stormwater runoff" was identified in the draft Bay Protection Cleanup Plan as constituting a candidate toxic hot spot in several Delta backsloughs (Ranking Matrix Table). Staff briefed the Central Valley Regional Board on 23 October 1998 on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program to be considered as a candidate high priority toxic hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act as the same pesticides excursions were also listed as a medium priority 303(d) impairment. The Board unanimously determined that the pattern of pesticide detections observed in urban runoff around the Delta were frequent and merited consideration as high priority candidate Bay Protection Hot Spots. The Board also directed staff to seek a variance and regulate pesticides under the Clean Water Act. Outlined below are all required elements of the Bay Protection Clean Up Plan except sections D through G which address the assessment of the necessary control actions and their associated cost. The activities covered by the latter sections will be addressed by the Regional Board as it develops a waste load allocation program under section 303(d) of the Clean Water Act.

Three hundred and forty thousand pounds of diazinon and 775 thousand pounds of chlorpyrifos active ingredients were used in reported landscape and structural pest control in California in 1994 for control of ants, fleas and spiders (Scanlin and Cooper, 1997; Department of Pesticide Regulation, 1996). The figure likely underestimates by about half the total use as it does not include unreported

homeowner purchases. In February and again in October 1994 *Ceriodaphnia* bioassay mortality was reported in Morrison Creek in the City of Sacramento and in Mosher Slough, 5 Mile Slough, Calaveras River, and Mormon Slough in the City of Stockton (Connor, 1994;1995). All these waterbodies are within the legal boundary of the Delta. A modified phase I TIE was conducted on samples from each site which implicated a metabolically activated pesticide(s) (such as diazinon and chlorpyrifos). Chemical analyses demonstrated that diazinon and occasionally chlorpyrifos was present at toxic concentrations. A phase III TIE was conducted on water collected from Mosher Slough on 1 May 1995 which confirmed that the primary cause of acute toxicity was a combination of diazinon and chlorpyrifos.

It was not known at the time that the Bay Protection samples were being collected that an assessment of the frequency of pesticide excursions would be needed to determine whether a location should be considered as a candidate toxic hot spot. Therefore, no intensive sampling was conducted at Mosher, Five Mile, and Mormon Sloughs, or the Calaveras River or Morrison Creek. However, in other testing 230 samples were collected from urban dominated waterways in the Sacramento and Stockton areas (Bailey *et al*. 1996). These sites are thought to exhibit water quality similar to those locations being considered here as candidate hot spots. All 230 samples were analyzed for diazinon. Eighty-five percent of the measured values (195 samples) exceeded Fish and Game recommended acute hazard criteria. Ninety samples were analyzed for chlorpyrifos. Eighty percent of the values (72 samples) also exceeded the recommended chlorpyrifos acute hazard criteria. Finally, *Ceriodaphnia* bioassays were run on 47 samples. Seventy-seven percent of these (36 samples) produced total mortality within 72 hours. Modified Phase I TIEs suggested that the toxicity was due to metabolically activated pesticides, such as diazinon and chlorpyrifos. Chemical analysis was consistent with these conclusions suggesting that the two organophosphate insecticides were the major contaminants.

In second set of data, the Sacramento River Watershed Program has monitored Arcade Creek in Sacramento monthly since 1996 for toxicity. Arcade Creek was selected to represent a typical urban creek. In the 1996-97

sampling period, Arcade Creek was monitored 13 times during 12 months. Seventy-seven percent of those samples exhibited significant *Ceriodaphnia* mortality. Diazinon and chlorpyrifos concentrations were measured in the seven samples causing 100% mortality. TIEs and pesticide detections in the seven samples confirm that both pesticides contributed to the observed toxicity. Toxicity was detected during both wet and dry weather (Larson *et al*., 1998a). The 1997-98 sampling period data has been summarized for only five dates. In four of the five samples (eighty percent), 100% *Ceriodaphnia* mortality was detected and linked through TIEs to the presence of diazinon and chlorpyrifos. Again, toxicity was detected during wet and dry periods (Larson *et al*., 1998b).

Background concentrations of diazinon in urban storm runoff in the Central Valley increase after application on orchards in January and February suggesting that urban use might not be the sole source of the chemical at this time (Connor, 1996). Volatilization following application is known to be a major diazinon dissipation pathway from orchards (Glotfelty *et al*., 1990) and a number of dormant spray insecticides have previously been reported in rain and fog in the Central Valley (Glotfelty *et al*., 1987). Therefore, composite rainfall samples were collected in South Stockton in 1995 which demonstrated that diazinon concentrations in rain varied from below detection to about 4,000 ng/l (ten times the acute *Ceriodaphnia* concentration). The rainfall study was continued through March and April of 1995 to coincide with application of chlorpyrifos on alfalfa for weevil control. Chlorpyrifos concentrations in composite rainfall samples increased, ranging from below detection to 650 ng/l (again 10 times the acute *Ceriodaphnia* concentration). However, unlike with diazinon, no study was conducted to ascertain whether chlorpyrifos concentrations in street runoff increased suggesting that agricultural inputs might be a significant urban source.

Similar invertebrate bioassay results coupled with TIEs and chemical analysis from the San Francisco Bay Area suggest that diazinon and chlorpyrifos may be a regional urban runoff problem (Katznelson and Mumley, 1997) This finding prompted the formation of an Urban Pesticide Committee (UPC). The UPC is an *ad hoc* committee formed to address the issue of toxicity in urban runoff and

wastewater treatment plant effluent due to organophosphate insecticides, in particular diazinon and chlorpyrifos. The UPC is composed of staff from the U.S. EPA, the San Francisco Bay and Central Valley Regional Water Quality Control Boards, the Department of Pesticide Regulation, Novartis and Dow Elanco, municipal storm water programs, the Bay Area Stormwater Management Agencies Association, County Agricultural commissions, Wastewater treatment plants, the University of California, and Consultants. The members of the UPC are committed to working in partnership with the various stakeholders to develop effective measures to reduce the concentrations of organophosphate insecticides in urban runoff and wastewater treatment plant effluent.

In conclusion, a combination of bioassay, chemical, and TIE work demonstrate that diazinon and chlorpyrifos are present in urban stormwater runoff discharged to urban creeks and back sloughs around the Cities of Sacramento and Stockton at concentrations toxic to sensitive invertebrates. The source of the diazinon appears to be primarily from urban sources although agricultural orchard use may also be important. Chlorpyrifos appears to be predominately of urban origin but the impacts from agricultural use need to be evaluated. Finally, bioassay and chemical analysis suggest that about 75 percent of the samples collected from urban runoff dominated waterbodies will test toxic in *Ceriodaphnia* bioassays while eighty to eighty-five percent of the samples will contain diazinon and chlorpyrifos at concentrations exceeding the acute California Department of Fish and Game Hazard Assessment criteria.

Bay Protection Toxic Cleanup Program guidance recommends that a site or situation be considered a candidate toxic hot spot for pesticides if toxicity in bioassays can be demonstrated, bioassay results are collaborated by both chemical analysis and TIEs, and the pesticide residues reoccur in a pattern of frequent pulses. On 23 October 1998 the Central Valley Regional Board reviewed the data and unanimously concluded that pesticides in urban runoff dominated backsloughs around the Delta fit the recommended criteria for listing as a high priority candidate toxic hot spot.

A. Areal Extent

The potential threat posed by diazinon and chlorpyrifos in urban storm runoff is localized to Morrison Creek in the City of Sacramento and Mosher Slough, 5 Mile Slough, the Calaveras River, and Mormon Slough in the City of Stockton. Together the areal extent of impairment may be up to 5 linear miles of back sloughs within the legal boundary of the Delta.

B. Sources

Detailed information on urban sources are not available for the Central Valley. However, source information has been obtained for the Bay Area and the conclusions are thought to also apply in the Valley with the caveat that the Bay area does not receive significant amounts of diazinon in rainfall as appears to occur in the Central Valley (personal communication, Connor). Confirmatory studies are needed to verify that the Bay Area conclusions also apply in the Valley.

The primary source of diazinon and chlorpyrifos in Bay Area creeks is from urban runoff. Sampling in urbanized areas in Alameda County indicated that residential areas were a significant source but runoff from commercial areas may also be important (Scanlin and Feng, 1997). It is not known what portion of the diazinon and chlorpyrifos found in creeks is attributable to use in accordance with label directions versus improper disposal or over application. However, a preliminary study of runoff from residential properties suggest that concentrations in creeks may be attributable to proper use (Scanlin and Feng, 1997).

C. Summary of Actions

The discovery of diazinon in urban storm runoff in both the Central Valley and San Francisco Bay Region at toxic concentrations to *Ceriodaphnia* led to the formation of the Urban Pesticide Committee (UPC). The objective of the UPC is to provide a forum for information exchange, coordination and collaboration on the development and implementation of a urban pesticide control strategy. An additional advantage of the Committee is that it facilitates a more efficient use

of limited resources. The initial characterization of the pesticide problem through extensive bioassay, chemical and TIE work occurred in the Central Valley with confirmation in the Bay Area while the follow-up studies identifying sources and loads has primarily occurred in the Bay Area.

The UPC has prepared three reports describing various aspects of the urban pesticide problem in the Bay Area and a fourth volume describing a strategy for reducing diazinon levels in urban runoff. The first report provides a compilation and review of water quality and aquatic toxicity data in urban creeks and storm water discharges in the San Francisco Bay Area focusing on diazinon (Katznelson and Mumley, 1997). The review also includes a discussion of the potential adverse impact of diazinon on aquatic ecosystems receiving urban runoff. The second report characterizes the temporal and spatial patterns of occurrence of diazinon in the Castro Valley Creek watershed (Scanlin and Feng, 1997). Runoff at an integrator point for the entire watershed was sampled during multiple storms to record both seasonal and within-event variations in diazinon concentration. The purpose of the third report was to compile information on the outdoor use of diazinon in urban areas in Alameda County including estimates of quantity applied, target pests, and seasonal and long term trends (Scanlin and Cooper, 1997). This information will be used in the development of a strategy to reduce the levels of diazinon in Bay Area creeks. Finally, the UPC has produced a strategy for reducing diazinon levels in Bay Area creeks (Scanlin and Gosselin, 1997). Since pesticides are regulated on the state and national level, much of the strategy focuses on coordinating with enforcement agencies. The strategy presents a framework of roles and responsibilities that can be taken by various agencies to achieve the overall goal. The strategy focuses on diazinon as it is the most common insecticide detected at toxic levels. In the Central Valley both diazinon and chlorpyrifos are regularly observed and must be simultaneously addressed in any cleanup plan.

As was explained in the diazinon orchard dormant spray clean up plan, DPR and the SWRCB both have statutory responsibilities for protecting water quality

from adverse effects of pesticides. In 1997 DPR and the SWRCB signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicative pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the SWRCB and RWQCB water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses. At present pesticides in urban storm water are managed through stage 1 of the MAA.

The U.S. EPA requires Regional Boards under the Clean Water Act to maintain 303(d) lists of impaired water bodies. In January 1998 the Central Valley Regional Board approved a revised 303(d) list of impaired water bodies and provided a schedule for the development of Total Maximum Daily Loads. Morrison Creek, Mosher Slough, and Five Mile Slough were listed because of diazinon and chlorpyrifos impairments to water quality. The Regional Board ranked the impairment in all three locations as a medium priority and committed to the development of a TMDL by the year 2011. Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation. If compliance monitoring demonstrates that the problem has not been corrected by 2011, then the TMDL waste load allocation, including an implementation schedule, must be adopted as a Basin Plan amendment by the

Regional Board.

D. Assessment of Actions Required.

In January 1998 the Central Valley Regional Water Quality Control Board adopted a revised 303(d) list, ranked diazinon and chlorpyrifos impairments in urban runoff dominated back sloughs around the Delta as a medium priority and committed to the development of a load reduction program by the year 2011. In October 1998 staff briefed the Regional Board on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program in order to be considered as a candidate high priority hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act. The Board unanimously decided that the pattern of pesticide detections observed in urban runoff were frequent and merited consideration as high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and begin pesticide regulation under section 303(d) of the Clean Water Act.

E. An estimate of the total costs to develop the plan.

Not Applicable.

F. An estimate of recoverable costs from potential dischargers.

Not Applicable.

G. Two year expenditure schedule identifying funds to implement the plan that are not recoverable from potential dischargers.

Not Applicable.

Irrigation Return Flow Pesticide Cleanup Plan

Background

"Chlorpyrifos in irrigation tailwater" has been identified in the draft Bay Protection Clean-Up Plan as constituting a

candidate hot spot in various agriculturally dominated backsloughs within the Delta (Ranking Matrix Table). Staff briefed the Central Valley Regional Board on 23 October 1998 on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program to be considered as a candidate high priority toxic hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act as pesticide excursions in the San Joaquin River and Delta-Estuary were also listed as a high priority 303(d) impairment. The Board unanimously determined that the pattern of pesticide detections observed in various Delta backsloughs from irrigated agriculture was frequent and merited consideration as a high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and regulate pesticides under the Clean Water Act. Outlined below are all required elements of the Bay Protection Clean Up Plan except sections D through G which address the assessment of the necessary control actions and their associated cost.

One and a half million pounds of chlorpyrifos active ingredient were used in the Central Valley on agriculture in 1990 (Sheipline, 1993). Major uses in March are on alfalfa and sugarbeets for weevil and worm control and between April and September on walnuts and almonds for codling moth and twig borer control. Two minor uses are on apples and corn. A bioassay study was conducted in agriculturally dominated waterways in the San Joaquin Basin in 1991 and 92. Chlorpyrifos was detected on 190 occasions between March and June of both years, 43 times at toxic concentrations to *Ceriodaphnia* (Foe, 1995). Many of the crops grown in the San Joaquin Basin are also cultivated on Delta Tracts and Islands. Not known was whether these same agricultural practices might also contribute to instream toxicity in the Delta. BPTCP resources were used between 1993 and 1995 to conduct a bioassay monitoring program in the Delta. Chlorpyrifos toxicity was detected on nine occasions in surface water from four agriculturally dominated backsloughs (French Camp Slough, Duck Slough, Paradise Cut, and Ulatis Creek; Deanovic *et al*., 1996;1997). In each instance the *Ceriodaphnia* bioassay results were accompanied by modified phase I and II TIEs and chemical analysis which implicated chlorpyrifos. On

four additional occasions phase III TIEs were conducted (Ulatis Creek 21 March 1995, Paradise Cut 15 March 1995, Duck Slough 21 March 1995, and French Camp Slough 23 March 1995). These confirmed that chlorpyrifos was the primary chemical agent responsible for the toxicity. Analysis of the spatial patterns of toxicity suggest that the impairment was confined to backsloughs and was diluted away upon tidal dispersal into main channels. The precise agricultural crops from which the chemicals originated are not known because chlorpyrifos is a commonly applied agricultural insecticide during the irrigation season. However, the widespread nature of chlorpyrifos toxicity in March of 1995 coincided with applications on alfalfa and subsequent large rainstorms. Follow up studies are needed to conclusively identify all responsible agriculture practices.

It was not known at the time that the Bay Protection samples were being collected that an assessment of the frequency of pesticide excursions would be needed to determine whether a location should be considered as a candidate toxic hot spot. Therefore, no intensive sampling was conducted in French Camp and Duck Sloughs or in Paradise Cut or Ulatis Creeks to determine the precise frequency of irrigation induced pesticide toxicity. However, as has been previously mentioned, the same agricultural crops and pesticide application patterns occur in the Delta as in the San Joaquin Basin. Novartis (1997) conducted an ecological risk assessment using all the available pesticide data and concluded that the mainstem San Joaquin River should experience acutely toxic conditions about 20 percent of the time (approximately 70 days/year) from a mixture of insecticides but predominately diazinon and chlorpyrifos. Diazinon was most commonly observed during the dormant spray season (January and February) while chlorpyrifos explained most of the toxicity during the irrigation season (March through September). It has previously been calculated that the mainstem San Joaquin River is expected to experience acutely toxic conditions for about 7 days in January and February from off site movement of diazinon. Therefore, it is estimated that acute toxicity will occur for about 63 days during the remaining year (70-7=63). Most of this toxicity is predicted to be from chlorpyrifos excursions.

In a more recent study, Dow AgroSciences, the primary

registrant for chlorpyrifos, monitored diazinon and chlorpyrifos concentrations daily in Orestimba Creek for one year (1 May 1996-30 April 1997). Orestimba Creek is about 25 miles south of the Delta in the San Joaquin Basin. The water body was selected for study as it's water quality is thought to be typical of a local agriculturally dominated watershed. Diazinon and chlorpyrifos were measured at acutely toxic conditions to sensitive organisms like *Ceriodaphnia* for 50 days during the irrigation season (15 March-30 September; Dow AgroSciences, 1998). Forty-four of the fifty events (88%) were from elevated chlorpyrifos concentrations.

In conclusion, the frequency of toxicity from pesticides was not measured in agriculturally dominated back sloughs in the Delta. However, estimates of the frequency of toxicity from chlorpyrifos excursions in similar nearby watersheds range between 44 and 63 days per irrigation season. Similar frequency rates are expected in Delta backsloughs.

Bay Protection Toxic Cleanup Program guidance recommends that a site or situation be considered a candidate toxic hot spot for pesticides if toxicity in bioassays can be demonstrated, bioassay results are collaborated by both chemical analysis and TIEs, and the pesticide residues reoccur in a pattern of frequent pulses. On 23 October 1998 the Central Valley Regional Board reviewed the above data and unanimously concluded that Ulatis Creek, Paradise Cut, French Camp and Duck Sloughs fit the recommended criteria for listing as a high priority candidate toxic hot spot because of elevated concentrations of chlorpyrifos.

A. Areal Extent

The potential aquatic threat posed by chlorpyrifos in agricultural return flow is confined to the four previously named Creeks and Sloughs. The areal extent of the impairment may be up to 15 linear miles of waterway within the legal boundary of the Delta.

B. Sources

The only major use of chlorpyrifos in these four drainage basins is on agriculture. Detailed follow up studies are needed to determine the crop and precise

agricultural practice which led to the off site movement.

C. Summary of Actions

As described previously, DPR and SWRCB both have statutory responsibilities for protecting water quality from adverse effects of pesticides. In 1997, DPR and the SWRCB signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicative pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the SWRCB and RWQCB water quality control plans or other appropriate regulatory measures consistent with applicable authorities. Stages 1 through 4 are listed in a sequence that should generally apply. However, these stages need not be implemented in sequential order, but rather as necessary to assure protection of beneficial uses.

The U.S. EPA requires Regional Boards under the Clean Water Act to maintain 303(d) lists of impaired water bodies. In January 1998 the Central Valley Regional Board approved a revised 303(d) list of impaired water bodies and provided a schedule for the development of Total Maximum Daily Loads. The San Joaquin River and Delta-Estuary were listed, in part, because of chlorpyrifos impairments to water quality. The Regional Board ranked the impairment in both locations as a high priority and committed to the development of a TMDL by the year 2005. Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation. The TMDL waste

load allocation, including an implementation schedule, must be adopted as a Basin Plan amendment by the Regional Board should compliance monitoring demonstrate that the problem has not been corrected.

Two activities are underway in the Central Valley to develop BMPs to reduce pesticide movement into surface water in irrigated agriculture. Each are summarized below.

U.C. Statewide Integrated Pest Management Project. In December 1997 the U.C. Statewide Integrated Pest Management Project was awarded a three year one million dollar grant by the CALFED Bay Delta program. Objectives of the grant are to (1) Identify alternate urban and rural BMP practices to prevent and reduce off site movement of diazinon and chlorpyrifos into surface water. Study is to consider both summer and winter uses of the two insecticides. (2) Provide outreach and education on these new practices to the urban and agricultural community, and (3) design and initiate a monitoring program to assess the success of the new practices. Stanislaus County will be the focus of the study effort.

DowElanco The Registrant of chlorpyrifos has undertaken a multi year study in the San Joaquin Basin at Orestimba Creek to identify the specific agricultural use patterns and practices which contribute the majority of the off-site movement of their product into surface water. The study involves an evaluation of pesticide movement in both winter storms and in summer irrigation return flows. Objectives in subsequent years are to use the data to develop and field test BMPs to reduce off site chemical movement. The initial study is now complete. A report is expected soon.

Much similarity exits between agricultural practices in the
San Joaquin Basin and the Delta. The results of the DowElanco work may be important in helping to identify the agricultural practices responsible for causing instream toxicity in the Estuary and also for developing successful BMPs to solve the problem. All promising solutions need to be field tested in Delta farmland.

D. Assessment of Actions Required

In January 1998 the Central Valley Regional Water Quality Control Board adopted a revised 303(d) list, ranked chlorpyrifos impairments in the San Joaquin River and in the Delta as high priority and committed to the development of a load reduction program by the year 2005. In October 1998 staff briefed the Regional Board on pesticide detection patterns in the Central Valley and requested guidance on whether these should be considered "frequent" as required by the Bay Protection Program in order to be considered as a candidate high priority hot spot. In addition, guidance was sought on whether to prepare cleanup plans under Bay Protection or seek a variance and prepare a control program under section 303(d) of the Clean Water Act. The Board unanimously decided that the pattern of pesticide detections observed in various Delta backsloughs were frequent and merited consideration as a high priority candidate Bay Protection Hot Spot. The Board also directed staff to seek a variance and begin pesticide regulation under section 303(d) of the Clean Water Act._Therefore, no further assessment of the actions required under the Bay Protection Plan are listed here.

E. An estimate of the total costs to develop the plan.

Not Applicable.

F. An estimate of recoverable costs from potential dischargers.

Not Applicable

G. Two year expenditure schedule identifying funds to implement the plan that are not recoverable from potential dischargers.

Not Applicable.