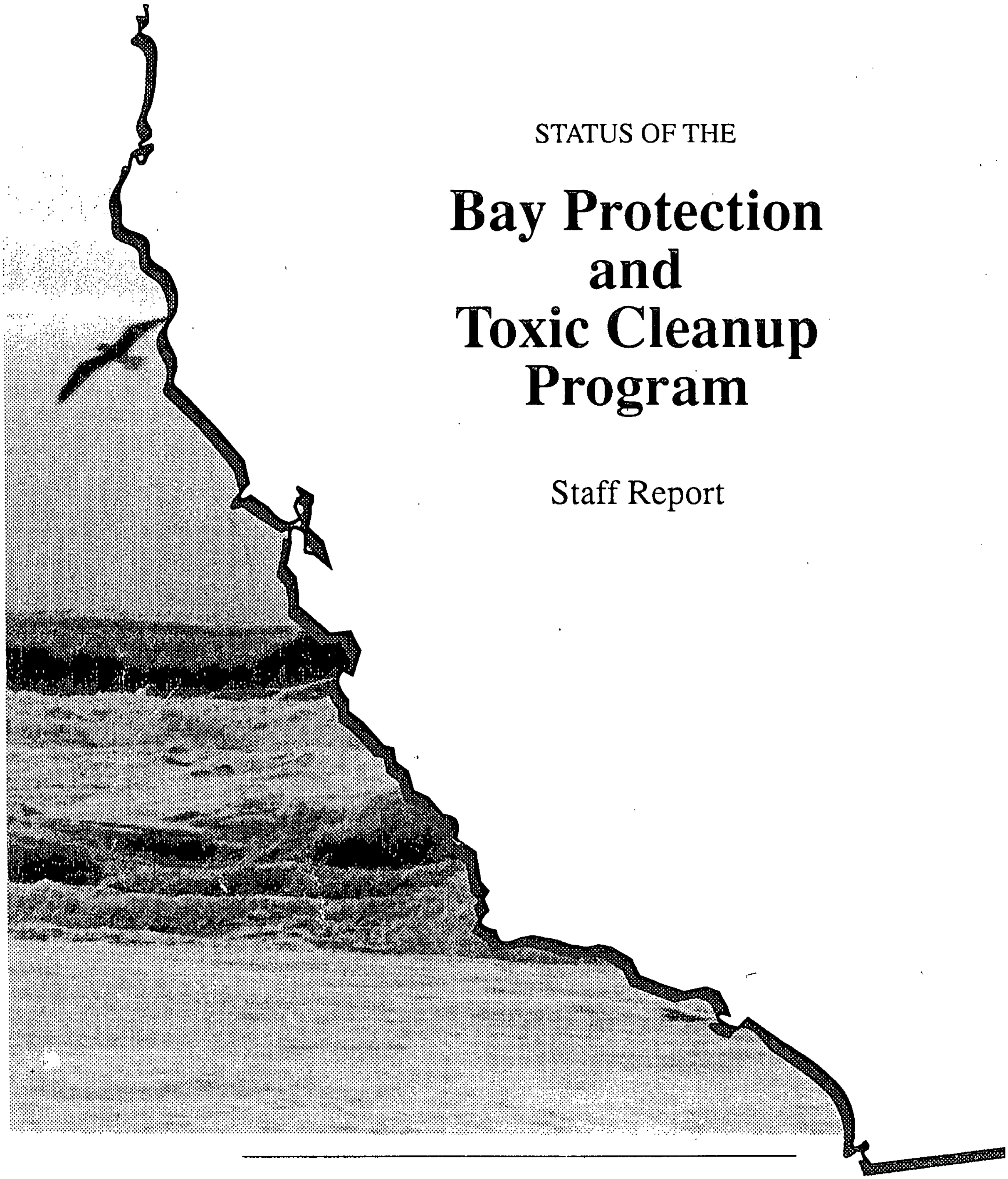
STATUS OF THE

Bay Protection and Toxic Cleanup Program

Staff Report



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STATUS OF THE
BAY PROTECTION AND TOXIC CLEANUP PROGRAM

STAFF REPORT

NOVEMBER 1993

PREPARED BY:

Bay Protection and Toxic
Cleanup Program

STATE WATER RESOURCES CONTROL BOARD

STATE OF CALIFORNIA

PREFACE

This is the first report issued on the status of the Bay Protection and Toxic Cleanup Program (BPTCP) of the State Water Resources Control Board (State Water Board). The BPTCP was created by the California State Legislature in 1989 (SB 475 Torres and AB 41 Wright). The goals of the Program are to:

1. Protect existing and future beneficial uses of bay and estuarine waters;

2. Identify and characterize toxic hot spots;

3. Plan for the prevention of further pollution and remediation of existing toxic hot spots; and

4. Contribute to the development of effective strategies to control toxic pollutants.

The State Water Board and seven coastal Regional Water Quality Control Boards initiated the BPTCP in April 1990. This report describes the program accomplishments through March 1993.

Postscript: On October 10, 1993, Governor Pete Wilson signed SB 1084 (Calderon) (Chapter 1157, Stats. 1993) that extends fees for the BPTCP as discussed in this Staff Report. SB 1084 (Appendix F) extends deadlines for completion of ranking criteria, the database, and cleanup plans. The bill also requires the State Water Board to convene an advisory committee and consider federal sediment quality criteria when adopting sediment quality objectives. Another requirement is for the State Water Board to fund an epidemological study on the impacts of swimming near urban storm drains.

ACKNOWLEDGEMENTS

The State Water Resources Control Board (State Water Board) thanks the joint efforts of the State Water Board's Division of Water Quality and staff of North Coast, San Francisco Bay, Central Coast, Los Angeles, Central Valley, Santa Ana and, San Diego Regional Water Quality Control Boards (Regional Water Boards). The State and Regional Water Board principal contributors are listed below:

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BAY PROTECTION AND TOXIC CLEANUP PROGRAM

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LIST OF ABBREVIATIONS

AET	Apparent Effects Treshold
Ag	Silver
ASTM	American Society for Testing Materials
BPTCP	Bay Protection and Toxic Cleanup Program
CalEPA	California Environmental Protection Agency
Cd	Cadmium
CEQA	California Environmental Quality Act
Cr	Chromium
Cu	Copper
CWA	Clean Water Act
DDT	1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane
DFG	Department of Fish and Game
DHS	Department of Health Services
DUST	Demonstration Urban Stormwater Treatment
DWR	Department of Water Resources
EBEP	Enclosed Bays and Estuaries Plan
EDL	Elevated Data Level
ER-L	Effects Range - Low
EqP	Equilibrium Partition
ER-M	Effects Range Medium
EROD	Ethoxy resorufin O-deethylase
FDA	U.S. Food and Drug Administration
FED	Functional Equivalent Document
FSR	Feasibility Study Report
FY	Fiscal Year
GIS	Geographical Information System
H_2S	Hydrogen Sulfide
Hg	Mercury
ISO	Information Services Office (State Water Board)
IRIS	Integrated Risk Information System
Mi	Mile(s)
MTRL	Maximum Tissue Residue Levels
NOEL	No Observable Effects Level
NAS	National Academy of Sciences
NH_3	Ammonia
Ni	Nickel
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OAL	Office of Administrative Law
OEHHA	Office of Environmental Health Hazard Assessment
PAH	Polynuclear Aromatic Hydrocarbons
Pb	Lead
PC	Personal computer
PCB	Polychlorinated Biphenyl

PCT	Polychlorinated Terphenyl
PEL	Probable Effects Level
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RDBMS	Relational Database Management System
RfD	Reference Dose
RGS	Reporter Gene System
RMP	Regional Monitoring Plan
RWQCB	Regional Water Quality Control Board
Se	Selenium
SMW	State Mussel Watch
SQO	Sediment Quality Objective
SWRCB	State Water Resources Control Board
TBD	To be Determined
TBT	Tributyltin
TDC	Teale Data Center
THS	Toxic Hot Spot
TIE	Toxicity Identification Evaluation
TSMP	Toxic Substances Monitoring Program
UNK	Unknown
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Zn	Zinc

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EXECUTIVE SUMMARY

California Water Code, Division 7, Chapter 5.6 (Appendix A) established a comprehensive program within the State Water Resources Control Board (State Water Board) to protect the existing and future beneficial uses of California's bays and estuaries. The Bay Protection and Toxic Cleanup Program (BPTCP) provides new focus on the State Water Board and the California Regional Water Quality Control Boards' (Regional Water Boards) efforts to control pollution of the State's bays and estuaries and to establish a program to identify toxic hot spots and plan for their cleanup. SB 475 (Stats. 1989, Chapter 269), SB 1845 (Stats. 1990, Chapter 1294), and AB 41 (Stats. 1989, Chapter 1032) added Chapter 5.6 Bay Protection and Toxic Cleanup (Water Code Sections 13390-13396.5) to Division 7 of the Water Code. New legislation (SB 1084 Calderon) (Stats. 1993, Chapter 1157) extends program funding through 1998 (Appendix F).

Program Activities

The BPTCP has four major goals: (1) protect existing and future beneficial uses of bay and estuarine waters; (2) identify and characterize toxic hot spots; (3) plan for the prevention of further pollution and the remediation of existing hot spots; and (4) develop prevention and control strategies for toxic pollutants that will prevent creation of new hot spots or perpetuation of existing hot spots.

The BPTCP is a comprehensive effort by the State and Regional Water Boards to programmatically link standards development, environmental monitoring, water quality control planning, and site cleanup planning. The primary program activities are:

1. Development and amendment of the California Enclosed Bays and Estuaries Plan. This plan contains the State's water quality objectives for enclosed bays and estuaries and contains the implementation measures for the objectives.

2. Development and implementation of regional monitoring programs designed to identify toxic hot spots. This monitoring program includes analysis for a variety of chemicals, the completion of a variety of toxicity tests, and measurements of biological communities.

3. Development of a consolidated database that contains information pertinent to describing and managing toxic hot spots.

4. Development of narrative and numeric sediment quality objectives for the protection of California enclosed bays and estuaries.

5. Preparation of criteria to rank toxic hot spots that are based on the severity of water and sediment quality impacts.

6. Development of regional and statewide toxic hot spot cleanup plans that include identification and priority ranking of toxic hot spots, strategies for preventing formation of new toxic hot spots, and cost estimates for remedial action recommendations.

7. Implementation of a fee system to support all BPTCP activities.

Toxic Hot Spot Identification

The Water Code defines toxic hot spots as locations in enclosed bays, estuaries, or the ocean where pollutants have accumulated in the water or sediment to levels which (1) may pose a hazard to aquatic life, wildlife, fisheries, or human health, or (2) may impact beneficial uses or (3) exceed State Water Board or Regional Water Board adopted water quality or sediment quality objectives.

To identify toxic hot spots, waterbodies of interest have been assessed both on a regional and site-specific basis. Regional assessments require evaluating whether water quality objectives are attained and beneficial uses are supported throughout the waterbody. Existing data on enclosed bays and estuaries are relatively limited. However, as monitoring and surveillance programs are implemented and a database is developed, the regional and statewide assessments will be updated.

Where sites are not well characterized, regional monitoring programs have been implemented. This monitoring activity has been performed by the California Department of Fish and Game under contract with the State Water Board.

The consolidated statewide database required by legislation will include all data generated by the regional monitoring programs. The statewide database will be updated regularly to serve as the information source for making toxic hot spot determinations. It contains information on pollutant concentrations in water, sediment, and tissue and the impacts on waterbodies. The database will also include geographic information system (GIS) capabilities to allow mapping and accurate site identification.

Ranking Criteria

The Water Code (Section 13393.5) requires the State Water Board to develop criteria for ranking toxic hot spots. The ranking criteria must consider the pertinent factors relating to public health and environmental quality. These factors include: (1) potential hazards to public health, (2) toxic hazards to fish, shellfish, and wildlife, and (3) the extent to which the deferral of a remedial action will result or is likely to result in a significant increase in environmental damage, health risks, or cleanup costs.

Sediment Quality Objectives

State law defines sediment quality objectives as "that level of a constituent in sediment which is established with an adequate margin of safety, for the reasonable protection of beneficial uses of water or prevention of nuisances" (Water Code Section 13391.5). Water Code Section 13393 further defines sediment quality objectives as: "...objectives...based on scientific information, including but not limited to chemical monitoring, bioassays or established modeling procedures." The Water Code requires adequate protection for the most sensitive aquatic organisms." Sediment quality objectives can be either numerical values based on scientifically defensible methods or narrative descriptions implemented through toxicity testing or other methods.

Toxic Hot Spot Cleanup Plans

The Water Code requires that each Regional Water Board must complete a toxic hot spot cleanup plan and the State Water Board must prepare a consolidated toxic hot spot cleanup plan.

Each cleanup plan must include: (1) a priority listing of all known toxic hot spots covered by the plan; (2) a description of each toxic hot spot including a characterization of the pollutants present at the site; (3) an assessment of the most likely source or sources of pollutants; (4) an estimate of the total costs to implement the cleanup plan; (5) an estimate of the costs that can be recovered from parties responsible for the discharge of pollutants that have accumulated in sediments; (6) a preliminary assessment of the actions required to remedy or restore a toxic hot spot; and (7) a two-year expenditure schedule identifying State funds needed to implement the plan.

Within 120 days from the ranking of a toxic hot spot in a Regional cleanup plan, each Regional Water Board is required to begin reevaluating waste discharge requirements for dischargers who have contributed any or all or part of the pollutants which have caused the toxic hot spot. These reevaluations shall be used to revise water quality control plans and water quality control plan amendments wherever necessary; reevaluations shall be initiated according to the priority ranking established in cleanup plans.

Funding and Agency Participation

In Fiscal Year (FY) 1989-90, FY 1990-91, and part of FY 1991-92, the BPTCP was funded with $5 million from the Hazardous Waste Control Account. In FY 1991-92 fees were assessed by the State Water Board on point and nonpoint discharges into enclosed bays, estuaries, or coastal waters. The State Water Board's BPTCP fee system splits the costs of the program among all dischargers. The fee system was created as an incentive to reduce discharges and are based on the relative threat to water quality from these discharges.

The BPTCP also has received grants from National Oceanic and Atmospheric Administration and from the U.S. Environmental Protection Agency (USEPA) Region 9, to fund portions of the Program activities.

The State Water Board, seven Regional Water Boards (six coastal and the Central Valley Regional Water Board), the California Department of Fish and Game, and the California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment are supported with BPTCP funds. These agencies coordinate the Program activities through the BPTCP Monitoring and Surveillance Task Force (Water Code Section 13392.5).

The BPTCP Monitoring and Surveillance Task Force:

1. Serves as a review panel for proposals related to program activities, including the review of proposals related to monitoring programs, task order development, hot spot ranking criteria, toxic hot spot cleanup plans, and the development of sediment quality objectives.

2. Exchanges of regulatory information, such as cleanup strategies, sediment quality assessment, implementation measures, and in the future, waste discharge permit revisions.

Program Accomplishments

Since 1990, program accomplishments include:

1. Adoption and amendment of the California Enclosed Bays and Estuaries Plan.

   The Plan was adopted in April 1991 and amended in November 1992. The Plan contains references to beneficial use designations, water quality objectives for the priority pollutants, and a program of implementation. A recent tentative court decision (October 15, 1993) invalidates the Plan. **As of the date this staff report was printed, a final court decision had not been issued and, consequently, the State Water Board has not determined its own course of action.**

2. Adoption of an approach for establishing sediment quality objectives.

   This workplan was adopted by the State Water Board in July 1991. This report presents a summary of the research that is needed and the approach for developing narrative, toxicity, and numerical sediment quality objectives.

3. The installation of a computer system for a consolidated database of information being collected to identify toxic hot spots.

   The feasibility study report has been completed for the consolidated database and the equipment is being purchased.

4. Implementation of regional monitoring programs in each coastal region. A pilot regional monitoring program has been completed in San Francisco Bay.

   The Regional Water Boards have identified 19 sites as known toxic hot spots and 179 sites as potential toxic hot spots. Over 500 sites (100 in San Francisco Bay) have been monitored throughout the State's bays and estuaries.

5. Development of draft site ranking criteria to be used for priority ranking of toxic hot spots.

   Criteria for ranking potential and known toxic hot spots have been drafted and have been discussed at two staff workshops and a State Water Board workshop.

6. Implementation of a fee system supporting the program.

   Approximately $2.5 million per year has been collected under the fee program. This amount is less than the $4 million authorized by the Water Code. This undercollection is a result of overestimating the number of fee payers when the fee regulations were developed.

Program Activities not Completed

Fy 1993-94 is the first year that the program is funded for the preparation of Regional and Statewide Toxic Hot Spot Cleanup Plans. Therefore, the State and Regional Boards have not made significant progress in the development of regional and statewide cleanup plans. The Water Code-mandated deadlines were extended by SB 1084 (Stats. 1993, Chapter 1157) to 1998 and 1999, respectively.

Conclusions and Recommendations

Although the State and Regional Water Boards have made significant progress in implementing the requirements of Bay Protection and Toxic Cleanup Program (Chapter 5.6 of the Water Code), all of the mandates will not be completed within the deadlines of the Water Code or before the fee system end was scheduled to end (January 1, 1994). Therefore, the BPTCP recommends and SB 1084 requires the following:

1. Extension of the deadlines for the Regional and Statewide toxic hot spot cleanup plans to 1998 and 1999, respectively.

2. Extension of the fee program to fund full implementation of the program.

CHAPTER I

INTRODUCTION

A. The Problem

California's enclosed bays and estuaries are unique environmental resources that help make the State a highly desirable place to live. These waters support many beneficial uses such as swimming, diving, boating, fish and wildlife, commercial and recreational fishing, industry, and commerce.

The people of California value its bays and estuaries highly. The majority of our population chooses to live near the coast and our bays and estuaries support the State's ports and many industrial facilities. However, the high use of bay and estuarine waters also threats their quality. The affected bays and estuaries exhibit:

- o Exceeded water quality objectives (standards);
- o Toxicity of water or sediment to test organisms; and
- o Elevated organic chemical levels in fish and shellfish tissue which pose a threat to human health.

The Bay Protection and Toxic Cleanup Program (BPTCP), within the State Water Resources Control Board (State Water Board), was established by legislation in 1989 to address these problems. This report describes the status of the BPTCP through March 1993 (except as noted). This report describes the progress toward: (1) identifying toxic hot spots in enclosed bays and estuaries; (2) implementing regional monitoring programs at each of the seven coastal Regional Water Boards;

(3) developing a consolidated database to use for identifying known and potential toxic hot spots; (4) preparing the California Enclosed Bays and Estuaries Plan, (which includes progress Sediment Quality Objectives development); and (5) collecting adequate fees to support the BPTCP activities.

B. Legislative Direction

In 1989, State legislation (Stats. 1989, Chapter 269, SB 475, Torres; Stats. 1989, Chapter 1032, AB 41, Wright; Stats. 1990, Chapter 1294, SB 1845, Torres) added Chapter 5.6, Bay Protection and Toxic Cleanup, Sections 13390 through 13396.5 to Division 7 of the Water Code which established the BPTCP (Appendix A). The BPTCP has four major goals: (1) provide protection to existing and future beneficial uses of bay and estuarine waters; (2) identify and characterize toxic hot spots; (3) plan for toxic hot spot cleanup or other remedial or mitigating actions; and (4) develop prevention and control strategies for toxic pollutants that will prevent creation of new hot spots or the perpetuation of existing hot spots. SB 1084 (Calderon), in part, extends several of the program deadlines and extends funding until 1998 (Appendix F).

C. BPTCP Purpose

The BPTCP programmatically links the environmental monitoring, standards development, water quality control planning through the BPTCP to the Enclosed Bays and Estuaries Plan and the Enclosed Bays and Estuaries Policy, and site-cleanup planning functions. The relationships of the various program elements are presented in Figure 1.

The Water Code requires the State Water Board and California Regional Water Quality Control Boards (Regional Water Boards) to do the following to attain the BPTCP goals:

- Formulate and adopt a Water Quality Control Plan for Enclosed Bays and Estuaries of California;

- Review waste discharge requirements to conform to the Plan and revise if necessary;

- Develop and maintain a program to identify toxic hot spots, plan for their cleanup or mitigation, and amend water quality control plans and water to abate toxic hot spots;

- Develop a database of toxic hot spots;

- Develop an ongoing toxic hot spot monitoring and surveillance program;

- Develop sediment quality objectives;

- Develop criteria for the assessment and priority ranking of toxic hot spots;

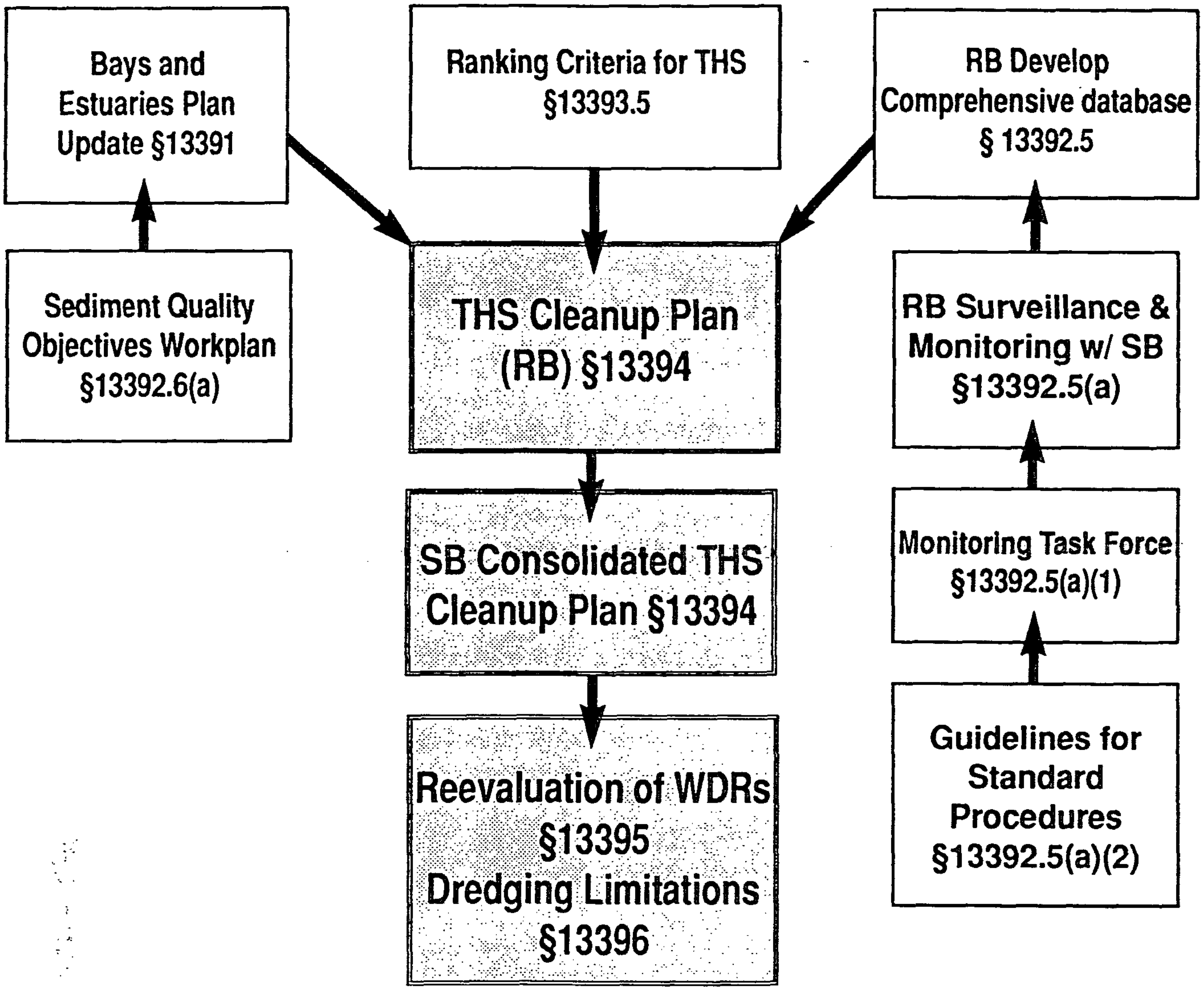
- Collect fees to support BPTCP activities;

- Report on program implementation and the adequacy of the annual fees; and

- Submit to the Legislature, as part of the annual budget process, an annual expenditure plan for the implementation of the BPTCP legislation.

Figure 1

Schematic of the Bay Protection and Toxic Cleanup Program



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D. Legislatively Mandated Deadlines

The statute (Appendix A) originally contained several deadlines to be met by mid 1994. These deadlines were recently modified (Appendix F). The new deadlines (required by SB 1084) are:

- On or before July 1, 1991, the State Water Board shall submit to the Legislature a workplan for the adoption of sediment quality objectives for toxic pollutants.

- On or before January 30, 1994, the Regional Water Boards shall develop a consolidated database for each enclosed bay or estuary which identifies and describes all known and suspected toxic hot spots. The Regional Water Boards shall also develop an ongoing monitoring and surveillance programs.

- On or before January 30, 1994, the State Water Board shall adopt general criteria for the assessing and priority ranking of toxic hot spots.

- On or before January 1, 1996, the State Water Board shall report to the Legislature on progress toward implementing the BPTCP and on the adequacy of the fees implementing the program.

- On or before January 1, 1998, each Regional Water Board shall submit to the State Water Board a toxic hot spot cleanup plan.

- On or before June 30, 1999, the State Water Board shall submit to the Legislature a consolidated statewide toxic hot spot cleanup plan.

Legislation passed in 1990 (Chapter 1294, SB 1845, Torres) added Section 13396.5 to the Water Code. This section requires that the State Water Board establish fees beginning in FY 1991-92 and continuing into 1994 to fund the bay protection responsibilities contained in Chapter 5.6 of the Water Code. The program was funded in FY 1989-90, FY 1990-91, and a portion of FY 1991-92 by $5 million from the Hazardous Waste Control Account. The State Water Board is authorize to collect up to $4 million in fees per year to support program activities.

E. The Enclosed Bays and Estuaries Policy and Its Relationship to the Enclosed Bays and Estuaries Plan

In 1991, the State Water Board adopted the California Enclosed Bays and Estuaries Plan. This statewide Plan is a water quality control plan that contains beneficial use designations, narrative and numeric water quality objectives, and a program of implementation for the water quality objectives. The provisions of the Plan are the basis for regulation of water quality in California bays an estuaries. Please refer to Chapter VIII for discussion.

On October 15, 1993, the Sacramento County Superior Court issued a tentative decision in a lawsuit challenging the Calilfornia Enclosed Bays and Estuaries Plan (State Water Board Resolution No. 91-33). The tentaltive decision invalidates the Plan. **As of the date that this report was printed, a final court decision had not been issued and, consequently, the State Water Board has not determined its own course of action.**

The Water Quality Control Policy for the Enclosed Bays and Estuaries of California (Enclosed Bays and Estuaries Policy) adopted by the State Water Board in 1974 (pursuant to Section 13140 of the Water Code), contains water quality principles and guidelines as well as discharge prohibitions.

To minimize confusion between the Plan and the Policy, the legislation (Water Code Section 13391) requires the State Water Board to review the Enclosed Bays and Estuaries Policy and to incorporate the results of that review into the California Bays and Estuaries Plan. In 1990, the State Water Board received a grant [Clean Water Act Section 201(g)] to perform this work.

F. Organization of the Status Report

This report provides a summary of all the activities of the BPTCP. The remainder of the report is organized as follows:

Chapter	Water Code Section	Topic
II	13392 & 13392.5	Toxic Hot Spots in California
III	13392.5	Regional Monitoring: Identification of Toxic Hot Spots
IV	13392.5	Regional Monitoring Plans
V	13392 & 13392.5	Consolidated Database
VI	13393.5	Toxic Hot Spots Ranking Criteria
VII	13394	Regional and Statewide Toxic Hot Spot Cleanup Plans
VIII	13391	Enclosed Bays and Estuaries Plan
IX	13394.5 & 13396.5	Annual Budget Expenditures and Fees
X		Conclusions and Recommendations
XI		References

CHAPTER II

TOXIC HOT SPOTS IN CALIFORNIA

Introduction

To plan for the cleanup and remediation of polluted or contaminated sites, the sites must be clearly and specifically identified. The information in this chapter explains techniques for identification of toxic hot spots, including:

(A) The statutory definition of a toxic hot spot;

(B) Criteria to be considered in specifying a toxic hot spot;

(C) A rationale for a specific working definition;

(D) A working definition of a toxic hot spot;

(E) A list of water bodies included in the BPTCP, including preliminary lists of "known" and "potential" toxic hot spots.

A. The Statutory Definition of a Toxic Hot Spot

Section 13391.5 of the Water Code defines toxic hot spots as "...locations in enclosed bays, estuaries, or adjacent waters in the 'contiguous zone' or the 'ocean' as defined in Section 502 of the Clean Water Act (33. U.S.C.

Section 1362), the pollution or contamination of which affects the interests of the State, and where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in the water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives." This definition is necessarily general and potentially could result in the designation of large portions (if not all) of California's coastline as a toxic hot spot. The broad interpretation is too imprecise for the State and Regional Water Boards to use in planning the cleanup or remediation of toxic hot spots, since efforts could not be concentrated where regulatory response is most needed. Therefore, the State and Regional Water Board staff have developed a working definition of a toxic hot spot which includes more specific programmatic and regulatory factors. These factors are described below.

B. Criteria to be Considered in Specifying a Toxic Hot Spot

Identification of a toxic hot spot is a critical first step in the assessment, cleanup or remediation of polluted sites in California's enclosed bays and estuaries. To initiate this effort, the State Water Board sponsored a technical workshop that, in part, presented criteria to be used in developing a Sediment Quality Assessment Strategy (Lorenzato et al., 1991). The workshop was attended by more than twenty scientific experts in sediment quality assessment from around the nation as well as observers from state and federal agencies, discharger organizations, and environmental groups. Table 1 presents recommended criteria developed at the workshop for an ideal sediment quality assessment strategy.

Table 1

Criteria for Sediment Quality Assessment Strategy. (Lorenzato, et al., 1991.)

HIGHER PRIORITY

1. Differentiate between the effects due to toxic substances from discharges and changes due to natural factors (describe the significant variability of exposure and response, including identification of major sources of variability).

2. Be of broad and local ecological relevance.

3. Detect the effects on biota from long-term exposure.

4. Consider the bioavailability, exposure, and/or bioaccumulation of toxic agents.

5. Be a tiered approach that utilizes multiple assessment tools and/or approaches, including a first tier that is rapid, sensitive, and overprotective.

6. Use of a suite of appropriate sensitive species.

7. Identify agent(s) causing toxicity in the field.

8. Clearly identify range above which impairment occurs and below which no impairment is predicted.

9. Identify and quantify potentially toxic agent(s).

10. Include a mechanism to evaluate efficacy and incorporate improvements.

11. Be scientifically defensible.

LOWER PRIORITY

12. Detect the effects on biota from short-term exposure.

13. Clearly described.

14. Specify the degree of certainty of protection which will be attained for sensitive organisms.

15. Be of low or moderate cost.*

* Costs were de-emphasized in an effort to define the most technically appropriate assessment approach. Cost limitations are to be considered by the SWRCB as part of its ongoing program management.

The rationale for the criteria in Table 1 is presented below:

1. The ability to separate natural factors from the effects of pollutants was seen as a fundamental requirement of any assessment effort. A number of other criteria help define the intent of this statement. The assessment should encompass both broad and local ecological relevance. That is, the assessment should contain methods for evaluating the effects of pollutants on local sites and specific relationships among organisms, and also be able to embrace general ecological relationships and very broad-based relationships such as community level comparisons.

2. The exposures of greatest significance are long-term and sublethal therefore, assessment should focus at this level. Lethal effects and effects of consequence arising from short-term exposures will most likely be obvious and readily detectable with the detection of long-term effects more difficult to discern. In general, sublethal effects occur at lower bioavailable concentrations than do acute, lethal effects. Therefore, we assume that the protection against sublethal effects would encompass protection against acute effects while the reverse (focusing on acute effects) would not be sufficient.

3. Coupled with long-term exposure was the concern for emphasis on bioaccumulative substances, their routes of exposure, and toxic effects. While a full detailing of environmental fate and exposure routes may not be possible or desirable (given cost constraints) some mechanism for assessing fundamental aspects of bioaccumulation should be included in the strategy.

4. Identification of agents causing toxicity in the field and the quantification of levels causing toxicity are the ultimate goals of the assessment from the regulatory perspective. These goals are encompassed by the criteria, with the qualification that the assessment should identify a range of concentrations which are of concern for each substance of interest. Given the state-of-the-art of assessment tools, it is considered unlikely that a single value can consistently characterize protective levels. However, defining a range of importance can provide a consistent treatment across sites and species. In any event, the desire for quantifying an assessment should not override the information being presented by the biota being tested or measured. The inclusion of sensitive test species is of paramount concern if the overall assessment is to yield information on levels which are generally protective.

5. A tiered approach to site investigation should be used. Using a tiered approach allows for efficient allocation of resources. The first tier should be a rapid, sensitive overprotective measure.

6. Finally, the assessment should have some mechanism for evaluating the efficacy of the overall method and for incorporating improvements as they arise.

Other programmatic and regulatory factors should also be considered in the development of a specific toxic hot spot definition. These additional factors include:

1. The ability to distinguish between sites with significant or little information on the impacts of toxic pollutants.

2. Testability using interpretable scientific procedures (i.e., indicators or actual measurements of impacts on beneficial uses);

3. Usability with existing monitoring information and any new monitoring information that might be collected;

4. Usefulness of new or emerging scientific methods in defining toxic hot spots as long as substantial evidence is available to support the hot spot designation;

5. The higher importance of biological response of organisms than chemical measurement alone;

6. A biological response associated with the presence of non-naturally-occurring toxic pollutants. Association of biological response with other sources of response, e.g., hydrogen sulfide (H_2S), grain size, total organic carbon (TOC), etc. alone is not sufficient to identify a toxic hot spot.

7. Pollution indicators can be used to designate a toxic hot spot. Actual loss of beneficial use is not required to designate a site as a toxic hot spot.

8. The very general term "interests of the State" is defined as the public health and welfare of the people of California. This definition includes protection of the environment.

C. Rationale for a Specific Working Definition

1. Defining Toxic Hot Spots Based on the Weight-of-Evidence.

One of the most important views expressed by the sediment quality assessment workshop participants was the adoption of a weight-of-evidence approach to the evaluation of sediment quality assessment information. A weight-of-evidence approach relies on a comprehensive judgement of chemical, physical, biological, toxicological, and modelling information to draw conclusions regarding the effects of pollutants on biological resources and human health (Lorenzato et al., 1991). To implement this approach, the toxic hot spot definition must include an assessment of biological response as well as an evaluation of the chemical contamination of various media.

Weight-of-evidence is a representation of the environment and forms a baseline from which to make judgements regarding the adverse effects that may have been generated by toxicants in the environment. Several assessment measures are available to create a weight-of-evidence that spans the breadth of problem conditions. These measures focus on biological organization ranging from subcellular to community and from single-celled organisms to the highest order predators. Any of these measures taken singly provide limited insight into the quality of an estuarine environment. Taken together, however, these measures present a more comprehensive impression of the environment than when any one measure is viewed in isolation. Even though only one trigger is necessary for designating a "known" toxic hot spot, when sites are ranked (please refer to Chapter VI) all available information will be used to determine the weight-of-evidence to characterize the site.

When selecting environmental indicators, the measures providing the most information will be the most useful. The selection of measures will represent a reasonable judgement that protection of all levels is "modelled" by the measures selected.

2. Categories of Biological Measurements Useful in Defining Toxic Hot Spots

Toxicity can be assessed in relation to either complex mixtures or individual substances. It can also be evaluated on the basis of acute or chronic exposures. Several species have been tested for acute toxicity to bedded (as opposed to suspended) sediment samples. For saline and brackish waters, tests for amphipods are well developed and widely used as acute, lethal tests (e.g., ASTM, 1991; De Witt et al., 1989. Nebecker et al., 1984). Amphipods have been used to test field samples and laboratory spiked sediments. Chronic exposures have been tested with the polychaete Neanthes (Johns et al., 1990). Growth of the polychaete is measured in a 20-day exposure. Reduction in growth over this period has been shown to predict adverse effects on reproduction.

Direct measurement of reproductive effects is another indicator of environmental impairment. Several tests developed for measuring adverse reproductive effects arising from exposure to polluted water have been adapted to characterize potential problem sediments. Most of these tests require the preparation of an elutriate (the mixing of sediment with water, subsequent settling, and then testing in the water separated from the settled sediments; e.g., ASTM, 1987). Another method of evaluating reproductive effects is histopathological examinations for morphological deformities. In general, examinations are not limited to reproductive organs but, instead, look for cancerous tissue in gills, liver, and reproductive organs (e.g., Hinton et al., 1990; Malins et al., 1987). These measurements focus on specific tissues. Lesions in the tissues are often correlated with death, deformity, or poor general fitness (condition indices) of the animal, although some abnormalities appear to be the early stages of more damaging pathologies. These early stage lesions may be reversible, therefore, are considered indications of exposure rather than actual adverse effects.

Several other exposure measures focussing on cellular or subcellular levels are available. Several enzyme systems which are induced in the presence of pollutants can be measured. These include EROD (ethoxyresorufin o-deethylase), cytochrome P450, arylhydrocarbon hydroxylase (e.g., Stegman et al., 1988; Long and Buchman, 1989), and stress protein induction (Sanders, 1990). In addition, several tests for genotoxicity have been developed. These include tests of DNA integrity (strand breakage and adduct measurements) and measures of mitotic aberration in urchin embryos (Nacci and Jackim, 1989; Shugart, 1988). These tests are characterized by biochemical systems essential to cellular function which demonstrates unusual intensity or function.

Benthic community structure can be used to assess whether two sites with substantially similar physical characteristics differ in terms of the species present and numbers of individuals of each species. These measurements can then be analyzed using ordination techniques, principal component analysis or other techniques to identify potential causes of any differences detected. Indicator species identification is associated with this type of measure (i.e., a species that represents a particular characteristic condition). An example of an indicator species is the brittle star, Amphiodia urtica (EcoAnalysis, et al., 1992). At depths greater than 30 meters in the Southern California Bight, this animal appears to be abundant in areas not impacted by sewage discharge and scarce or absent in areas influenced by the discharge of treated sewage. Other species which are pollutant tolerant can also be used as indicator species. These types of measures focus on the population or community level. Due to the many forces influencing the composition of a community or population, it is often difficult to determine whether toxic pollutants act as a controlling factor. To clarify whether toxicants are exerting significant effects, community analysis can be coupled with measures of individual organisms.

Measures of exposure of organisms to pollutants is another powerful tool for identifying toxic hot spots. Many biomarkers fall into the category of exposure measures, as do measures of tissue burdens (e.g., State Mussel Watch). One advantage of exposure measures are that many are adaptable to inexpensive, rapid assessment methods.

Three types of biomarker data are available for identification of toxic hot spots. Selected enzymes in the cytochrome P450 system are induced upon exposure to a variety of organic pollutants (Spies et al., 1990). Measurements of the concentration of these enzymes in gill and liver tissue can be used to identify polluted sites. The BPTCP is developing special application of the P450 system using a genetically engineered cell line to elucidate exposure to dioxins, furans and related substances (see Chapter VIII). Building on work conducted to examine the biological fate of dioxin, this new system (the Reporter Gene System) has the potential to allow quantitative assessment of exposure to this very important group of toxicants.

Stress proteins are another enzyme system of interest (Sanders, 1990). These enzymes appear to be elevated in the presence of metals. Stress proteins generally function to stabilize macromolecules during transport within cells and in the repair of damaged enzymes.

The third type of enzyme group of interest are those enzymes that have been associated with the development of cancer. A number of enzymes are either depressed or elevated in tumor cells and cells identified as precancerous lesions. Further work is needed to evaluate the usefulness of this group in environmental monitoring.

3. Information Available for the Definition of a Toxic Hot Spot.

Toxic hot spots can be defined in two categories: "known" and "potential." These categories are based on the amount of information available and the level of confidence in interpreting the information. A site can be considered a "known" toxic hot spot if the site exhibits significant toxicity, high levels of bioaccumulation, impairment of resident organisms, degradation of biological resources, or water or sediment quality objectives that are exceeded. In all cases, repeated or recurrent and replicated measurements are needed to characterize the known hot spots.

To become a known toxic hot spot a significant amount of confirming information must be available. With existing information, relatively few sites are expected to meet the stated requirements.

A site with some data but not sufficient enough to designate as a known toxic hot spot shall be grouped as a potential toxic hot spot. Any site designated as a potential hot spot will be a candidate for further monitoring to confirm preliminary indications of site impairments. The types of information available for these sites can vary widely. A site is considered a potential toxic hot spot if chemical concentrations in water or sediment are elevated, the water or sediments are toxic (in single tests), tissue bioaccumalation is elevated to a level of concern but is not at a level where the use is impaired, or concentrations exceed water or sediment quality criteria. Those sites where little or no information is available shall not be classified as a potential toxic hot spot.

4. Reference Site Characterization.

In defining toxic hot spots, the use of control sediments, reference sediments, and reference toxicants in toxicity testing requires explanation. A control is defined as an experimental unit absent the treatment conditions. Generally, in sediment toxicity tests, controls are the medium that will allow optimal response of the test organism. The purpose of the control is to demonstrate the proper function of the test protocol. The use of reference toxicants (i.e., a spiked water control) affirms the "normal" response of the test organism. The reference toxicant allows us to confirm the sensitivity of the test organisms and, therefore, further clarifies the proper function of the test protocol.

In testing bedded sediments we also consider the use of reference sediments. Reference sediments are not the same as reference toxicants. The purpose of reference sediments is to apportion that part of the response that may be attributable to physical factors of the sediment. It is not an indicator of the appropriateness of the animals response as are controls and reference toxicant tests. Instead, it is a measure of the background "stress" of the test conditions. Since some sediments have been shown to exert significant stress irrespective of toxicant exposure, some means of assessing the magnitude of this stress is needed to be able to identify the additional stress imparted by toxicants.

A reference site is a location with physical characteristics as close to the conditions at a test site as is practical, except that the reference site is distinguished by an absence of pollutants. Therefore, reference sites should span the full range of conditions expected to be encountered at test sites. A control is selected to optimize the response of the test organism. Tests using control sediments are used to assess the usual, expected vitality of the test organisms. Tests using reference sediments are used to partition organism response into that induced by physical features of the sediments and that which is attributable to pollutant loads.

The working definition of a toxic hot spot that follows combines consideration of sediment quality assessment criteria, the programmatic and regulatory criteria, and the tools available to identify toxic hot spots.

D. Working Definition of a Toxic Hot Spot

Although the Water Code provides some direction in defining a toxic hot spot, the definition presented in Section 13391.5 is broad and somewhat ambiguous regarding the specific attributes of a toxic hot spot. The following draft definition provides the BPTCP with a specific working definition and a mechanism for identifying and distinguishing between "known" and "potential" toxic hot spots.

1. Known Toxic Hot Spot

A site meeting any one or more of the following conditions is considered to be a "known" toxic hot spot:

1. The site exceeds water or sediment quality objectives for toxic pollutants that are contained in appropriate water quality control plans.

   This finding requires chemical measurement of water or sediment, or measurement of toxicity using tests and objectives stipulated in water quality control plans. Determination of a toxic hot spot using this finding should rely on recurrent measures over time (at least two separate sampling dates). Suitable time intervals between measurements must be determined.

2. The water or sediment exhibits toxicity associated with toxic pollutants, based on toxicity tests acceptable to the BPTCP.

   To determine whether toxicity exists, recurrent measurements (at least two separate sampling dates) should demonstrate an effect. Appropriate reference and control measures must be included in the toxicity testing. The methods acceptable to and used by the BPTCP may include some toxicity test protocols not referenced in water quality control plans (Table 8 in Chapter III). Toxic pollutants should be present in the media at concentrations sufficient to cause or contribute to toxic responses in order to satisfy this condition.

3. The tissue toxic pollutant levels of organisms collected from the site exceed levels established by the Office of Environmental Health Hazard Assessment (OEHHA), California Department of Health Services (DHS), United States Food and Drug Administration (FDA) for the protection of human health, or the National Academy of Sciences (NAS) for the protection of human health or wildlife. When health warning against the consumption of edible organisms has been issued by OEHHA or DHS, on a site, the site is automatically classified a "known" toxic hot spot.

Acceptable tissue concentrations are measured either as muscle tissue (preferred) or whole body residues. Residues in liver tissue alone are not considered a suitable measure for known toxic hot spot designation. Animals can either be deployed (if a resident species) or collected from resident populations. Recurrent measurements are required. Residue levels established for the protection of human health can be applied to any consumable species.

<u>Shellfish:</u> Except for existing information, each sampling episode should include a minimum of three replicates. The value of interest is the average value of the three replicates. Each replicate should be comprised of at least 15 individuals. For existing State Mussel Watch information related to organic pollutants, a single composite sample (20-100 individuals), may be used instead of the replicate measures. When recurrent measurements exceed one of the levels referred to above, the site is considered a known toxic hot spot.

<u>Fin-fish:</u> A minimum of three replicates is necessary. The number of individuals needed will depend on the size and availability of the animals collected; although a minimum of five animals per replicate is recommended. The value of interest is the average of the three replicates. Animals of similar age and reproductive stage should be used.

4. Impairment is associated with toxic pollutants found in resident individuals.

Impairment means reduction in growth, reduction in reproductive capacity, abnormal development, histopathological abnormalities, or identification of adverse effects using biomarkers. Each of these measures must be made in comparison to a reference condition where the endpoint is measured in the same species and tissue is collected from an unpolluted reference site.

Growth Measures: Reductions in growth can be addressed using suitable bioassays acceptable to the BPTCP or through measurements of field populations. (please refer to Table 8).

Reproductive Measures: Reproductive measures must clearly indicate reductions in viability of eggs or offspring, or reductions in fecundity. Suitable measures include: pollutant concentrations in tissue, sediment, or water which have been demonstrated in laboratory tests to cause reproductive impairment, or significant differences in viability or development of eggs between reference and test sites.

Abnormal Development: Abnormal development can be determined using measures of physical or behavioral disorders or aberrations. Evidence that the disorder can be caused by toxic pollutants, in whole or in part, must be available.

Histopathology: Abnormalities representing distinct adverse effects, such as carcinomas or tissue necrosis, must be evident. Evidence that toxic pollutants are capable of causing or contributing to the disease condition must also be available.

Biomarkers: Direct measures of physiological disruption or biochemical measures representing adverse effects, such as significant DNA strand breakage or perturbation of hormonal balance, must be evident. Biochemical measures of exposure to pollutants, such as induction of stress enzymes, are not by themselves suitable for determination of "known" toxic hot spots. Evidence that a toxic pollutant causes or contributes to the adverse effect are needed.

5. Significant degradation in biological populations and/or communities associated with the presence of elevated levels of toxic pollutants.

This condition requires that diminished numbers of species or changes in the number of individuals of a single species (when compared to a reference site) are associated with concentrations of toxic pollutants. The analysis should rely on measurements from multiple stations. Care should be taken to ensure that at least one site is not degraded so that a suitable comparison can be made.

In summary, sites are designated as "known" hot spots after generating information which satisfies any one of the five conditions constituting the working definition. To use the working definition, a list of toxicity tests for BPTCP toxicity testing is provided in Table 8 (Chapter III). This list identifies toxicity tests for monitoring and surveillance activities described in regional monitoring plans and partially satisfies the Water Code requirement [Section 13392.5(a)(2)] for standardized analytical methods (Department of Fish and Game, 1993).

2. Potential Toxic Hot Spot

In addition to the identification of "known" toxic hot spots, the statute requires the identification of suspected or "potential" toxic hot spots (Water Code Section 13392.5). Sites with existing information indicating possible impairment, but without sufficient information to be classified as a "known" toxic hot spot are classified as "potential" hot spots. Four conditions sufficient to identify a "potential" toxic hot spot are defined below. If any one of the following conditions is satisfied, a site can be designated a "potential" toxic hot spot:

1. Concentrations of toxic pollutants are elevated above background levels, but insufficient data are available on the impacts associated with such pollutant levels to determine the existence of a known toxic hot spot;

2. Water or sediments which exhibit toxicity in screening tests or tests other than those specified by the BPTCP;

3. Toxic pollutant levels in the tissue of resident or test species are elevated, but do not meet criteria for determination of the site as a known toxic hot spot, tissue toxic pollutant levels exceed maximum tissue residue levels (MTRLs) derived from water quality objectives contained in appropriate water quality control plans, or a health warning has been issued for the site by a local public health agency.

4. The level of pollutant at a site exceeds Clean Water Act Section 304(a) criterion, or sediment quality guidelines or EPA sediment toxicity criteria for toxic pollutants.

E. Water Bodies Included in the BPTCP

Each of the Coastal Regional Boards has identified the water bodies in their regions that are included in the BPTCP. The definitions of "enclosed bays" and "estuaries" are from the Water Code, Section 13391.5.

"Enclosed Bays": Indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. "Enclosed Bays" include all bays where the narrowest distance between the headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. "Enclosed bays" include, but are not limited to, Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles-Long Beach Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay. For identifying, characterizing, and ranking toxic hot spots pursuant to this chapter, Monterey Bay and Santa Monica Bay shall also be considered enclosed bays.

"Estuaries": Waters, including coastal lagoons, located at the mouths of streams which serve as mixing zones for fresh and ocean waters (also tidal prisms). Coastal lagoons and mouths of streams which are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and sea water. Estuarine waters include, but are not limited to, the Sacramento-San Joaquin Delta, as defined in Water Code Section 12220, Suisun Bay, Carquinez Strait downstream to the Carquinez Bridge, and appropriate areas of the Smith, Mad, Eel, Noyo, Russian, Klamath, San Diego, and Otay Rivers.

"Open Bays": Coastlines that do not satisfy the "75 percent" requirement for enclosed bays are considered "open bays". Santa Monica Bay and Monterey Bay are examples of this type of bay.

The estuaries list has been subdivided into the three types mentioned in the definition: (a) coastal lagoons, (b) river mouths, and (c) the Sacramento/San Joaquin River Delta. Each water body included in the BPTCP is listed in Tables 2A-2G. For some of the water bodies the Regional Boards have identified segments. Each segment is listed below the water body name. The water body locations in each of the regions are presented in Figures 2 through 5.

1. Region 1 - North Coast BPTCP Primary Water Bodies

Region 1 has a wide distribution of bay and estuary primary water body locations (see Figure 2 following Table 2A). Beginning at Smith River Estuary in northern Del Norte County and ranging south to the Estero de San Antonio in Northern Marin, the Region encompasses a large number of major river estuaries. Other north coast rivers and streams with significant estuaries include the Klamath River, Redwood Creek, Little River, Mad River, Eel River, Matthole River, Ten Mile River, Noyo River, Big River, Albion River, Navarro River, Elk Creek, Garcia River, Gualala River, Russian River, and Salmon Creek (this creek mouth also forms a lagoon). Northern Humboldt County coastal lagoons include Big Lagoon and Stone Lagoon. Del Norte County is the location Lake Earl the Region's only estuarine lake.

Humboldt County is the location of Humboldt Bay and Arcata Bay, the two largest enclosed bays in the North Coast Region. The other significant enclosed bay, Bodega Bay, is located in Sonoma County near the southern border of the Region. A full list of North Coast BPTCP water bodies is provided in Table 2A.

Table 2A

North Coast Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal Extent
Water Body Type: Estuaries		
MAD RIVER SLOUGH	109.00	450 Acre(s)
CRESCENT CITY MARINE	103.11	100 Acre(s)
DEAD LAKE WETLAND	103.11	50 Acre(s)
LAKE EARL	103.11	2521 Acre(s)
LAKE EARL WETLAND	103.11	2290 Acre(s)
LAKE TALAWA	103.11	270 Acre(s)
KLAMATH RIVER DELTA ESTUARY	105.11	400 Acre(s)
REDWOOD CREEK DELTA	107.10	5 Acre(s)
REDWOOD CREEK ESTUARY	107.10	1 Acre(s)
BIG LAGOON	108.10	1220 Acre(s)
DRY LAGOON	108.10	80 Acre(s)
FRESHWATER LAGOON	108.10	245 Acre(s)
STONE LAGOON	108.10	521 Acre(s)
LITTLE RIVER ESTUARY	108.20	2 Acre(s)
MAD RIVER ESTUARY	109.10	100 Acre(s)
CLARK'S SLOUGH	110.00	1 Acre(s)
EUREKA SLOUGH	110.00	4 Acre(s)
HUMBOLDT BAY NWR	110.00	115 Acre(s)
EEL RIVER DELTA ESTUARY	111.11	9600 Acre(s)

MATTOLE RIVER ESTUARY	112.30	175 Acre(s)
BEAR HARBOR ESTUARY	113.11	2 Acre(s)
JACKASS CREEK ESTUARY	113.11	3 Acre(s)
SMITH RIVER DELTA ESTUARY	103.11	415 Acre(s)
USAL CREEK ESTUARY	113.11	10 Acre(s)
COTTONEVA CREEK ESTUARY	113.12	14 Acre(s)
HARDY CREEK ESTUARY	113.12	6 Acre(s)
TEN MILE RIVER DELTA	113.13	109 Acre(s)
CASPER CREEK ESTUARY	113.20	13 Acre(s)
CLEON LAKE WETLAND	113.20	32 Acre(s)
INGLENOOK CREEK ESTUARY	113.20	5 Acre(s)
INGLENOOK FEN	113.20	2 Acre(s)
NOYO RIVER ESTUARY	113.20	82 Acre(s)
PUDDING CREEK ESTUARY	113.20	58 Acre(s)
SANDHILL LAKE ESTUARY	113.20	25 Acre(s)
BIG RIVER DELTA	113.30	215 Acre(s)
ALBION RIVER DELTA	113.40	128 Acre(s)
BIG SALMON CREEK ESTUARY	113.40	9 Acre(s)
NAVARRO RIVER DELTA	113.50	20 Acre(s)
GREENWOOD CREEK ESTUARY	113.61	14 Acre(s)
ELK CREEK ESTUARY	113.62	17 Acre(s)
ALDER CREEK ESTUARY	113.63	9 Acre(s)
BRUSH CREEK ESTUARY	113.64	2 Acre(s)
HUNTERS LAGOON	113.64	86 Acre(s)
LAGUNA CREEK MARSH	113.64	20 Acre(s)
GARCIA RIVER DELTA	113.70	264 Acre(s)
HATHAWAY CREEK ESTUARY	113.70	80 Acre(s)

GUALALA RIVER DELTA	113.80	20 Acre(s)
RUSSIAN RIVER DELTA ESTUARY	114.11	150 Acre(s)
SALMON CREEK LAGOON	115.10	40 Acre(s)
ESTERO AMERICANO	115.30	692 Acre(s)
ESTERO DE SAN ANTONIO	115.40	319 Acre(s)

Water Body Type: Enclosed Bays

CRESCENT CITY HARBOR	103.11	384 Acre(s)
ARCATA BAY	110.00	8500 Acre(s)
HUMBOLDT BAY	110.00	8000 Acre(s)
HUMBOLDT BAY - CENTRAL	110.00	1900 Acre(s)
HUMBOLDT BAY - NORTH	110.00	1300 Acre(s)
HUMBOLDT BAY - SOUTH	110.00	3400 Acre(s)
BODEGA BAY	115.00	5000 Acre(s)
BODEGA HARBOR	115.20	340 Acre(s)
BODEGA HARBOR WETLAND	115.20	416 Acre(s)

Water Body Type: Open Bays and Ocean

KELP BEDS TRINIDAD COAST	108.10	1581 Acre(s)
PYGMY FOREST ASBS	108.10	259 Acre(s)
OCEAN OFF OF SAMOA PENINSULA	110.00	2 Mile(s)
KINGS RANGE NATIONAL CONSERVATION AREA	112.30	3680 Acre(s)
KELP BEDS SAUNDERS REEF	113.70	618 Acre(s)
DEL MAR LANDING RESERVE	113.85	77 Acre(s)
GERSTLE COVE	113.85	2 Acre(s)
BODEGA MARINE REFUGE	115.20	200 Acre(s)
REDWOOD NATIONAL PARK	107.10	4160 Acre(s)

* Hydrologic Units are listed in the Basin Plan for this Region.

Figure 2
Bay Protection and
Toxic Cleanup Program
Primary Waterbody Locations
North Coast Region

2. Region 2 - San Francisco Bay Area BPTCP Primary Water Bodies

The Region 2 BPTCP includes a substantial number of both coastal water bodies and San Francisco Bay/Estuary waters with their tidally influenced tributaries (Figure 3, following Table 2C). Region 2 coastal bays and estuaries include Tomales Bay near the northern border of the Region, Drakes Estero on the Point Reyes Peninsula, Bolinas Bay, and Half Moon Bay. Tributaries to Tomales Bay include Walker Creek, Keys Creek, Lagunitas Creek, and Olema Creek. Coastal creeks include Webb Creek, Denniston Creek, Frenchmans Creek, and Pilarcitos Creek.

Major San Francisco Bay/Estuary waters include (east to west) the lower Sacramento and San Joaquin rivers, Honker Bay, Grizzly Bay, Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, and Central, Lower, and South San Francisco Bay. Major creeks tributary to the bay(s) and other significant area waters include New York Slough, Mare Island Strait, Petaluma River, Castro Cove, Richmond Harbor, Oakland Harbor, the Port of San Francisco, Coyote Creek, Redwood Creek, and many smaller streams too numerous to illustrate on the Region 2 map. A full listing of San Francisco Bay Region BPTCP water bodies is provided in Table 2B.

BAY PROTECTION AND TOXIC CLEANUP PROGRAM
PRIMARY WATER BODIES LIST
March 1993

Table 2B

San Francisco Bay Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal** Extent
Water Body Type: Estuaries		
ALAMERE CREEK	200.00	N/A
ARROYO DE EN MEDIO	200.00	N/A
BOLINAS LAGOON	200.00	N/A
DENNISTON CREEK	200.00	N/A
FRENCHMANS CREEK	200.00	N/A
GLENBROOK CREEK	200.00	N/A
KEYS CREEK	200.00	N/A
LAGUNITAS CREEK	200.00	N/A
NORTH RICHMOND MARSH	200.00	400 Acre(s)
NOVATO CREEK MARSH	200.00	130 Acre(s)
OLEMA CREEK	200.00	N/A
PESCADERO MARSH	200.00	520 Acre(s)
PETALUMA RIVER MARSH	200.00	3800 Acre(s)
PILARCITOS CREEK	200.00	N/A
POINT EDITH WETLANDS	200.00	380 Acre(s)
POMPONIO CREEK LAGOON	200.00	1 Acre(s)
PRINCETON MARSH	200.00	30 Acre(s)
REDWOOD SHORES ECOLOGICAL RESERVE	200.00	100 Acre(s)
RODEO LAGOON	200.00	38 Acre(s)

SAN GREGORIO CREEK LAGOON	200.00	6 Acre(s)
SAN PEDRO HILL MARSH	200.00	50 Acre(s)
SAN RAFAEL CREEK MARSH	200.00	200 Acre(s)
SANDPIPER WETLANDS	200.00	13 Acre(s)
TUNITAS CREEK LAGOON	200.00	11 Acre(s)
VICENTE CREEK	200.00	N/A
WALKER CREEK MARSH	200.00	15 Acre(s)
WEBB CREEK	200.00	Acre(s)
TOMALES BAY	201.11	7820 Acre(s)
DRAKES ESTERO	201.20	2560 Acre(s)
ESTERO DE LIMANTOUR	201.20	1 Acre(s)
MARIN COASTAL WETLANDS	201.30	Acre(s)
SAN MATEO COASTAL WETLANDS	202.20	Acre(s)
NAPA RIVER WETLANDS	206.50	10000 Acre(s)
SACRAMENTO SAN JOAQUIN DELTA:	207.10	3400 Acre(s)
MIDDLE SLOUGH	207.10	N/A
NEW YORK SLOUGH	207.10	N/A
SACRAMENTO RIVER	207.10	N/A
SAN JOAQUIN RIVER	207.10	N/A
SHERMAN LAKE	207.10	N/A
SPOONHILL CREEK	207.10	N/A

Water Body Type: Enclosed Bays

HONKER BAY	200.00	N/A
PIRATE COVE	200.00	N/A
RODEO COVE	200.00	N/A
SEAL COVE	200.00	N/A

SHELTER COVE	200.00	N/A
TOMALES BAY WETLANDS	201.11	1905 Acre(s)
BOLINAS LAGOON WETLANDS	201.30	850 Acre(s)
HALF MOON BAY WETLANDS	202.21	N/A
CENTRAL SAN FRANCISCO BAY:	203.12	67700 Acre(s)
CENTRAL SAN FRANCISCO BAY WETLANDS	203.12	N/A
ALCATRAZ DISPOSAL SITE	203.12	N/A
ARROYO CORTE MADERA DEL PRESIDIO	203.12	N/A
ARROYO VIEJO	203.12	N/A
BERKELEY AQUATIC PARK	203.12	N/A
BERKELEY MARINA	203.12	N/A
CERRITO CREEK	203.12	N/A
CODORNICES CREEK	203.12	N/A
CORTE MADERA CREEK	203.12	N/A
CORTE MADERA MARSH	203.12	200 Acre(s)
COYOTE CREEK (MARIN COUNTY)	203.12	N/A
DAMON SLOUGH	203.12	N/A
EAST SLOUGH	203.12	N/A
ELMHURST CREEK	203.12	N/A
EMERYVILLE MARSH	203.12	N/A
HOFFMAN MARSH	203.12	N/A
INDIA BASIN	203.12	N/A
ISLAIS CREEK	203.12	N/A
LAKE MERRITT	203.12	N/A
LAURITZEN CANAL	203.12	N/A

LION CREEK	203.12	N/A
NOAA CENTRAL BAY STATION	203.12	N/A
OAKLAND INNER HARBOR	203.12	N/A
OAKLAND OUTER HARBOR	203.12	N/A
PICKLEWEEK INLET	203.12	N/A
PORT OF SAN FRANCISCO	203.12	N/A
RICHMOND INNER HARBOR	203.12	N/A
RICHMOND OUTER HARBOR	203.12	N/A
SAN CLEMENTE CREEK	203.12	N/A
SAN LEANDRO BAY	203.12	N/A
SAN LEANDRO BAY	203.12	N/A
SAN RAFAEL CREEK	203.12	N/A
SANTA FE CHANNEL	203.12	N/A
SILVA ISLAND MARSH	203.12	N/A
STAUFER	203.12	N/A
TEMESCAL CREEK	203.12	N/A
TREASURE ISLAND	203.12	N/A
YERBA BUENA ISLAND	203.12	N/A
RICHARDSON BAY	203.13	2560 Acre(s)
LOWER SAN FRANCISCO BAY:	204.10	79900 Acre(s)
LOWER SAN FRANCISCO BAY WETLANDS	204.10	N/A
ALAMEDA CREEK	204.10	N/A
BAIR ISLAND	204.10	N/A
BELMONT SLOUGH	204.10	N/A
COLMA CREEK	204.10	N/A
CORKSCREW SLOUGH	204.10	N/A

COYOTE HILLS SLOUGH	204.10	N/A
DEEPWATER SLOUGH	204.10	N/A
EASTON CREEK	204.10	N/A
HAYWARD FLATS	204.10	N/A
HAYWARD MARSH	204.10	N/A
HUNTER'S POINT	204.10	N/A
MILLS CREEK	204.10	N/A
MT. EDEN SLOUGH	204.10	N/A
NOAA SAN LEANDRO SITE	204.10	N/A
RAVENSWOOD SLOUGH	204.10	N/A
REDWOOD CREEK	204.10	N/A
SAN BRUNO POINT	204.10	N/A
SAN LORENZO CREEK	204.10	N/A
SAN MATEO CREEK	204.10	N/A
SANCHEZ CREEK	204.10	N/A
SEAL SLOUGH	204.10	N/A
SIERRA/OYSTER POINT	204.10	N/A
STEINBERGER SLOUGH	204.10	N/A
WESTPOINT SLOUGH	204.10	N/a
SOUTH SAN FRANCISCO BAY	205.10	N/A
SOUTH SAN FRANCISCO BAY WETLANDS	205.10	N/A
ALVISO SLOUGH	205.10	N/A
BEARDS CREEK	205.10	N/A
CHARLESTON SLOUGH	205.10	N/A
COYOTE CREEK	205.10	N/A
DUMBARTON BRIDGE	205.10	N/A

GUADALUPE RIVER/SLOUGH	205.10	N/A
MAYFIELD SLOUGH	205.10	N/A
MOUNTAIN SLOUGH	205.10	N/A
MOWRY SLOUGH	205.10	N/A
NEWARK SLOUGH	205.10	N/A
PLUMMER CREEK	205.10	N/A
SAN FRANSQUITO CREEK	205.10	N/A
SOUTH OF DUMBARTON BRIDGE	205.10	N/A
STEVENS CREEK	205.10	N/A
SAN PABLO BAY:	206.10	71300 Acre(s)
AMERICAN CANYON CREEK	206.10	N/A
APPLEBY BAY	206.10	N/A
CARNEROS CREEK	206.10	N/A
CASTRO CREEK	206.10	N/A
CHINA SLOUGH	206.10	N/A
DUTCHMAN SLOUGH	206.10	N/A
FAGAN CREEK	206.10	N/A
FAGAN SLOUGH	206.10	N/A
FLY BAY	206.10	N/A
GALLINAS CREEK	206.10	850 Acre(s)
GARRITY CREEK	206.10	N/A
GREEN ISLAND SLOUGH	206.10	N/A
HUDEMAN SLOUGH	206.10	N/A
HUICHICA CREEK	206.10	N/A
MILLER CREEK	206.10	N/A
NAPA RIVER	206.10	N/A
NAPA SLOUGH	206.10	N/A

NOVATO CREEK	206.10	N/A
PETALUMA RIVER	206.10	N/A
PINOLE CREEK	206.10	N/A
POINT MOLATE	206.10	N/A
RICHMOND ROD & GUN CLUB	206.10	N/A
RODEO CREEK	206.10	N/A
SAN ANTONIO CREEK	206.10	N/A
SAN PABLO BAY WETLANDS	206.10	35000 Acre(s)
SAN PABLO CREEK	206.10	N/A
SAN RAFAEL CREEK	206.10	N/A
SHEEHY CREEK	206.10	N/A
SONOMA CREEK	206.10	N/A
SOUTH SLOUGH	206.10	N/A
STEAMBOAT SLOUGH	206.10	N/A
SUSCOL CREEK	206.10	N/A
TOLAY CREEK MOUTH	206.10	N/A
WHITE SLOUGH	206.10	40 Acre(s)
WILDCAT CREEK	206.10	N/A
BOLINAS BAY	206.10	1 Acre(s)
HALF MOON BAY	206.10	N/A
SUISUN BAY:	207.10	25000 Acre(s)
BOYNTON SLOUGH	207.10	N/A
BROWNS ISLAND (WETLAND)	207.10	N/A
CHADBOURNE SLOUGH	207.10	N/A
CHIPPS ISLAND (WETLAND)	207.10	N/A

CORDELIA SLOUGH	207.10	N/A
CROSS SLOUGH	207.10	N/A
CUTOFF SLOUGH	207.10	N/A
DENVERTON SLOUGH	207.10	N/A
DUCK SLOUGH	207.10	N/A
FRANK HORAN SLOUGH	207.10	N/A
FROST SLOUGH	207.10	N/A
GOODYEAR SLOUGH	207.10	N/A
GRIZZLY BAY	207.10	N/A
GRIZZLY ISLAND (WETLAND)	207.10	N/A
HAMMOND ISLAND (WETLAND)	207.10	N/A
HARVEY SLOUGH	207.10	N/A
HASTINGS SLOUGH	207.10	N/A
HILL SLOUGH	207.10	N/A
JOICE ISLAND (WETLAND)	207.10	N/A
LUCO SLOUGH	207.10	N/A
MONTEZUMA SLOUGH	207.10	N/A
MUD SLOUGH	207.10	N/A
NOYCE SLOUGH	207.10	N/A
NURSE SLOUGH	207.10	N/A
RYER ISLAND (WETLAND)	207.10	N/A
SELBY	207.10	N/A
SHERMAN ISLAND (WETLAND)	207.10	N/A
SIMMONS ISLAND (WETLAND)	207.10	N/A
STAKE POINT	207.10	N/A

SUISUN BAY WETLANDS	207.10	57000 Acre(s)
SUISUN MARSH	207.10	N/A
SUISUN SLOUGH CHANNEL	207.10	N/A
UNION CREEK	207.10	N/A
VAN SICKLE ISLAND (WETLAND)	207.10	N/A
VOLANTI SLOUGH	207.10	N/A
WELLS SLOUGH	207.10	N/A
WHEELER ISLAND (WETLAND)	207.10	N/A
CARQUINEZ STRAIT:	207.10	6560 Acre(s)
BENECIA BRIDGE	207.10	N/A
CASTRO COVE	207.10	25 Acre(s)
GLEN COVE	207.10	N/A
MARE ISLAND STRAIT	207.10	N/A
PACHECO CREEK	207.10	N/A
PEYTONIA SLOUGH	207.10	1 Acre(s)
SEMPLE POINT	207.10	N/A
SOUTH HAMPTON BAY	207.10	N/A
SOUTH HAMPTON BAY WETLANDS	207.21	300 Acre(s)

Water Body Type: Open Bays & Ocean

BIRD ROCK	200.00	72 Acre(s)
DOUBLE POINT	200.00	86 Acre(s)
DUXBURY REEF RESERVE	200.00	1626 Acre(s)
FARALLON ISLANDS AREA	200.00	2000 Acre(s)
GULF OF THE FARALLONS NMS	200.00	N/A

DRAKES BAY	201.20	N/A
DRAKES BAY WETLANDS	201.20	N/A
POINT REYES HEADLANDS ASBS	201.20	2333 Acre(s)
JAMES FITZGERALD RESERVE	202.21	1006 Acre(s)

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* Hydrologic Units are listed in the Basin Plan for this Region

** N/A = Not Available

3. Region 3 - Central Coast BPTCP Primary Water Bodies

Region 3 BPTCP primary water bodies are diverse, numerous, and widespread along the central California coast (Figure 3 following Table 2C). Region 3 BPTCP water bodies include one large open bay, Monterey Bay; and several smaller open bays, which include Morro Bay, San Luis Bay, and Carmel Bay. Numerous creek and river estuaries extend down the coast from San Mateo County on the northern border of the Region to Santa Barbara County on the south. These waters, from north to south, include Gazos Creek Estuary, Cascade Creek Estuary, Green Oaks Creek, Waddell Creek Estuary, Laguna Creek Estuary, Baldwin Creek Estuary, Wilder Creek Estuary, San Lorenzo River Estuary, Pajaro River, Salinas River Lagoon, Old Salinas River Estuary, Carmel River Estuary, San Jose Creek Estuary, Little Sur River, Big Sur River Estuary, San Carppoforo Creek, Arroyo del Corral, Little Pico Creek, Pico Creek Estuary, San Simeon Creek, Santa Rosa Creek Estuary, San Luis Obispo Creek Estuary, Pismo Creek Estuary, Santa Maria River Estuary, San Antonio Creek Estuary, Scoot Creek Lagoon, Santa Ynez River Estuary, Canada Honda Creek, and Jelama Creek Estuary. In addition, numerous sloughs enter central Monterey Bay, including Harkins Slough, Watsonville Slough, McClusky Slough, Elkhorn Slough/Parsons Slough, Moro Cojo Slough, Tembladero Slough, and Espinosa Slough. The Central Coast Region's bay and estuary water resources also include lagoons, marshes, harbors (Santa Cruz Harbor, Moss Landing Harbor, Monterey Harbor, San Luis Harbor, and Santa Barbara Harbor), estuarine lakes, and a reclamation canal. A full listing of Central Coast Region BPTCP water bodies is provided in Table 2C.

BAY PROTECTION AND TOXIC CLEANUP PROGRAM
PRIMARY WATER BODIES LIST
March 1993

Table 2C

Central Coast Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal** Extent
Water Body Type: Estuaries		
BALDWIN CREEK ESTUARY	304.11	12 Acre(s)
LUCERNE LAKE ESTUARY	304.11	80 Acre(s)
SCOTT CREEK LAGOON	304.11	25 Acre(s)
WADDELL CREEK ESTUARY	304.11	20 Acre(s)
YOUNGER'S LAGOON (WETLAND)	304.11	7 Acre(s)
ANTONELLIS POND (WETLAND)	304.12	8 Acre(s)
LAGUNA CREEK ESTUARY	304.12	27 Acre(s)
NEARY'S LAGOON (WETLAND)	304.12	50 Acre(s)
SAN LORENZO RIVER ESTUARY	304.12	2 Acre(s)
SCHWAN LAKE (WETLAND)	304.12	32 Acre(s)
WILDER CREEK ESTUARY	304.12	13 Acre(s)
WOODS LAGOON	304.12	45 Acre(s)
CORCORAN LAGOON (WETLAND)	304.13	26 Acre(s)
SOQUEL LAGOON (WETLAND)	304.13	2 Acre(s)
CASCADE CREEK LAGOON/ESTUARY	304.20	10 Acre(s)
GAZOS CREEK LAGOON/ESTUARY	304.20	2 Acre(s)
GREEN OAKS CREEK LAGOON/ESTUARY	304.20	28 Acre(s)
CORRALITOS LAGOON (WETLAND)	305.10	37 Acre(s)

GALLIGHAN SLOUGH	305.10	N/A
HANSON SLOUGH	305.10	N/A
HARKINS SLOUGH	305.10	N/A
MCCLUSKY SLOUGH	305.10	181 Acre(s)
PAJORO SLOUGH	305.10	270 Acre(s)
PARSONS SLOUGH	305.10	1 Acre
STRUVE SLOUGH	305.10	3 Acre(s)
WATSONVILLE SLOUGH	305.10	150 Acre(s)
TEQUISQUITA SLOUGH (WETLAND)	305.40	300 Acre(s)
BENNETT SLOUGH/ESTUARY	306.00	44 Acre(s)
ELKHORN SLOUGH	306.00	2500 Acre(s)
CARMEL RIVER ESTUARY	307.00	37 Acre(s)
BIG SUR RIVER ESTUARY	308.00	5 Acre(s)
LITTLE SUR RIVER ESTUARY	308.00	2 Acre(s)
SAN JOSE CREEK ESTUARY	308.00	9 Acre(s)
ESPINOSA SLOUGH (WETLAND)	309.10	320 Acre(s)
MARINA PONDS (WETLAND)	309.10	8 Acre(s)
MORO COJO SLOUGH (WETLAND)	309.10	345 Acre(s)
OLD SALINAS RIVER ESTUARY	309.10	50 Acre(s)
SALINAS LAGOON	309.10	50 Acre(s)
SALINAS RECLAMATION CANAL	309.10	N/A
SALINAS RIVER LAGOON	309.10	175 Acre(s)
TEMBLADERO SLOUGH	309.10	150 Acre(s)
LAGUNA GRANDE (WETLAND)	309.50	17 Acre(s)
SAN CARPPOFORO ESTUARY	310.11	47 Acre(s)
ARROYO DE CORRAL	310.12	40 Acre(s)

ARROYO DE LA CRUZ ESTUARY	310.12	36 Acre(s)
ARROYO LAGUNA	310.13	3 Acre(s)
LITTLE PICO CREEK ESTUARY	310.13	3 Acre(s)
PICO CREEK ESTUARY	310.13	3 Acre(s)
SAN SIMEON CREEK ESTUARY	310.13	32 Acre(s)
SANTA ROSA CREEK ESTUARY	310.13	5 Acre(s)
SAN LUIS OBISPO CREEK ESTUARY	310.24	23 Acre(s)
PISMO CREEK ESTUARY	310.26	4 Acre(s)
OCEANO LAGOON (WETLAND)	310.31	32 Acre(s)
PISMO MARSH (WETLAND)	310.31	105 Acre(s)
DUNE LAKES/BLACK LAKE	310.32	900 Acre(s)
OSO FLACO LAKE	312.10	320 Acre(s)
SANTA MARIA RIVER ESTUARY	312.10	145 Acre(s)
SAN ANTONIO CREEK ESTUARY	313.00	7 Acre(s)
SANTA YNEZ RIVER ESTUARY	314.00	69 Acre(s)
GRAVES WETLAND	314.10	30 Acre(s)
CANADA HONDA CREEK ESTUARY	315.10	1 Acre(s)
JALAMA CREEK ESTUARY	315.10	2 Acre(s)
DEVEREAUX LAGOON (WETLAND)	315.31	53 Acre(s)
GOLETA POINT MARSH (WETLAND)	315.31	35 Acre(s)
GOLETA SLOUGH/ESTUARY	315.31	400 Acre(s)
LOS CANEROS WETLAND	315.31	25 Acre(s)
CARPINTERIA MARSH (EL ESTERO MARSH)	315.34	230 Acre(s)

Water Body Type: Enclosed Bays

SANTA CRUZ HARBOR	304.12	38 Acre(s)
MOSS LANDING HARBOR	306.00	160 Acre(s)
MONTEREY HARBOR	309.50	74 Acre(s)
MORRO BAY	310.22	3200 Acre(s)
SAN LUIS HARBOR	310.22	20 Acre(s)
SANTA BARBARA HARBOR	315.32	78 Acre(s)

Water Body Type: Open Bays and Ocean

ANO NUEVO COAST	304.00	26 Mile(s)
PESCADERO COAST	304.00	17 Mile(s)
ANO NUEVO ISLAND	304.20	1 Mile(s)
CARMEL BAY	307.00	16 Mile(s)
BIG SUR COAST	308.00	86 Mile(s)
JULIA PFEIFFER BURNS UNDERWATER PARK	308.00	10 Mile(s)
POINT LOBOS ECOLOGICAL RESERVE	308.00	8 Mile(s)
PACIFIC GROVE MARINE GARDENS	309.05	7 Mile(s)
MONTEREY BAY NORTH	309.50	N/A
MONTEREY BAY SOUTH	309.50	105 Mile(s)
ESTERO BAY COAST	310.00	23 Mile(s)
PISMO COAST	310.00	26 Mile(s)
SAN SIMEON COAST	310.13	31 Mile(s)
DIABLO COAST	310.25	17 Mile(s)
SANTA BARBARA NORTH COAST	313.00	56 Mile(s)
VANDENBURG COAST	314.10	25 Mile(s)
SANTA BARBARA SOUTH COAST	315.00	25 Mile(s)

SAN MIGUEL ISLAND	316.10	26 Mile(s)
SANTA CRUZ ISLAND	316.10	76 Mile(s)
SANTA ROSA ISLAND	316.10	56 Mile(s)

* Hydrologic Units are Listed in the Basin Plan for this Region

** N/A = Not Available

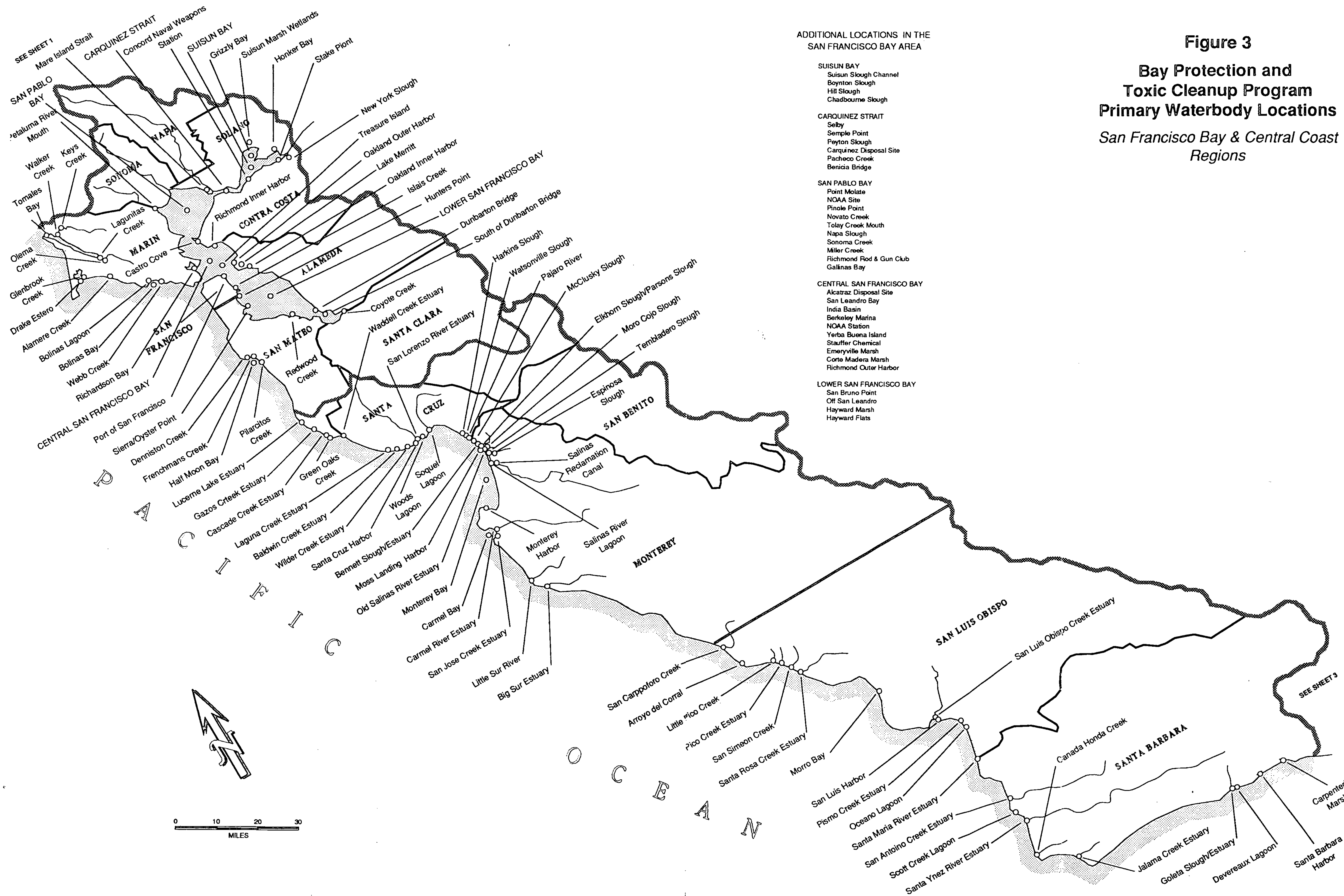


Figure 3

Bay Protection and Toxic Cleanup Program Primary Waterbody Locations

San Francisco Bay & Central Coast Regions

4. Region 5 - Sacramento - San Joaquin Delta Primary Water Bodies

The Sacramento-San Joaquin Delta in the Central Valley Region includes numerous rivers, sloughs, and canal segments (Figure 4 following Table 2D). Major estuarine and tidally-influenced rivers of the Sacramento-San Joaquin Delta include (proceeding from north to south) the Sacramento River, the North and South Forks of the Mokelumne River, the Consumnes River, the Calaveras River, the Old River, Middle River, and the San Joaquin River. Major canals and sloughs of the delta include the Sacramento Deep Water Ship Channel, the Delta Cross Channel, Cache Slough, Steamboat Slough, and Georgiana Slough, which are associated with the Sacramento River. Dry Creek, Snodgrass Slough, Beaver Slough, and Sycamore Slough flow into the Mokelumne River. Fourteen Mile Slough, and Disappointment Slough, flow into the San Joaquin River. Flooded Delta 'islands' include Franks Tract. State and Federal water project facilities include Clifton Court Forebay, and the Delta-Mendota and California Aqueducts. Region 5 waters also include several lakes located along the Sacramento River. These include Lake Washington, Winchester Lake, and Stone Lake. For a complete listing of Sacramento-San Joaquin Delta BPTCP Primary Water Bodies, refer to Table 2D.

Table 2D

Central Valley Region

Water Body or Segment Name	Hydrologic* Unit No.
Water Body Type: Estuaries	
CENTRAL DELTA AREA:	544.00
BEAR CREEK	544.00
BIG BREAK	544.00
BISHOP SLOUGH	544.00
BROAD SLOUGH	544.00
BURNS CUTOFF	544.00
CALVERAS RIVER	544.00
COLUMBIA CUT	544.00
CONNECTION SLOUGH	544.00
DEER CREEK	544.00
DISAPPOINTMENT SLOUGH	544.00
DRY CREEK	544.00
DUTCH SLOUGH	544.00
FALSE RIVER	544.00
FISHERMAN'S CUT	544.00
FOURTEEN MILE SLOUGH	544.00
FRANKS TRACT	544.00
HOLLAND CUT	544.00
HORSESHOE BEND	544.00

JACKSON SLOUGH	544.00
KELLOG CREEK	544.00
LAKE LINCOLN	544.00
LATHMAN SLOUGH	544.00
MARSH CREEK	544.00
MAYBERRY SLOUGH	544.00
MIDDLE RIVER	544.00
MONTEZUMA SLOUGH	544.00
MORMON CHANNEL	544.00
MOSHER SLOUGH	544.00
NEW YORK SLOUGH	544.00
OLD RIVER	544.00
PIPER SLOUGH	544.00
PIXLEY SLOUGH	544.00
POTATOE SLOUGH	544.00
ROCK SLOUGH	544.00
SACRAMENTO R.: RIO VISTA - COLLINSVILLE	544.00
SAN JOAQUIN RIVER, LOWER	544.00
SAND CREEK	544.00
SAND MOUND SLOUGH	544.00
SEVEN MILE SLOUGH	544.00
SHERMAN LAKE	544.00
SMITH'S CANAL	544.00
SUISUN BAY	544.00

TAYLOR SLOUGH	544.00
TELEPHONE CUT	544.00
THREE MILE SLOUGH	544.00
TURNER CUT	544.00
WHISKEY SLOUGH	544.00
WHITE SLOUGH	544.00
NORTH-WEST DELTA AREA:	544.00
BABEL SLOUGH	544.00
BARKER SLOUGH	544.00
CACHE SLOUGH	544.00
HAAS SLOUGH	544.00
HASTINGS CUT	544.00
HESS SLOUGH	544.00
LAKE WASHINGTON	544.00
LIBERTY CUT	544.00
LOOKOUT SLOUGH	544.00
PROSPECT SLOUGH	544.00
SACRAMENTO DEEP WATER SHIP CHANNEL	544.00
SHAG SLOUGH	544.00
STEAMBOAT SLOUGH	544.00
SWEANY CREEK	544.00
THE BIG DITCH	544.00
TOE DRAIN	544.00
WINCHESTER LAKE	544.00
NORTH-EAST DELTA AREA:	544.00
BEACH LAKE	544.00

BEAVER SLOUGH	544.00
DELTA CROSS CHANNEL	544.00
DRY CREEK	544.00
ELK CREEK	544.00
GEORGIANA SLOUGH	544.00
HOG SLOUGH	544.00
LAGUNA CREEK	544.00
MINER SLOUGH	544.00
MOKELUMNE RIVER	544.00
MOKELUMNE RIVER, NORTH FORK	544.00
MOKELUMNE RIVER, SOUTH FORK	544.00
MORRISON CREEK	544.00
OXFORD SLOUGH	544.00
SACRAMENTO R.: SACRAMENTO TO RIO VISTA	544.00
SNODGRASS SLOUGH	544.00
STEAMBOAT SLOUGH	544.00
STONE LAKE	544.00
SYCAMORE SLOUGH	544.00
WILLIAMSON TRACT	544.00
SOUTH DELTA AREA:	544.00
BETHANY RESERVOIR	544.00
CLIFTON COURT FOREBAY	544.00
CROCKER CUT	544.00
DISCOVERY BAY	544.00
DOUGHTY CUT	544.00
FABIAN & BELL CANAL	544.00

FRENCH CAMP SLOUGH	544.00
GRANT LINE CANAL	544.00
INDIAN SLOUGH	544.00
ITALIAN SLOUGH	544.00
LATERAL 4W, 5W, 6W, 5E, AND 6E	544.00
LOWER & UPPER MAIN CANAL	544.00
NORTH CANAL	544.00
NORTH VICTORIA CANAL	544.00
PARADISE CUT	544.00
RED BRIDGE SLOUGH	544.00
SALMON SLOUGH	544.00
SAN JOAQUIN R.: VERNALIS TO PARADISE CUT	544.00
SUGER CUT	544.00
TOM PAINE SLOUGH	544.00
TRAPPER SLOUGH	544.00
VICTORIA CANAL	544.00
WEST CANAL	544.00
WOODWARD CANAL	544.00

* Hydrologic Units are Listed in the Basin Plan for this Region.

Figure 4

Bay Protection and Toxic Cleanup Program Primary Waterbody Locations

Sacramento-San Joaquin Delta Area

5. Region 4 - Los Angeles Region BPTCP Primary Water Bodies

The Los Angeles coastal region includes another of the state's large open bays, Santa Monica Bay, with its associated harbors, tidal prisms, and lagoons (Figure 5, following Table 2G). To the north lie a variety of BPTCP waters; including additional ports and harbors (Channel Island Harbor, Port Hueneme), marinas (Ventura Marina), river and creek estuaries (Ventura and Santa Clara River Estuaries, Calleguas Creek Tidal Prism), lagoons (Mugu Lagoon), and estuarine lakes (McGarth Lake Estuary). Santa Monica Bay BPTCP waters and the associated tributaries include Malibu Lagoon, Marina Del Rey Harbor, Ballona Creek Tidal Prism, and King Harbor. To the south of Santa Monica Bay lie numerous other bays (San Pedro Bay, Alamitos Bay, and Queens Way Bay) and harbors (Los Angeles, Long Beach, and Sunset Harbors), marinas, lagoons, and other estuarine waters. A full listing of Los Angeles Region BPTCP water bodies is provided in Table 2E.

BAY PROTECTION AND TOXIC CLEANUP PROGRAM
PRIMARY WATER BODIES LIST
March 1993

Table 2E

Los Angeles Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal** Extent
Water Body Type: Estuaries		
ORMOND BEACH WETLANDS	400.00	N/A
VENTURA RIVER ESTUARY	402.10	10 Acre(s)
SANTA CLARA RIVER ESTUARY	403.00	60 Acre(s)
CALLEGUAS CREEK TIDAL PRISM	403.11	N/A
MCGRATH LAKE ESTUARY	403.11	40 Acre(s)
MUGU LAGOON	403.11	150Q Acre(s)
MUGU LAGOON, EAST ARM	403.11	N/A
MUGU LAGOON, WEST ARM	403.11	N/A
MALIBU LAGOON	404.31	29 Acre(s)
COLORADO LAGOON	405.12	13 Acre(s)
DOMINGUEZ CHANNEL TIDAL PRISM	405.12	8 Mile(s)
LOS ANGELES R(TIDAL PRISM)/QUEENSWAY BAY	405.12	3 Mile(s)
LOS CERRITOS CHANNEL TIDAL PRISM & WETLAND	405.12	N/A
SIM'S POND	405.12	N/A
BALLONA WETLANDS	405.13	150 Acre(s)
VENICE CANAL	405.13	N/A
SAN GABRIEL RIVER (TIDAL PRISM)	405.15	3 Mile(s)

Water Body Type: Enclosed Bays

CHANNEL ISLANDS HARBOR	403.11	220 Acre(s)
PORT HUENEME (HARBOR)	403.11	121 Acre(s)
VENTURA HARBOR	403.11	423 Acre(s)
ALAMITOS BAY	405.12	285 Acre(s)
KING HARBOR	405.12	90 Acre(s)
LONG BEACH HARBOR (INNER)	405.12	840 Acre(s)
LONG BEACH MARINA	405.12	N/A
LOS ANGELES HARBOR (INNER)	405.12	1260 Acre(s)
SAN PEDRO BAY	405.12	10700 Acre(s)
SHORELINE MARINA	405.12	N/A
MARINA DEL REY HARBOR	405.13	354 Acre(s)

Water Body Type: Open Bays & Ocean

NEARSHORE - POINT MUGU TO LATIGO POINT	400.00	11710 Acre(s)
SANTA MONICA BAY (CO. LINE TO PT FERMIN)	405.13	256000 Acre(s)
SANTA MONICA BAY, NEAR SHORE ASBS	405.13	N/A
SANTA MONICA BAY, OFFSHORE	405.13	N/A
ANACAPA ISLAND ASBS	406.10	21280 Acre(s)
SAN NICOLAS ISLAND AND BEGG ROCK ASBS	406.20	102528 Acre(s)
SANTA BARBARA ISLAND ASBS	406.30	14000 Acre(s)
SANTA CATALINA ISLAND (AREAS 1-4) ASBS	406.40	17936 Acre(s)
SAN CLEMENTE ISLAND ASBS	406.50	80512 Acre(s)

* Hydrologic Units are Listed in the Basin Plan for this Region

** N/A = Not Available

6. Region 8 - Santa Ana BPTCP Primary Water Bodies

Region 8's BPTCP water bodies include a number of marinas, harbors, and bays (Figure 5 following Table 2G). A significant number of these are clustered near Anaheim Bay near the northern border of the Region. A second concentration of BPTCP water bodies occurs to the south near Newport Bay. Significant river and creek estuaries include the Santa Ana River mouth, located north of Newport Bay, and San Diego Creek, which flows into upper Newport Bay. Newport Bay, the largest bay of the Region, is an enclosed bay. Two smaller enclosed bays, Bolsa Bay and Anaheim Bay, are located to the north with their associated wetlands (Anaheim Bay Marsh and Bolsa Chica Marsh). Other BPTCP waters located in or adjacent to these bays include Huntington and Sunset Harbors. A full listing of Santa Ana Region BPTCP water bodies is provided in Table 2F.

BAY PROTECTION AND TOXIC CLEANUP PROGRAM
PRIMARY WATER BODIES LIST
March 1993

Table 2F

Santa Ana Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal** Extent
Water Body Type: Estuaries		
ANAHEIM BAY MARSH	801.11	780 Acre(s)
BOLSA BAY MARSH	801.11	900 Acre(s)
BOLSA CHICA ECOLOGICAL RESERVE	801.11	294 Acre(s)
SAN DIEGO CREEK ESTUARY	801.11	N/A
SANTA ANA RIVER MOUTH	801.11	270 Acre(s)
UPPER NEWPORT BAY ECOLOGICAL RESERVE	801.11	752 Acre(s)
Water Body Type: Enclosed Bays		
ANAHEIM BAY	801.11	180 Acre(s)
ANAHEIM BAY, INNER HARBOR	801.11	N/A
ANAHEIM BAY, OUTER HARBOR	801.11	N/A
BOLSA BAY	801.11	N/A
HUNTINGTON HARBOUR	801.11	150 Acre(s)
NEWPORT BAY	801.11	N/A
NEWPORT BAY, LOWER	801.11	700 Acre(s)
Water Body Type: Open Bays and Ocean		
BOLSA CHICA STATE BEACH	801.11	7 Mile(s)
CORONA DEL MAR STATE BEACH	801.11	1 Mile(s)
HUNTINGTON BEACH STATE PARK	801.11	3 Mile(s)

IRVINE COAST REFUGE	801.11	1024 Acre(s)
NEWPORT BEACH	801.11	6 Mile(s)
NEWPORT BEACH REFUGE	801.11	166 Acre(s)
SEAL BEACH	801.11	1 Mile(s)
SUNSET BEACH	801.11	3 Mile(s)

* Hydrologic Units are Listed in the Basin Plan for this Region

** N/A = Not Avaliable

7. Region 9 - San Diego BPTCP Primary Water Bodies

Region 9's coastline includes a large number of lagoons, harbors, and river and creek estuaries, scattered along the entire coastline (Figure 5 following Table 2G). This southern coastal area also includes a smaller number of sloughs, marshes, and wetlands. BPTCP water bodies located north of Mission Bay in Region 9 include (from north to south) Aliso Creek, Dana Point Harbor, San Juan Creek, San Mateo Creek Estuary, San Onofre Creek, Las Flores Creek Estuary, Santa Margarita Lagoon, Del Mar Boat Basin, Oceanside Harbor, San Luis Rey River Estuary, Loma Alta Slough, Buena Vista Lagoon, Agua Hediona Lagoon, Batiquitos Lagoon, San Elijo Lagoon, San Dieguito Lagoon, and Los Penasquitos Lagoon. In addition, there are two significant enclosed bays to the south, Mission Bay and San Diego Bay, the largest bay of the Region. Waters adjacent or tributary to Mission Bay include the Kendall-Frost Marsh, San Diego River Estuary, and Famosa Slough. The Sweetwater Marsh is located at the mouth of the Sweetwater River, which flows (intermittently) into Central San Diego Bay. The Tijuana River Estuary is located south of San Diego Bay. A full listing of San Diego Region BPTCP water bodies is provided in Table 2G.

BAY PROTECTION AND TOXIC CLEANUP PROGRAM
PRIMARY WATER BODIES LIST
March 1993

Table 2G

San Diego Region

Water Body or Segment Name	Hydrologic* Unit No.	Total Areal** Extent
Water Body Type: Estuaries		
ALISO CREEK ESTUARY	901.10	1 Acre(s)
SAN JUAN CREEK ESTUARY	901.20	1 Acre(s)
SAN MATEO CREEK ESTUARY	901.41	30 Acre(s)
SAN ONOFRE CREEK ESTUARY	901.51	1 Acre(s)
LOS FLORES CREEK ESTUARY	901.52	10 Acre(s)
SANTA MARGARITA LAGOON	902.11	268 Acre(s)
SAN LUIS REY RIVER ESTUARY	903.11	160 Acre(s)
LOMA ALTA SLOUGH	904.10	8 Acre(s)
BUENA VISTA LAGOON	904.21	350 Acre(s)
AGUA HEDIONDA LAGOON	904.31	400 Acre(s)
BATIQUITOS LAGOON	904.51	420 Acre(s)
SAN ELIJO LAGOON	904.61	330 Acre(s)
SAN DIEGUITO LAGOON	905.11	300 Acre(s)
LOS PENASQUITOS LAGOON	906.10	385 Acre(s)
FAMOSA SLOUGH	906.40	31 Acre(s)
KENDALL-FROST MISSION BAY MARSH	906.40	25 Acre(s)
SAN DIEGO RIVER ESTUARY	907.11	320 Acre(s)
SOUTH SAN DIEGO BAY WETLANDS	908.21	2400 Acre(s)

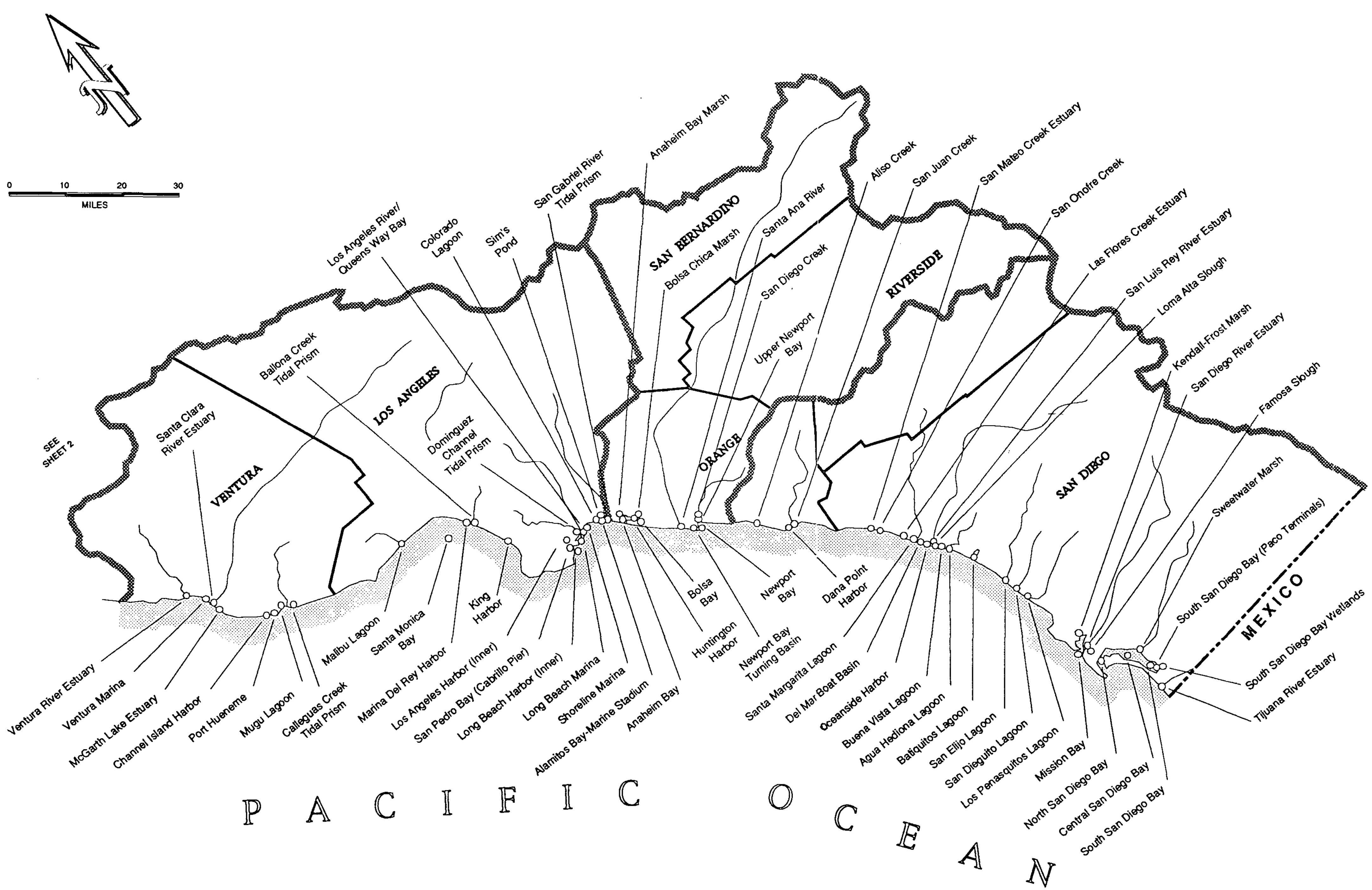
SWEETWATER MARSH	909.12	936 Acre(s)
TIJUANA RIVER ESTUARY	911.11	150 Acre(s)
Water Body Type: Enclosed Bays		
DANA POINT HARBOR	901.14	215 Acre(s)
DEL MAR BOAT BASIN	902.11	70 Acre(s)
OCEANSIDE HARBOR	902.11	210 Acre(s)
CENTRAL MISSION BAY	906.40	1040 Acre(s)
EAST MISSION BAY	906.40	500 Acre(s)
SAN DIEGO BAY, CENTRAL	908.21	4000 Acre(s)
SAN DIEGO BAY, NORTH	908.21	4000 Acre(s)
SAN DIEGO BAY, SOUTH	908.21	4000 Acre(s)
Water Body Type: Open Bays and Ocean		
HEISLER PARK ECOLOGICAL RESERVE	901.11	1536 Acre(s)
LA JOLLA	906.30	12 Mile(s)
SAN DIEGO MARINE LIFE REFUGE	906.30	92 Acre(s)
SAN DIEGO-LA JOLLA ECOLOGICAL REFUGE	906.30	518 Acre(s)
POINT LOMA KELP BEDS	908.10	6 Mile(s)
TIJUANA ESTUARY SHORELINE	911.11	10 Mile(s)

* Hydrologic Units are Listed in the Basin Plan for this Region

Figure 5

Bay Protection and Toxic Cleanup Program Primary Waterbody Locations

Los Angeles, Santa Ana & San Diego Regions



F. Regional Board Consolidated Databases and Preliminary Lists of Potential and Known Toxic Hot Spots

Each of the seven Regional Water Boards participating in the program has assembled the information necessary to develop a preliminary list of "known" and potential toxic hot spots (Table 3 and Figures 6 through 9). These lists were developed using the working definition of known and potential toxic hot spots. The trigger number listed in Table 3 refers to the various conditions listed under the working definition of a toxic hot spot. The numbers correspond to the condition(s) that were met to designate the site as a "known" or "potential" toxic hot spot.

For the program as a whole, 19 known toxic hot spots and 179 potential toxic hot spots have been identified. At this time, each Regional Water Board maintains files containing the information cited in Table 3.

Note: The "known" and "potential" toxic hot spots identified in Table 3 and Figures 6 through 9 are presented for information only. These lists are not ranked nor are they part of a toxic hot spot cleanup plan. Therefore, the lists should be considered as draft lists only. The lists are presented to allow State and Regional Water Board staff to test the usefulness of the working definition of a toxic hot spot. They are preliminary and subject to revision as new information becomes available.

TABLE 3
KNOWN AND POTENTIAL TOXIC HOT SPOTS

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
NORTH COAST REGION							
Known Toxic Hot Spots							
None Reported							
Potential Toxic Hot Spots							
Arcata Bay	McDaniel Slough	SMW 95.0	3	PCB,DDT	10	4	
Pacifc Ocean	Off Samoa Peninsula	Unknown	2	Unk/TBD	Unk/TBD	42	
Bodega Harbor	Mason's Marina	Unknown	1	TBT	10	43	
Bodega Harbor	Spud Pt. Marina	Unknown	1	TBT	10.	43	
Crescent City Harbor	Inner Marina	Unknown	1	TBT Chromium	2	4	
Crescent City Harbor	Near STP Outfall	SMW 2.0	3	PCB,PAH, Pesticides, Chromium, Copper, Manganese, Mercury, Silver	2	4	
Russian River Delta Estuary	Near Penney Island	SMW 280.0	3	DDT, Cadmium, Copper, Manganese	50	4	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Aeral Estimate (Acres)	Citation	Comments
SAN FRANCISCO BAY REGION							
Known Toxic Hot Spots							
Central SF Bay	Oakland Inner Harbor	Multiple Sites	2	Ag,Cd,Cr,Cu Hg,Pb,DDTs, PAHs,PCBs,TBT, Chlordane, Dieldrin	10-50	4,98,99,100 114,117, 119,135,157	
Lower SF Bay	Hunters Point	Multiple Sites	2	Ag,Cr,Cu,Hg Pb,Zn,PCBs,TBT	10-50	4,97,120, 165,198	
Central SF Bay	Richmond Harbor	Lauritzen Canal	3	DDT,Dieldrin, Aldrin, Endrin, Hg,Zn	10-50	4,103,121, 125	4
San Pablo Bay	Castro Cove	Multiple Sites	2	PAHs,Hg	50-150	154,160-162, 4,117,164	
South SF Bay	South SF Bay (South of Dumbarton Bridge)	Multiple Sites in South Bay including South Bay Basin, Coyote Creek, Artesian Slough, Guadalupe Slough, Mowry Slough, and off Palo Alto Outfall	1,P2	Ag,Cd,Cr,Cu, Hg,Ni,Pb,Se, PCBs,DDTs, Chlordane	>250	103,117,120, 124-127,135, 166-168, 203	5

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Aeral Estimate (Acres)	Citation	Comments
Lower SF Bay	Between Dumbarton and Bay Bridge	Multiple Stations including Dumbarton Bridge *RMP-BA30 and Redwood Creek-RMP-BA40	1	Cu	>250	120,175, 176,177	6
San Pablo Bay	Between Richmond Bridge and Carquinez Bridge	Multiple Stations including Miller Creek	1	Cu	>250	120,175,176, 177	6
Carquinez Strait/Suisun Bay	Between Carquinez Bridge and Chipps Island	Multiple Stations including Honker Bay, Peyton Slough, Boynton Slough Peytonia Slough, and Chadbourne Slough	1	Cu	>250	120,175, 176,177	6
San Francisco Bay/Delta	SF Bay/Delta	See Comments	3	Hg	>250	155	7
Suisun Bay	Suisun Bay	See Comments	3	Se	>250	156	8

* RMP San Francisco Bay Regional Monitoring Program Station

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Potential Toxic Hot Spots							
South SF Bay	Redwood Creek	Multiple Sites	1, 2	Ag,Cr,Cu, Hg,Ni,Pb, Se, TBT	50-250	4,117,120, 122,124,135 163,170,179	
Central SF Bay	Islais Creek	Above 3rd St. Bridge	1, 2	Ag,As,Cr,Hg, Pb,PAHs,PCBs	10-50	4,144	
Central SF Bay	Oakland Outer Harbor	Multiple Sites	1, 2	Ag,Cr,Cu, Hg,Pb,TBT	10-50	98,99,114, 157,159	
Carquinez Strait	Mare Island Strait	RMP BD51 & BD52	2	Ag,Cd,Cr, Hg,Pb	10-50	98,117	
Central SF Bay	China Basin	Multiple Sites	1, 2	Ag,Cd,Cr, Cu,Hg,Pb, PAH,PCB	<10	98,193,171	
Central SF Bay	Warmwater Cove (S. of Potrero Point)	Multiple Sites	1	Cr, Ni, Pb, Zn, PAHs	<10	171,200	
Central SF Bay	Alcatraz Disposal Site	Multiple Sites	2	See Comments	50-250	102,104,108, 110,113,115, 116,118,123, 128,132,137, 143,145,153, 158,169,174, 180-193	19
Central SF Bay	Treasure Island	Multiple Sites	2	Cd,Cr,Hg, DDT,PAH,PCB	<10	97,99	20
Suisun Bay	Concord Naval Weapons Station	Middle Pnt Marsh, Port Chicago Reach	1	As,Cd,Hg, Ni,Pb,Se,Zn	50-250	140,141	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Lower Bay	Alameda NAS	Multiple Stations	2	Ag,As	<10	40,49,97, 135,144	
South SF Bay	Guadalupe Slough	Multiple Sites	1, 2	Ag, Cr, Hg, Ni	<10	98,108,166, 190,200,201, 203,204	
South SF Bay	Moffett Channel	C-1-1	1	Ag, Cr, Hg, Ni, Se	Unk	203	
South SF Bay	Artesian Slough	C-2-5	1, 2	Ag, Cr, Cu, Hg, Ni, Se, Zn	<10	167,203,204	
South SF Bay	Mowry Slough	R-2, R-4 R-5	1, 2	Ag, Cr, Hg, Ni	<10	167,203,204, 205	
South SF Bay	Coyote Creek	RMP Sta BA10,C3-0, C-6-0,C-X	1, 2	Ag, Cr, Hg, Ni, PAHs, PCBs, DDTs, Chlordane	<10	127,167,203, 205	
South SF Bay	Mayfield Slough (includes Palo Alto discharge channel)	Sta 2, 3 & 4	1, 2	Ag, Cr, Cu, Ni	<10	126,166,202	
South SF Bay	South Bay Basin	SB-5, SB-6 SB-7, RMP Sta BA20	1, 2	Ag, Cr, Cu, Ni	<10	167,203,204, 205	
Lower SF Bay	Dumbarton Bridge	SB-4, RMP Sta BA30, NOAA Sta, SMW Sta	2	Cr, Cu, Hg, Ni	<10	109,111,117,4, 126,127,166,162, 202,203	
Carquinez Strait	Selby	Multiple Sites	1	Cr,Pb,Zn	<10	4,138,139, 142,179	21

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Suisun Bay	Suisun Slough	Sections 1,2	2		<10	172	
Carquinez Strait	Peyton Slough	Multiple Sites	1, 2	As,Cd,Cr, Cu,Ni,Zn,TPH	<10	21,51-57 117,146-152	
Lower SF Bay	San Bruno Shoals	RMP Station 4SBS,NOAA Station	1, 2	Cu*	<10	120,135	
Central SF Bay	San Leandro Bay	Multiple Sites	2	Cr,Hg,Pb,Zn	10-50	98,117,129, 130	
San Pablo Bay	Point Molate	Fuel Pier	2	TPH	<10	113	
Carquinez Strait	Carquinez Disposal Site	Multiple Sites	2	See Comments	<10	105,112, 194-197	19
Gallinas Creek	Gallinas Creek	RMP MD20	2	Cr,Cu,Pb	<10	98,117	
San Pablo Bay	San Pablo Bay	NOAA Station	2		<10	98,99,135, 144,204,205	
Suisun Bay	Grizzly Bay	RMP BF20	2		<10	117	
Central SF Bay	India Basin	Multiple Sites	1	PAHs,PCBs	50-250	98	
Suisun Bay	Boynton Slough	RMP MF10, MF11,MF12	2		<10	117	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Central SF Bay	Port of Richmond Pt. Potrero, Pasha	Long Wharf #3	1	PCBs, PAHs, Cu, Hg, Pb, Zn	<10	133,156	
Carquinez Strait	Semple Point Off Vallejo	NOAA Station VA7	1	Cr, Hg	<10	99	
Central SF Bay	Oakland Middle Harbor	IC2	2	Cr, Hg	10-50	159	
Richardson Bay	Sausalito Harbor	RMP BC30 + Other sites	1, 2	Cu, Hg, TBT	<10	117,170,173	
Central SF Bay	Off Staufer	RMP BC50	2		<10	117,119	
Carquinez Strait	Pacheco Creek	RMP BF10	2		<10	117	
Suisun Bay	Hill Slough	RMP MF20, MF21	2		<10	117	
Central SF Bay	Emeryville Marsh	EBMUD Storm Drain - RMP MC30	2	Pb, Zn	<10	117	
Central SF Bay	Corte Madera Marsh	RMP MC50	2		<10	117	
Central SF Bay	Hoffman Marsh	Multiple Stations	1	Ni, PCBs	<10	131	
Novato Creek	Novato Creek (Tributary to San Pablo Bay)	At Lock- RMP MD21	2		<10	117	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
San Pablo Bay	Tolay Creek Mouth	RMP MD31	2		<10	117	
San Pablo Bay	Napa Slough	RMP MD32 At Bridge	2		>10	117	
San Pablo Bay	Sonoma Creek	At Tubbs - RMP MD33, At Bridge - RMP MD34	2		<10	117	
Richardson Bay	Silva Island Marsh	At Seminary Dr. Storm Drain - RMP MC61	2	Pb	<10	117	
Miller Creek	Miller Creek (Tributary to San Pablo Bay)	Las Gallinas Discharge-- RMP MD10, Upstream from discharge-- RMP MD11	2		<10	117	
San Pablo Bay	Richmond Rod and Gun Club	Multiple Sites	1	Pb	<10	118	
Lake Merritt	Lake Merritt	Mussel Watch Station	1	Chlordane, PCB, PAH, DDT	10-50	119	
Suisun Bay	Chadbourne Slough	RMP MF13	2		<10	117	
Lower Bay	Off SFO Airport	NOAA Station	2		<10	135	
Lower Bay	Off Coyote Point	NOAA Station	2		<10	135	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Lower Bay	Off San Lorenzo	NOAA Station	2		<10	135	
Bolinas Lagoon	Bolinas Lagoon	North Shore	2		<10	119	
Lower San Francisco Bay	Oyster Point/ Sierra Point	Multiple sites RMP Sta BB30, BB31	1, 2	PAHs,Ni**	<10	117,120, 179	
San Pablo Bay	Petaluma River Mouth	RMP Station BD20	2		<10	117	
Lower San Francisco Bay	Hayward Marsh	Multiple Stations	2		<10	178	
San Pablo Bay	Davis Point	RMP Sta BD40	1	Ag	<10	117	
Lower Bay	Off San Leandro	NOAA Station	2		<10	135	

CENTRAL COAST REGION

Known Toxic Hot Spots

None Reported

Potential Toxic Hot Spots

Carmel Bay		Unknown	1	Silver, Zinc, Cadmium, in Shellfish	Unk/TBD	4,5,61,62	

** Exceeded water quality objective once.

*** Chemicals listed may have been measured at a different time or station than toxicity tests and, therefore, may not be related. This is true for sites with both a P1 and P2 trigger. Sites with a P2 trigger and chemicals listed had chemical concentrations elevated above background, but not as high as those given a P1, P2.

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Santa Cruz Harbor		Unknown	1,2	Cadmium, Copper, TBT	Unk/TBD	4,59,60	
Santa Barbara Harbor		Unknown	1,2	Mercury, Zinc, Copper in Shellfish	Unk/TBD	4,64,65 66	
San Luis Harbor		Unknown	1,2	Possible Metals and Hydrocarbons and Oil Facilities	Unk/TBD	4,67,68	
San Luis Obispo Creek		Unknown	1	Bacteria, Sulfur, Pesticides, Fertilizers	Unk/TBD	4,5,69,70,71, 72,73,74,75	
Monterey Bay	Monterey Harbor	Unknown	1,2,3	Lead in Shellfish and Sediments. Possible TBT in Sediments.	Unk/TBD	4,5,76,77	
Morro Bay		Unknown	1,2	Possible Pesticides, Bacteria, Metals, TBT	Unk/TBD	4,78,79,80,81	
Monterey Bay	Elkhorn Slough	Unknown	1,2	Pesticides in Shellfish	Unk/TBD	82,83,84	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Monterey Bay	Moss Landing Harbor	Unknown	1,2	Pesticides and bacteria in Shellfish, TBT	Unk/TBD	4,5,85	
Goleta Slough/ Estuary		Unknown	1	Bacteria in Shellfish and Copper in Water, Metals in Sediments	Unk/TBD	4,5,86,87	
Monterey Bay	Harkins Slough	Unknown	1	Pesticides in Fish and Shellfish	Unk/TBD	4,5	
Monterey Bay	Moro Cojo Slough	Unknown	1,2,3	Pesticides in Shellfish	Unk/TBD	4	
Monterey Bay	Tembladero Slough	Unknown	1,3	Pesticides in Fish	Unk/TBD	5	
Salinas River	Salinas River Lagoon	Unknown	1,2,3	Pesticides in Fish and Shellfish	Unk/TBD	4,5,88,89, 90,91	
Monterey Bay	Espinosa Slough and Salinas Rec. Canal	Unknown	1	Pesticides in Fish and Shellfish	Unk/TBD	4,5,92,93, 94,95	
Salinas River	Old Salinas River Estuary	Unknown	1,3	Pesticides in Fish and Shellfish	Unk/TBD	4,5,96	
Monterey Bay	Watsonville Slough and Pajaro River Estuary	Unknown	1,2,3	Pesticides in Fish and Shellfish	Unk/TBD	4,5	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
LOS ANGELES REGION							
Known Toxic Hot Spots							
Mugu Lagoon	Calleguas Creek tidal prism, main lagoon, & western arm	SMW507.1, 507.2, 507.3;RB# 1-5	4	Pesticides, Ni	>50	3,4,5, 11,30,33 41	1,2
San Pedro Bay	Cabrillo Pier area	SMW605.0, 664.0	3	DDT,PCBs	>50	3,4,15, 17,18, 21,31	1
Los Angeles Harbor (Inner)	Dominguez channel tidal prism, East Basin,Consolidated Slip	SMW601.0, 616.0; SCCWRP#1-3, 13-16,19-22	4,5	PCBs,TBT, PAHs,DDT, Metals	>50	1,2,3,4, 6,7,8,9, 13,15,17, 18,21,23, 25,31,33, 39,40	1,3
Long Beach Harbor (Inner)	Cerritos Channel to Gerald Desmond Bridge	SMW613.0, 615.0	3	DDT,PCBs,TBT	>50	3,4,6,15, 20,24	1
Santa Monica Bay	Palos Verdes Shelf, Santa Monica Canyon	SMW662.0	3,4,5	DDT,PCBs	>50	1,2,4, 16,18, 27,39	1
Potential Toxic Hot Spots							
Marina Del Rey Harbor	Back basins and main channel to Harbor Patrol	SMW553. 0-556.0; Soule#4-11, 13,18-20, 22,25	1,2,3	Cu,Zn,Pb, TBT,PCBs,	>50	4,12,16, 26,34,35, 34,35,36, 37,38,39, 40	4,5
Port Hueneme Harbor	Back basins	SMW506.1, 506.2	1,3	PAHs,PCBs, TBT,Zn	5-50	4,19,15, 40	4

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Los Angeles River Estuary	Los Angeles River Estuary and Queensway Bay	SMW609.4	1,2,3	Cr,Pb,Zn,DDT, PCBs,chlordane	>50	4,14,15, 20,22	4
King Harbor	Basins 1 and 2	SMW559.0; RB#KHSB 1-3	1,2,3	Cu,Zn,TBT	1-<5	4,6,16, 28,29,32 39,40	4,6
Los Angeles Harbor (Inner)	Inner harbor areas other than the known toxic hot spot,to Vincent Bridge	SMW602.0, 602.5, 602.7,603.0; RB#SB7-10; SCCWRP#$,6-8, 17,18	1,3	PCBs,DDT,PAHs, Cu,Zn,Pb,TBT	>50	4,7,17, 21,31,40	4,7,8
Long Beach Harbor (Inner)	Channel 2	Berth 80 (SMW)	1,3	PCBs,DDT,PAHs	1<5	4	4
Los Angeles Harbor (Inner)	Main Channel	SMW603.6; RB#SB14, SB16,SB17	1	As,Cu,Pb,Hg	<1	4,21	4,8
San Pedro Bay	Fish Harbor (Inner & Outer)	SMW606.2; RB#SB18-23	1,3	Cu,TBT,Zn,Pb	5-50	4,21,23, 31,40	4,8
San Pedro Bay	Watchorn Basin	SMW606.3; RB#WCSB3, WCSB4,WCSB4, SB11-13	1,3	Cu,TBT,Zn,Pb	1<5	4,23,31, 40	4,8
San Pedro Bay	Portions adjacent to Terminal Island and San Pedro Breakwater	Kinnetic# 1-5,15-17	1	Ag,Cr,Cu,Hg, Ni,Pb,Zn,PAHs, PCBs	>50	10,17	9
San Pedro Bay	East Channel	SMW602.8; RB#SB1-5	1,3	Cu,Zn	<1	4,23,31	4,8

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Ballona Creek	Ballona Creek tidal prism	SMW557.0; Soule#12	1,3	Chlordane,DDT, Zn,Pb,Cd	<1	4,16,22, 33,34,35, 36,37,38	4,5

CENTRAL VALLEY REGION

Known Toxic Hot Spots

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Sacramento River		Freeport to Hood	1	Copper	2,400	44,45	21
			1	Zinc	2,400	44,45	21
			1	Lead	2,400	44,45	21
			1	Chromium	2,400	44,45	21
			1	Cadmium	2,400	44,45	21
				Mercury		5	
			3	Chlordane	2,400	5	
			3	DDT	2,400	5	
			3	Toxaphene	2,400	5	
			3	Chlordane	654	5	
			3	DDT	654	5	
			3	Toxaphene	654	5	
Paradise Cut		Entire	3	Chlordane	48	5	
			3	DDT	48	5	
			3	Toxaphene	48	5	
SJ River		Vernalis to Old River	1	Selenium	654	46,47,48	
			1	Cadmium	654	44,45	
		Vernalis to variable	2	Diazinon	Unk/TBD	49,50	10
				Chlorpyrifos	Unk/TBD	49,50	
French Camp Slough		Lower 6 mi.	2	Diazinon	72	49,50	

Regional Water Board and Water Body Name	Segment Name	Site ID Number	Trigger Identified	Pollutant(s)	Areal Estimate (Acres)	Citation	Comments
Potential Toxic Hot Spots							
Bethel Island		Bethel Island	1	TBT	1	52	
Yacht Sales							
Paradise Pt.		Stockton	1	TBT	1	52	
Rio Vista Marina		Rio Vista	1	TBT	1	52	
SJ River		Antioch	3	Dioxin	Unk/TBD	51	
SJ River		Turning Basin	3	Dioxin	Unk/TBD	51	
Beach Lake	Entire		3	Mercury	295	5	
Ox Bow Marina		Rio Vista	1	TBT	1	52	
Stockton Wat. Front YC		Stockton	1	TBT	1	52	
Stockton Vil. West		Stockton	1	TBT	1	52	
Ladds Marina		Stockton	1	TBT	1	52	
Delta Waterways	Entire		1,2	Pesticides	48,000	49,50	11
			1	Cadmium	48,000	44	12
	Marinas not named on "known"		1	TBT	Unk/TBD		13

Regional Water Board and Water Body Name	Segment Name	Site ID Number	Trigger Identified	Pollutant(s)	Areal Estimate (Acres)	Citation	Comments
Georgiana Sl.	Entire		1	PCB Chlordane Lindane Heptachlor DDT	61, DDT		53
Snodgrass Sl.	Entire		1	PCB Chlordane Dieldrin PAH	291		53
<u>Potential Toxic Hot Spots</u>							
Morman Ch.	Entire		1	PCB Chlordane Lindane Heptachlor Dieldrin	1		53
Sacramento River	Rio Vista		1	PCB Chlordane Heptachlor PAH Dieldrin	Unk/TBD		53

Regional Water Board and Water Body Name	Segment Name	Site ID Number	Trigger Identified	Pollutant(s)	Areal Estimate (Acres)	Citation	Comments
SANTA ANA REGION							
Known Toxic Hot Spots							
None Reported							
Potential Toxic Hot Spots							
Newport Bay, Lower		PCH Bridge (SMW724) (EMA UNBCHB)	3	Cd,Se,Pb, Cu	Unknown	4,59	
Newport Bay, Lower		Rhine Channel (SMW726) (EMALNBRIN)	1,3	Cd,Pb,As, Se,Zn,Cu	Unknown	4,59	
Newport Bay, Lower		Crows Nest	3	Cd,Pb	Unknown		
Anaheim Bay	Navy Harbor	(EMAHUNHAR) (SMW 707)	1,3	Cd,Cu,Pb, Cr	Unknown	4,59	
Anaheim Bay	Entrance Channel	(SMW 709)	3	Pb	Unknown		
Anaheim Bay		Fuel Docks (SMW710.2) (EMAHUNSUM)	1,3	Pb,Cu	Unknown	4,59	
Huntington Harbor		Peters Landing (SMW712)	3	Pb	Unknown	4	

Regional Water Board and Water Body Name	Segment Name	Site ID Number	Trigger Identified	Pollutant(s) (Acres)	Areal Estimate Citation	Comments
Huntington Harbor		Edinger St. (SMW713)	3	Cd,Pb	Unknown	4
Huntington Harbor		Warner Ave. (SMW715) (EMAHUNCRB)	1,3	Cd,Pb,Se	Unknown	4,59
Newport Bay, Lower	Harbor Entrance	(EMALNBHAR)	1	Pb,Cu,Cd	Unknown	59
Newport Bay, Upper	Turning	(EMALNBTUB)	1	Pb,Cu,Cd	Unknown	59
Upper Newport Bay Ecological Reserve	San Diego Creek Depositional Area	(EMAUNBSDC)	1	Pb,Cu,Cd	Unknown	59
Huntington Harbor		(EMAHUNSUN)	1	Cr,Cu,Pb	Unknown	59
Balsa Bay		(EMABBOLR)	1	Cr,Cu,Pb	Unknwon	59
Anaheim Bay	Navy Harbor	SMW707 SMW708	3	Chlorbenside, DDT, HCH, Heptachlorepoxide	Unknown	4
Anaheim Bay		Fuel Docks (SMW710.2)	3	Aldrin, Chlordane, PCB, Chlorphyrifos, Endosulfan Heptachlorepoxide Hexachlorobenzene	Unknown	4

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Huntington Harbor		Launch Ramp (SMW711)	3	Lindane	Unknown	4	
Huntington Harbor		Petus Landing (SMW712)	3	Chlorbenside, Lindane Hexachlorobenzene	Unknown	4	
Huntington Harbor		Edinger St. (SMW713)	3	Chlorbenside, DDT Endosulfan, Toxaphene, Endrin, Heptachlorepoxide	Unknown	4	
Huntington Harbor		Warner Ave. (SMW715)	3	Aldrin, Chlorbenside,DDT Chlordane, Chlorpyrifos Lindane, Heptachlorepoxide	Unknown	4	
Huntington Harbor		Harbor Ln. (SMW717)	3	Aldrin, Chlordane, Chlordane, Chlorpyrifos Endrin, Heptachlorepoxide	Unknown	4	
Newport Bay, Lower	Entrance Channel	(SMW721)	3	Chlorpyrifos, Dacthal, PCB	Unknown	4	
Newport Bay, Lower		Police Docks (SMW722)	3	Chlorbenside, Dacthal, DDT, Lindane, PCB, Ronnel, Hexachlorobenzene	Unknown	4	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Newport Bay, Lower		El Paso Dr. (SMW 722.4)	3	DDT, PCB	Unknown	4	
Newport Bay, Lower		Bay Island (SMW723)	3	Chlordane, Dacthal, Chlorpyrifos, Lindane, PCB Heptachlorepoxide, DDT, Endosulfan, Toxaphene	Unknown	4	
Newport Bay, Lower	Turning Basin	(SMW723.4)	3	Aldrin, Dacthal, PCB, Endosulfan	Unknown	4	
Newport Bay, Lower		PCH Bridge (SMW724)	3	Chlordane, Chlorpyrifos, Dacthal, DDT, PCB, Endosulfan, Toxaphene, Heptachlorepoxide	Unknown	4	
Upper Newport Bay Ecological Reserve		Dunes Dock (SMW724.4)	3	Dacthal, DDT, PCB Endosulfan	Unknown	4	
Newport Bay, Lower		Crows Nest (SMW725)	3	Chlorbenside, Dacthal, Chlordane, DDT, PCB, Lindane, Cu, Hg, Zn	Unknown	4	
Newport Bay, Lower	Rhine Channel	(SMW726) (SMW726.2)	3	Chlordane, Chlorpyrifos, Dacthal, DDT, Dieldrin, Endosulfan, PCB, Hg, Heptachlorepoxide Heptachlor	20 Acres	4	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Upper Newport Bay Ecological Reserve	San Diego Creek Depositional Area	(SMW728.4)	3	Chlordane, Chlorpyrifos Diazinon, Lindane, PCB Heptachlorepoxide	Unknown	4	
SAN DIEGO REGION							
Known Toxic Hot Spots							
None Reported							
Potential Toxic Hot Spots							
San Diego Bay, So.	Sweetwater River old sloughs to south	11	2	Sediment toxicity to Rhepoxynius abronius	Unk/TBD	54	
San Diego Bay, So.	J Street Marina	12	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, Central	Between Naval Station & Amphib. Base	14	2	Sediment Toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, Central	Glorietta Bay	15	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
San Diego Bay, Central	SDG&E silvergate power plant /Southwest Marine shipyard	21	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, North	North Island across from Commerical Basin	23	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, North	North Island off Hanger 94	25	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, North	Sub Base	27	2	Sediment toxicity to Rehpoxynius abronius			
San Diego Bay, North	Sub Base	28	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, Central	National Steel shipyard	31	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
Dana Point Harbor	Dana Point Harbor off breakwater	33	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
Oceanside Harbor	Oceanside Harbor	34	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, North	Grape Street	37	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, Central	Campbell Marine shipyard	38	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, South	SDG&E jetty for South Bay power plant	41	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
Central Mission Bay	Mission Bay off Vacation Isle Ski Beach	42	2	Sediment toxicity to Rehpoxynius abronius	Unk/TBD	54	
San Diego Bay, Central	Campbell Marine shipyard	C	1	PCB, PCT	Unk/TBD	55	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
San Diego Bay, Central	Tenth Ave. Marine Terminal	D	1	PCB, PCT	Unk/TBD	55	
San Diego Bay, Central	Continental Maritime shipyard	E	1	PCB, PCT	Unk/TBD	55	
San Diego Bay, Central	KELCO	G	1	PCB, PCT	Unk/TBD	55	
San Diego Bay, Central	Southwest Marine shipyard	K	1	PCB, PCT	Unk/TBD	55	
San Diego Bay, Central	Naval Station graving dock	P	1	PCB	Unk/TBD	55	
San Diego Bay, North	North Island Naval Air Station	NM	1	PCB, PAH	Unk/TBD	56	
San Diego Bay, North	North Island Naval Air Station	SDNI-N1	1	PCB, PAH	Unk/TBD	56	
San Diego Bay, North	North Island Naval Air Station	SDNI-N1	1	PCB, PAH	Unk/TBD	56	
San Diego Bay, North	North Island Naval Air Station	SDNI-N18	1	PCB, PAH	Unk/TBD	56	
San Diego Bay, North	Sub Base	NSB-S1	1	PCB, PAH petroleum hydrocarbons	Unk/TBD	56	
San Diego Bay, North	Sub Base	NSB-M1	1	PCB, PAH	Unk/TBD	56	

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
San Diego Bay, North	Navy Magnetic Silencing Facility	NSB-R1	1	PCB, PAH	Unk/TBD	56	
San Diego Bay, Central	KELCO	F	1	PCB	Unk/TBD	57	
San Diego Bay, Central	KELCO/SDG&E Silvergate Power Plant	G	1	PCB	Unk/TBD	57	
San Diego Bay, Central	Southwest Marine shipyard	M	1	PCB	Unk/TBD	57	
Dana Point Harbor	Dana Point Boatyard		3	TBT, Copper zinc	Unk/TBD	4	
Oceanside Harbor	Oceanside Boatyard		3	TBT, Copper, Mercury, Zinc	Unk/TBD	4	
Central Mission Bay	Mission Bay Harbor Police		3	TBT	Unk/TBD	4	
San Diego Bay, South	Rohr channel	EA	1	PCB, PAH	Unk/TBD	58	
San Diego Bay, North	Stormdrain South of Grape Street	EM	1	PCB	Unk/TBD	58	
San Diego Bay, Central	Campbell Marine shipyard	CC	1	PCB, PCT	Unk/TBD	58	
San Diego Bay, Central	Campbell marine shipyard	CL	1	PCB	Unk/TBD	58	

COMMENTS

1. State Mussel Watch (SMW) data--citation #4.
2. Regional Board (RB) data--citation #36.
3. Southern California Coastal Water Research Project (SCCWRP) data--citation #7.
4. SMW data--citation #4.
5. Soule data--citations #42, 43, 44, 45.
6. Regional Board (RB) data--citation #38.
7. Southern California Coastal Water Research Project (SCCWRP) data--citation #7.
8. Regional Board (RB) data--citation #37.
9. Kinnetic data--citation #52.
10. Acres depend on season.
11. Widespread toxicity to test organisms has been documented throughout the Delta during certain times of the year. The toxicity has often been associated with elevated levels of pesticides in the water. Diazinon, chlorpyrifos, carbaryl, eptam, parathion, methyl parathion, dimethoate, methidathian, mevinphos, diuron, and methomyl have all been documented in San Joaquin River water entering the Delta. Some of these pesticides have been followed for some distance across the estuary. In the recent past, toxicity on the Sacramento side of the estuary has been linked to agricultural discharges of pesticides.
12. The Sacramento River and San Joaquin River have at times exceeded objectives for cadmium, so the entire Delta is at risk.
13. TBT problems seem to occur at nearly all marinas tested.
14. Organisms from the Lauritzen Canal have exceeded FDA action levels and MTRLs for DDT and dieldrin.
15. Exceeds water quality objective for Cu, Hg, and Ni.
16. Exceeds water quality objectives for Cu.
17. Health warning for striped bass which is a migratory species. This warning is presently being reevaluated.
18. Health warning for Diving Ducks, Scaups and Scoters.
19. These sites are constantly changing due to dredge disposal activities.
20. Reference #3 calls this site Yerba Buena Island.
21. Cleanup has occurred, but may not be complete.
22. The Sacramento River from Freeport to Hood qualifies as a Known Hot Spot for metals in, perhaps, both wet and dry seasons if (a) data for the wet season of 1992-93 do not conflict and (b) samples were collected in a manner appropriate to assess exceedance of a 4-day average water quality objective.

Unk = Unknown

TBD = To be determined

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Kaiser International Corp. C16998.

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Southern California Edison, Long Beach Generating Station CA0001171 M5764.

25. Receiving water monitoring data:
City of Los Angeles--Harbor Generating Station CA0000361 M2020.

26. Receiving water monitoring data:
Aggie Cal CA0056529 C15162.
Windward Yacht & Repair, Inc. CA0054089 CI6082.

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Chevron U.S.A., Inc.--El Segundo refinery CA0000337 M1603.
City of Los Angeles, Department of Water and Power--Scattergood Generating Station CA0000370 M1886.
City of Los Angeles, Department of Public Works--Hyperion Treatment Plant CA0109991 M1492.
Los Angeles County Sanitation District--JWPCP CA0053813 M1758.
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Figure 6

Bay Protection and Toxic Cleanup Program Potential & Known Toxic Hot Spots

North Coast Region

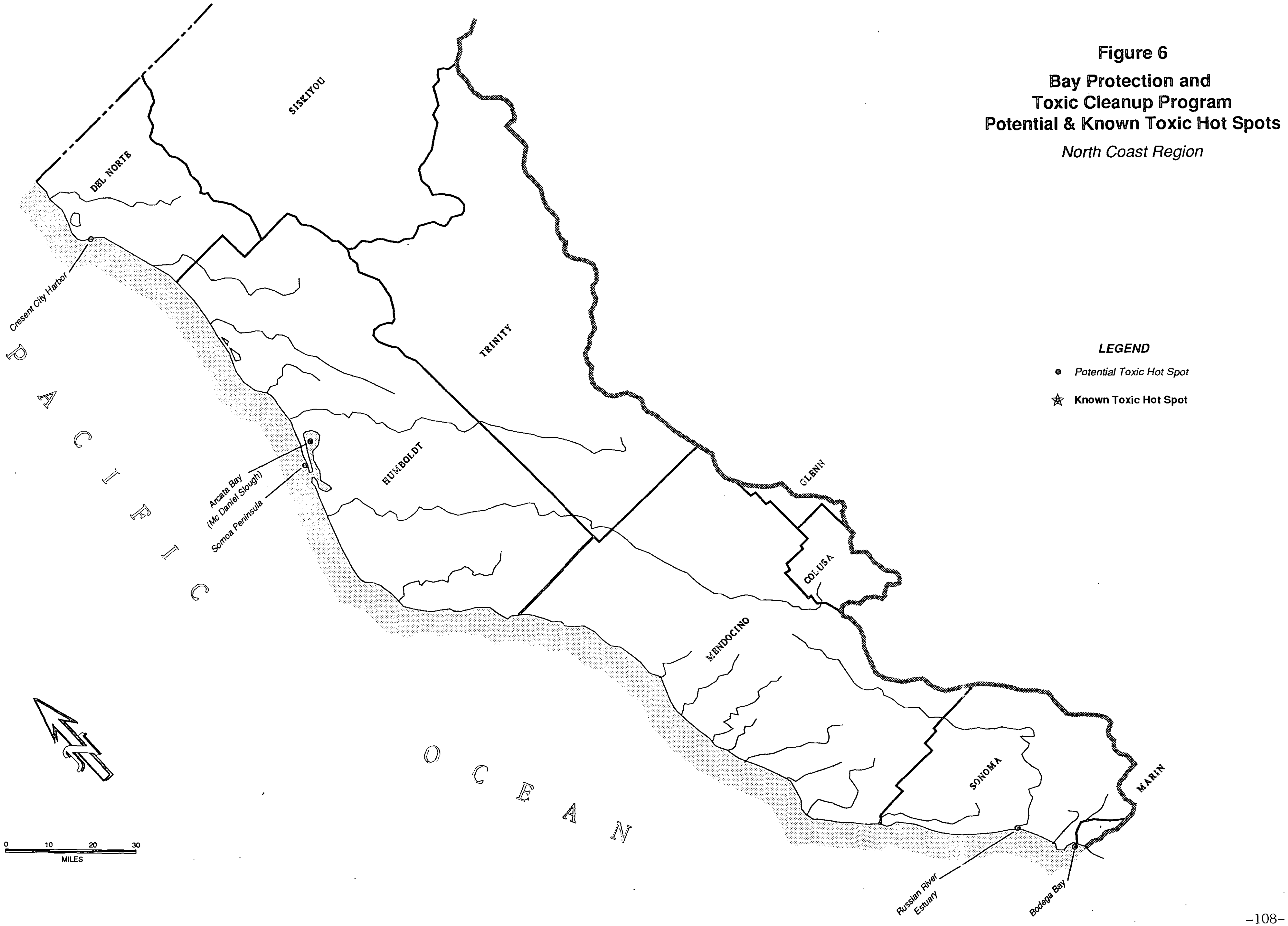
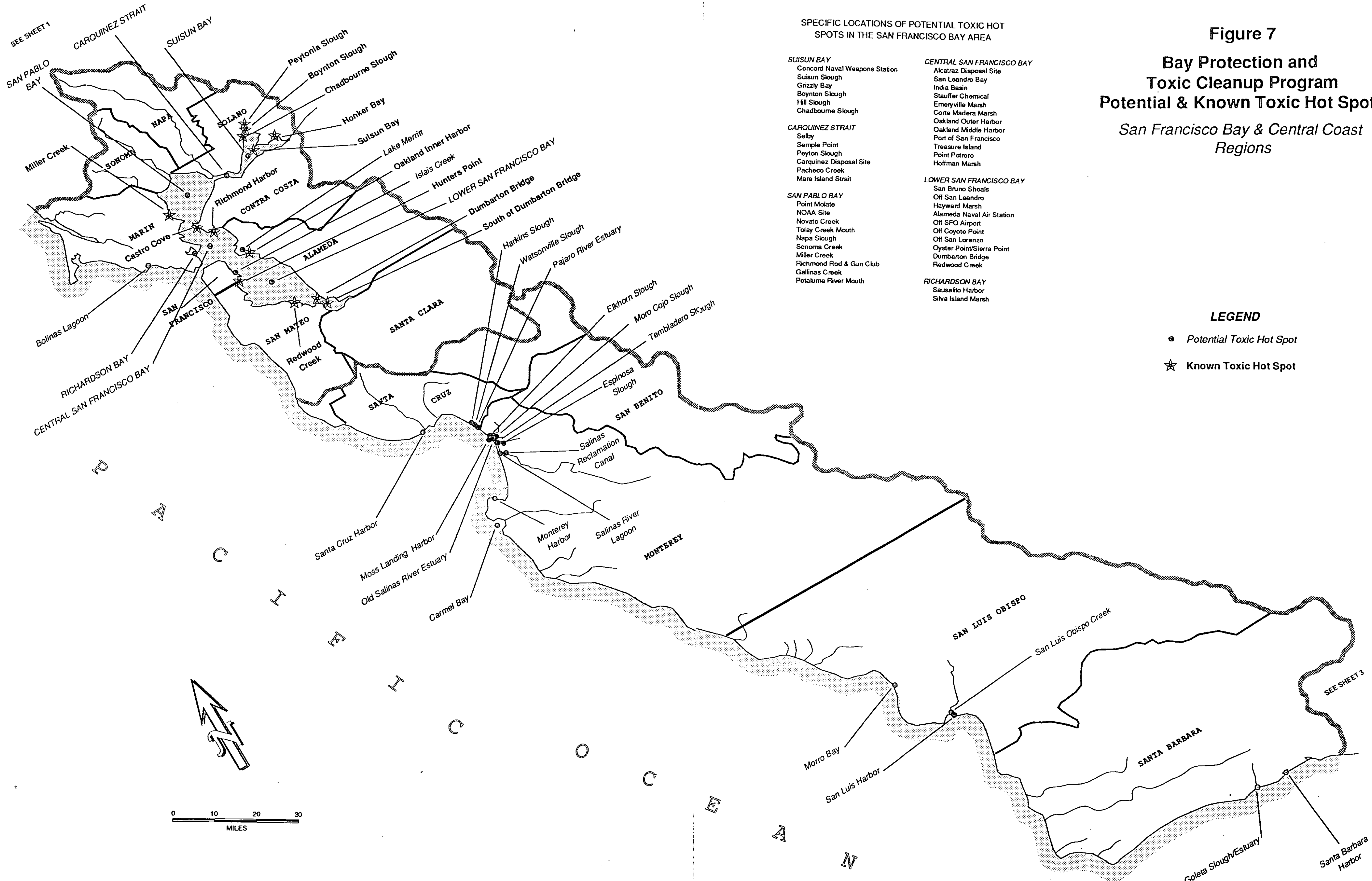


Figure 7

Bay Protection and Toxic Cleanup Program Potential & Known Toxic Hot Spots

San Francisco Bay & Central Coast Regions



SPECIFIC LOCATIONS OF POTENTIAL TOXIC HOT SPOTS IN THE SAN FRANCISCO BAY AREA

SUISUN BAY
- Concord Naval Weapons Station
- Suisun Slough
- Grizzly Bay
- Boynton Slough
- Hill Slough
- Chadbourne Slough

CARQUINEZ STRAIT
- Selby
- Semple Point
- Peyton Slough
- Carquinez Disposal Site
- Pacheco Creek
- Mare Island Strait

SAN PABLO BAY
- Point Molate
- NOAA Site
- Novato Creek
- Tolay Creek Mouth
- Napa Slough
- Sonoma Creek
- Miller Creek
- Richmond Rod & Gun Club
- Gallinas Creek
- Petaluma River Mouth

CENTRAL SAN FRANCISCO BAY
- Alcatraz Disposal Site
- San Leandro Bay
- India Basin
- Stauffer Chemical
- Emeryville Marsh
- Corte Madera Marsh
- Oakland Outer Harbor
- Oakland Middle Harbor
- Port of San Francisco
- Treasure Island
- Point Potrero
- Hoffman Marsh

LOWER SAN FRANCISCO BAY
- San Bruno Shoals
- Off San Leandro
- Hayward Marsh
- Alameda Naval Air Station
- Off SFO Airport
- Off Coyote Point
- Off San Lorenzo
- Oyster Point/Sierra Point
- Dumbarton Bridge
- Redwood Creek

RICHARDSON BAY
- Sausalito Harbor
- Silva Island Marsh

Figure 8

Bay Protection and
Toxic Cleanup Program
Potential & Known Toxic Hot Spots

Sacramento-San Joaquin Delta Area

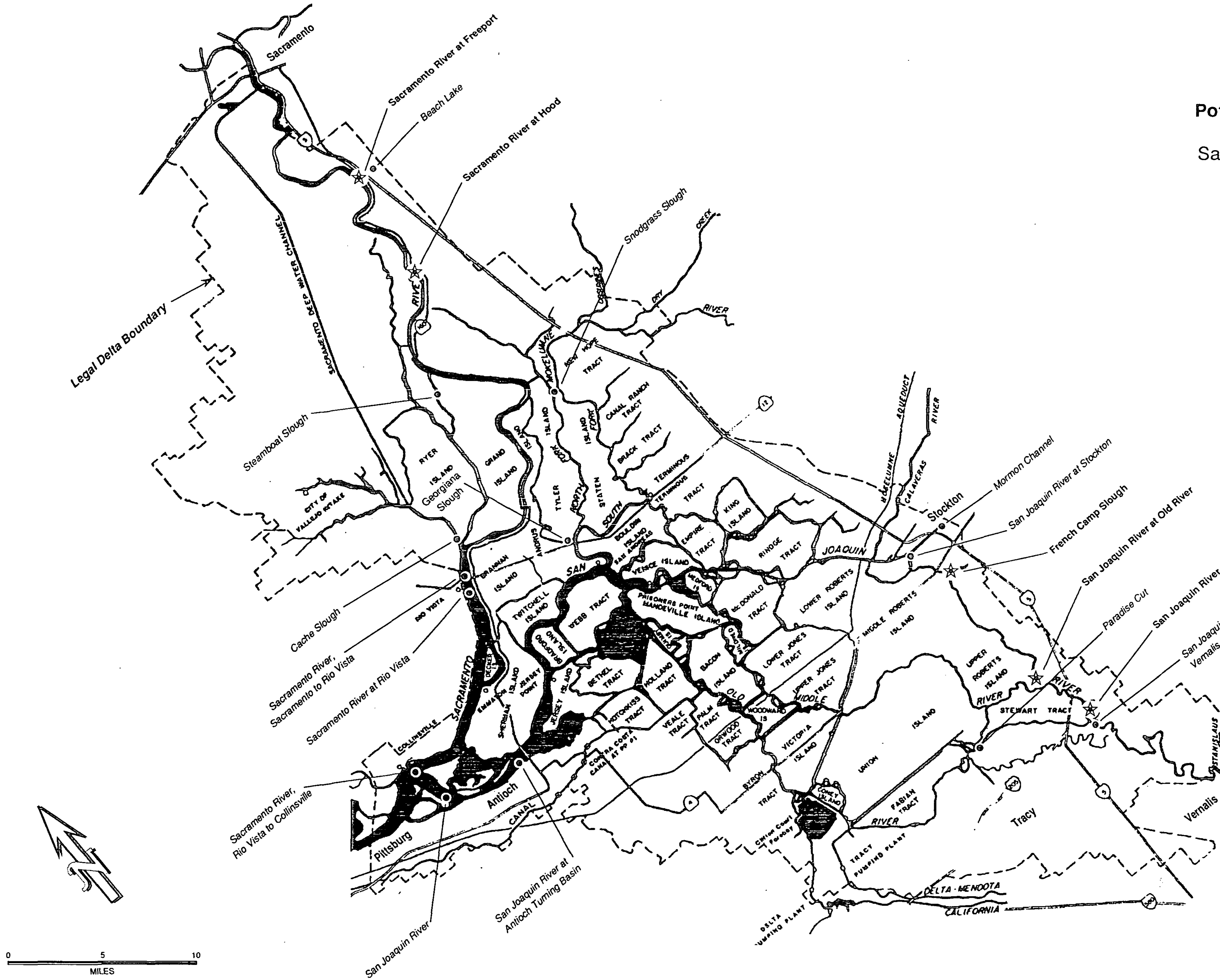
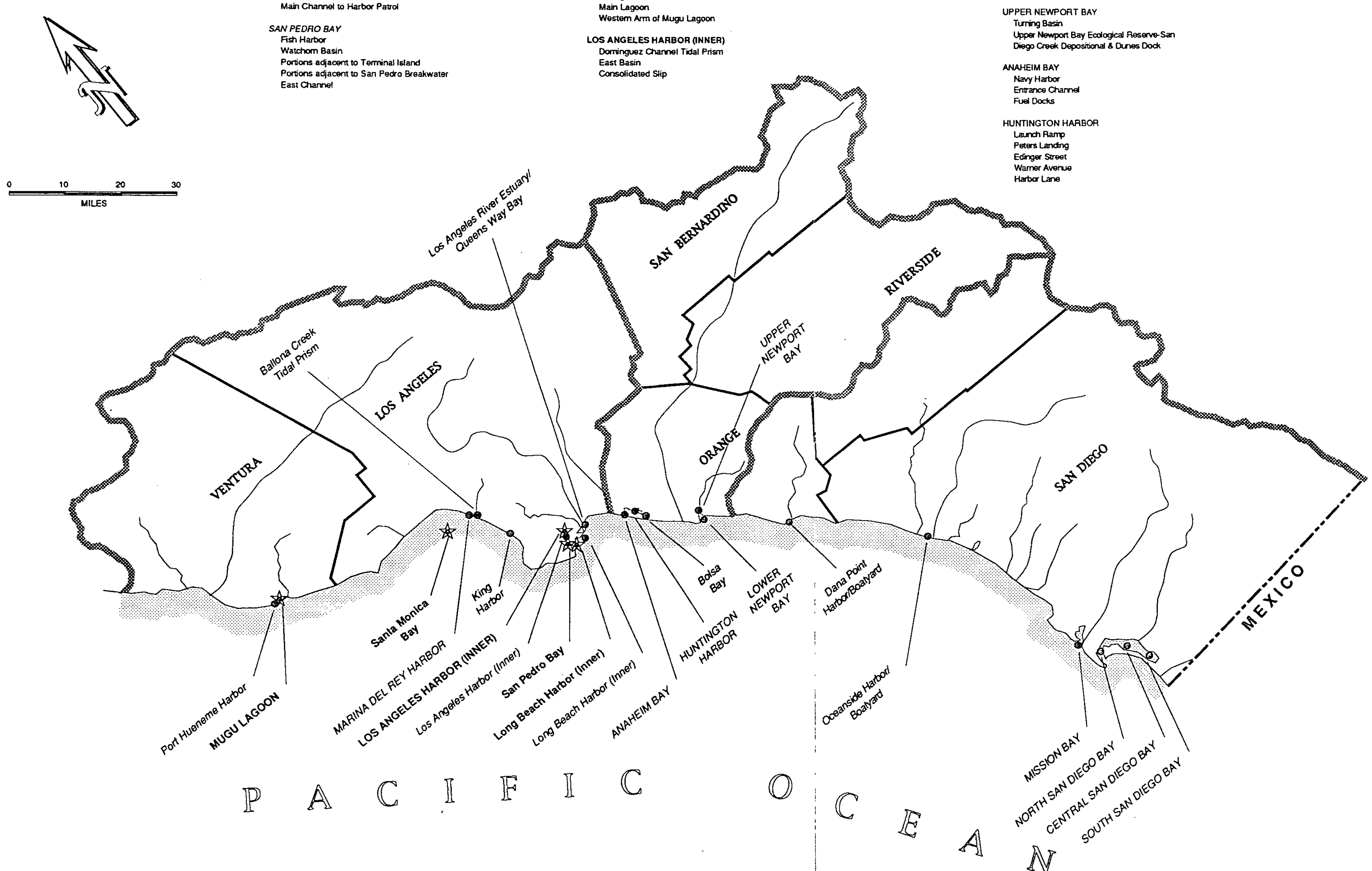


Figure 9

Bay Protection and Toxic Cleanup Program Potential & Known Toxic Hot Spots

Los Angeles, Santa Ana & San Diego Regions



LEGEND

- Potential Toxic Hot Spot
- **Known Toxic Hot Spot**

SPECIFIC LOCATIONS OF POTENTIAL TOXIC HOT SPOTS IN THE LOS ANGELES AREA

MARINA DEL REY HARBOR
- Back Basin
- Main Channel to Harbor Patrol

SAN PEDRO BAY
- Fish Harbor
- Watchorn Basin
- Portions adjacent to Terminal Island
- Portions adjacent to San Pedro Breakwater
- East Channel

SPECIFIC LOCATIONS OF KNOWN TOXIC HOT SPOTS IN THE LOS ANGELES AREA

MUGU LAGOON
- Calleguas Creek Tidal Prism
- Main Lagoon
- Western Arm of Mugu Lagoon

LOS ANGELES HARBOR (INNER)
- Dominguez Channel Tidal Prism
- East Basin
- Consolidated Slip

SPECIFIC LOCATIONS OF POTENTIAL TOXIC HOT SPOTS IN THE SANTA ANA AREA

LOWER NEWPORT BAY
- PCH Bridge
- Rhine Channel
- Crows Nest
- Harbor Entrance
- Turning Basin
- Bay Island
- El Paso Drive
- Police Docks

UPPER NEWPORT BAY
- Turning Basin
- Upper Newport Bay Ecological Reserve-San Diego Creek Depositional & Dunes Dock

ANAHEIM BAY
- Navy Harbor
- Entrance Channel
- Fuel Docks

HUNTINGTON HARBOR
- Launch Ramp
- Peters Landing
- Edinger Street
- Warner Avenue
- Harbor Lane

SPECIFIC LOCATIONS OF POTENTIAL TOXIC HOT SPOTS IN THE SAN DIEGO AREA

MISSION BAY
- Mission Bay off Vacation Isle Ski Beach
- Mission Bay Harbor Police

NORTH SAN DIEGO BAY
- North Island across from Commercial Basin
- North Island off Hangar 94
- Sub Base
- Grape Street
- North Island Naval Air Station
- Navy Magnetic Silencing Facility
- Stormdrain south of Grape Street
- Teledyne-Ryan Aeronautical
- Commercial Basin boatyards

CENTRAL SAN DIEGO BAY
- Between Naval Station & Amphibious Base
- Glorietta Bay
- SDG & E Silvergate Power Plant
- National Steel shipyard
- Campbell Marine shipyard
- Tenth Ave. Marine Terminal
- Continental Maritime shipyard
- KELCO
- Southwest Marine shipyard
- Naval Station graving Dock

SOUTH SAN DIEGO BAY
- Sweetwater River (old slough to south)
- J Street Marina
- SDG & E Jetty for South Bay Power Plant
- Rohr Channel
- Paco Terminals

CHAPTER III

REGIONAL MONITORING: PROGRAM DESIGN

Introduction

The Bay Protection and Toxic Cleanup Program is required by Water Code Section 13392.5(a) to develop regional monitoring and surveillance programs for the enclosed bays and estuaries of California. The primary purposes of monitoring programs are to identify toxic hot spots and aid in the development of sediment quality objectives. This chapter presents the Regional monitoring program (RMP) design and the issues considered during development.

A. Monitoring Program Objectives

Section 13392.5 requires, in part, that each Regional Water Board shall, in consultation with the State Water Board, develop a monitoring program that is composed of at least the following components:

1. Guidelines to promote standardized analytical methodologies and consistency in data reporting, and

2. Additional monitoring and analyses that are needed to develop a complete toxic hot spot assessment for each enclosed bay and estuary.

The four objectives of BPTCP regional monitoring are:

1. Identify locations in enclosed bays, estuaries or the ocean that are toxic hot spots as defined in Chapter II;

2. Determine the extent of biological impacts in portions of enclosed bays and estuaries not previously sampled (areas of unknown condition);

3. Confirm the extent of biological impacts in enclosed bays and estuaries that have been previously sampled; and

4. Assess the relationship between toxic pollutants and biological effects.

B. Technical/Scientific Criteria: Bioassessment and Chemical Information

Most of the criteria for a sediment assessment strategy presented in Table 1 are technical or scientific in nature. The following discussion explains how these criteria have been applied to the development of the RMP designs.

1. Selection of Assessment Options

One of the important conclusions of the sediment workshop (Lorenzato et al., 1991) was the need for a weight-of-evidence approach to the evaluation of sediment quality assessment information. An important question that was only generally addressed was which bioassessment (e.g., toxicity testing, bioaccumulation, biomarkers) and chemical information (e.g., biochemical effects and chemical analysis of water and sediment) would be most useful in assessing bays and estuaries.

Although the measurement of chemical concentrations in water may be effective for a few chemicals, the majority of those of greatest concern probably partition to sediment. Because there are, as yet, no chemical-specific objectives for sediment, this method alone serves little purpose in identifying toxic hot spots. However, sediment chemistry is critical for evaluating whether bioeffects are caused naturally or by human activity. Tissue analysis on its own is of little use except for mercury, PCB, and the 13 chlorinated hydrocarbon pesticides, due to the limited number of National Academy of Sciences (NAS), U.S. Food and Drug Administration (FDA), and OEHHA protective levels in fish and shellfish.

2. Biological Methods

Each of the scientific methods that are available for identifying toxic hot spots have both advantages and disadvantages. No single test or measurement of biological response is without some type of limitation. The challenge for the BPTCP is to select the most supported, cost-effective, and available combination of methods that will provide scientifically defensible analysis of the impacts at a site. The advantages and disadvantages of toxicity testing, biomarkers, bioaccumlation and benthic community analysis are presented in Tables 4 through 7, respectively.

Table 4
Advantages and Disadvantages of Toxicity Tests
(adapted from MacDonald et al., 1992)

Advantages	Disadvantages
Provides quantifiable information about the potential for biological effects at a site.	Not designed to mimic natural exposure, so may be difficult to relate directly to actual responses at a site.
Indirect indicator of bioavailability of pollutant contaminants.	Response not necessarily directly related to specific pollutants.
Response not restricted by predetermined list of pollutants.	If test organisms do not naturally occur at the site it may be difficult to relate effects on test organisms to organisms occurring naturally at the site.
Indicates potential effects to sensitive species or to species of particular concern.	Tests are difficult to perform correctly by inexperienced laboratories.
Performed under controlled test conditions (i.e., minimizes natural variability).	These tests are not surrogates for determining population changes.
Not dependent on the presence of any particular in-situ population.	Not appropriate for contaminants that cause subtle effects over long periods, or for those where the major concern lies in their potential to bioaccumulate.
Spatial resolution of toxicity test results is better than for most other assessment approaches.	May observe toxicity in unexpected places (i.e., clean sites) due to unknown or unquantified factors.
Many toxicity tests have well-developed and widely accepted protocols.	Results may conflict between tests on different media or different species.
Tests are quick and relatively inexpensive.	

Table 5

Advantages and Disadvantages of Bioaccumulation Monitoring (adapted from MacDonald et al., 1992)

Advantages	Disadvantages
Direct measure of bioavailability.	Relationship between body burdens and biological effects uncertain.
Integrates contamination levels over time.	High natural variability between individuals and between species.
Concentrates chemicals from water allowing easier and less expensive analyses.	No direct relationship between body burdens and environmental levels for some contaminants due to bioregulation or metabolism.
Potential for determining human health risk from data.	Difficult to associate contamination in mobile species to area of environmental contamination.
	Uptake of one contaminant may be inhibited by the presence of other contaminants.
	Rates of biological processes may be reduced by contamination thus reducing rates of bioaccumulation.

Table 6

Advantages and Disadvantages of Biomarker Monitoring
(adapted from MacDonald et al., 1992)

Advantages	Disadvantages
Measures actual biological responses to contaminants and pollutants.	Little history of use at waste sites.
May integrate patchy temporal exposure.	No existing EPA or other accepted protocols.
Demonstrates effects on indigenous organisms.	No absolute measure of unacceptable response.
Assesses a variety of severity levels.	Responses may be caused by natural factors.
Measures more sensitive responses than other bioassessment methods.	Requires experienced expert investigators.
Selective for particular pollutant or class of pollutant.	Not always a known relationship between response and significant ecological effects.
Selective for a particular species of concern.	Responses may take years to develop or disappear (after remediation).
May be cheaper than higher level ecological studies.	Not yet feasible for all groups of organisms or contaminants.
	Few commercial laboratories can perform the tests.

Table 7

Advantages and Disadvantages of Benthic Community Analysis
(adapted from MacDonald et al., 1992)

Advantages	Disadvantages
Direct measurement of environmental impacts.	Very costly.
Response not restricted by predetermined list of pollutants.	Pollutant effects difficult to distinguish from naturally occurring conditions (sediment texture, temperature, storm effects, etc.).
Can distinguish population changes.	Requires expert investigators.
Direct measure of actual exposure.	Sampling and handling methods may bias measurements.
	Interpretation of community structure may be very complex.

a. The Choice of Bioassessment Methods

The best bioassessment methodology would be the combination of an array of tests that exploits several exposure routes. Although biomarkers and community impacts can be difficult to interpret these methods hold significant promise and are worthy of further development because they offer insights into environmental impacts not available using toxicity testing alone. Although bioaccumulation in and of itself is unlikely to qualify many sites as toxic hot spots, this method should be pursued for the supporting information it provides in a weight-of-evidence approach.

A combination of community analysis and toxicity testing offers several productive elements. First, the analysis of community composition will provide a direct assessment of impacts and an opportunity to identify "indicator" species (i.e., species that mark the presence of either pollutant impacts or unpolluted conditions). Second, the combination of an array of toxicity testing endpoints including lethality and critical life stages will allow the evaluation of a variety of effects. The use of several different organisms ensures a greater opportunity to identify problem conditions than reliance on a single organism. By integrating community measurements and toxicity tests, the weight-of-evidence diminishes the possibility for false claims that pollutants are producing unwanted effects when, in fact, they are not. Individual toxicity testing methods or suites of toxicity tests to predict community level effects can also be evaluated.

Methods for bioaccumulation measurement in tissue have undergone extensive development for the State Mussel Watch Program and are mentioned in the section on chemistry methods (next section). Other bioassessment methods (i.e., biomarkers) are largely in the developmental stage. Studies are currently underway to evaluate the utility of Goby (a fish) and mussel biomarker methods (see Chapter VIII).

b. Toxicity Test Methods

Guidelines to promote standardized analytical methodologies are required by statute; details are contained in the program's draft Quality Assurance Project Plan (QAPP)(DFG, 1993). The set of toxicity tests used by or acceptable to the BPTCP is presented in Table 8. This list will be modified as new methods become available and as existing methods are improved. Elutriate tests are not included in the draft QAPP at this time because the program has not used this type of test for monitoring. If and when elutriate tests become needed they will be added to the QAPP.

Table 8
Toxicity Tests Used by or Acceptable to the BPTCP

Type of Toxicity Test	Organism Used: Common Name	Organism Used: Scientific Name	Reference
Solid Phase Sediment	Amphipod	Rhepoxinius	ASTM, 1991
	Amphipod	Eohaustorius	DeWitt et al., 1989
	Amphipod	Hyalella	Nebecker et al., 1984
	Polychaete	Neanthes	Johns et al., 1990
Sediment Pore Water Tests	Bivalve larvae	Crassostrea	ASTM, 1987; Tetra Tech 1986; Chapman & Morgan, 1983
		Mytilus	ASTM, 1987
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongy-locentrotus	Dinnel et al., 1990; with modification by EPA, 1992
	Giant kelp	Macrocystis	Anderson et al., 1990
	Red alga	Champia	Weber et al., 1988
	Fish embryos	Atherinops	Anderson et al., 1990
		Menidia	Middaugh et al., 1988
	Pimephales		Spehar et al., 1982
	Cladoceran	Daphnia	Nebecker et al., 1984
		Cereodaphnia	Mount and Norberg, 1984; Horning and Weber, 1985
Elutriate* Tests	Bivalve larvae	Crassostrea	ASTM, 1987; Tetra Tech, 1986; Chapman and Morgan, 1983
		Mytilus	ASTM, 1987
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm	Strongylocen-trotus	Dinnel et al., 1987
	Giant kelp	Macrocystis	Anderson et al., 1991
	Red alga	Champia	Weber et al., 1988
	Mysid	Holmesimysis	Hunt et al., 1992
	Fish embryos	Atherinops	Anderson et al., 1990
		Menidia	Middaugh et al., 1988
		Pimephales	Spehar et al., 1982
	Fish larvae	Atherinops	Anderson et al., 1990
		Menidia	Peltier and Weber, 1985; Weber et al., 1988
		Pimephales	Peltier and Weber, 1985; Weber et al., 1988
	Cladocerans	Daphnia	Nebecker et al., 1984
		Cereodaphnia	Mount and Norberg, 1984; Horning and Weber, 1985

Table 8 (Cont'd)

Type of Toxicity Test	Organism Used: Common Name	Organism Used: Scientific Name	Reference
Ambient Water	Bivalve larvae	Crassostrea	ASTM, 1987; Tetra Tech, 1986; Chapman and Morgan, 1983
		Mytilus	
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongylocentrotus	Dinnel et al., 1987; with modifications by EPA, 1992
	Giant kelp	Macrocystis	Anderson et al., 1991
	Red alga	Champia	Weber et al., 1988
	Mysid	Holmesimysis	Hunt et al., 1992
	Fish embryos	Atherinops	Anderson et al., 1990
		Menidia	Middaugh et al., 1988
		Pimephales	Spehar et al., 1982
	Fish larvae	Atherinops	Anderson et al., 1990
		Menidia	Peltier and Weber, 1985 Weber et al., 1988
		Pimephales	Peltier and Weber, 1985 Weber et al., 1988
	Cladocerans	Daphnia	Nebecker et al., 1984
		Cereodaphnia	Mount and Norberg, 1984 Horning and Weber, 1985

* Elutriate toxicity tests are of value in estimating the toxicity of disposed sediments to aquatic organisms. Elutriate test results can be used to qualify a site as a potential hot spot but should not be used to confirm a site as a known hot spot. Either a pore water or a solid phase test should be used to confirm toxicity.

3. Chemistry Methods

Methods for measuring chemicals in tissue, water and sediment are listed in the draft BPTCP Quality Assurance Program Plan (DFG, 1993). The QAPP summarizes the QA/QC elements which ensure accurate and precise proceedures for BPTCP sampling and chemical analysis. Chemical analyses currently performed by the program are listed in Table 9. Trace metal and organic analyses are performed on tissue, water, and sediment as needed. Grain size and TOC analyses are performed on sediment. The list of chemicals, most of which are routinely quantified by NOAA's National Status and Trends Program, may be expanded to include these chemicals which are analyzed by California's State Mussel Watch Program.

Table 9

Chemical Substances Currently Measured by the BPTCP

Chlorinated Synthetic Organics	Polycyclic Aromatic Hydrocarbons
Aldrin	Acenaphthene
Alpha-chlordane	Anthracene
o,p'-DDD	Benz(a)anthracene
p,p'-DDD	Benzo(a)pyrene
o,p'-DDE	Benzo(e)pyrene
p,p'-DDE	Biphenyl
o,p'-DDT	Chrysene
p,p'-DDT	Dibenz(a,h)anthracene
Dieldrin	2,6-Dimethylnaphthalene
Endosulfan (I,II, & sulfate)	Fluoranthene
Endrin	Fluorene
Heptachlor	1-Methylnaphthalene
Heptachlor epoxide	2-Methylnaphthalene
Hexachlorobenzene	1-Methylphenanthrene
Lindane (gamma-BHC)	Phenanthrene
Methoxychlor	Perylene
Mirex	Pyrene
Toxaphene	
Trans-nonachlor	Other Analyses
PCB Congeners:	Grain size, TOC

No.	Name	Elements
8	2,4'-dichlorobiphenyl	Aluminum
18	2,2',5-trichlorobiphenyl	Antimony
28	2,4,4'-trichlorobiphenyl	Arsenic
44	2,2',3,5'-tetrachlorobiphenyl	Cadmium
52	2,2',5,5'-tetrachlorobiphenyl	Chromium
66	2,3',4,4'-tetrachlorobiphenyl	Copper
		Iron
101	2,3',4,4'5-pentachlorobiphenyl	Lead
105	2,3,3',4,4'-pentachlorobiphenyl	Manganese
118	2,3',4,4',5-pentachlorobiphenyl	Mercury
		Nickel
128	2,2',3,3',4,4'-hexachlorobiphenyl	Selenium
138	2,2',3,4,4',5'-hexachlorobiphenyl	Silver
153	2,2',4,4',5,5'-hexachlorobiphenyl	Tin
170	2,2',3,3',4,4',5-heptachlorobiphenyl	Zinc
180	2,2',3,4,4',5,5'-heptachlorobiphenyl	
187	2,2',3,4',5,5',6-heptachlorobiphenyl	Tributyltin
195	2,2',3,3',4,4',5,6-octachlorobiphenyl	
206	2,2',3,3',4,4',5,5',6-nonachlorobiphenyl	
209	decachlorobiphenyl	

Table 9 (cont'd)

chlorbenside	ethion
trans-chlordane	HCH, alpha
chlordene, alpha	HCH, beta
chlordene, gamma	HCH, delta
chlorpyrifos	cis-nonachlor
dacthal	oxychlordane
DDMS, p,p'	parathion, ethyl
DDMU, p,p'	parathion, methyl
diazinon	pentachlorophenol
dichlorobenzophenone, p,p'	2,3,5,6-tetrachlorophenol
dicofol (Kelthane)	tetradifon (Tedion)

The BPTCP requires its laboratories to demonstrate comparability through strict adherence to common quality assurrance/quality control procedures, routine analysis of certified reference materials and regular participation in interlaboratory comparison exercises. The following methodology manuals are used (DFG, 1993; DFG QA/QC Manual) as guidelines for all analytical chemical methods:

- EPA Test Methods for the Evaluation of Solid Waste, Physical/Chemical methods, SW-846, third edition, 1986

- EPA Test Methods for Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057

- Standard Methods for the Examination of Water and Wastewater

- Manual for Association of Analytical Chemists

- A Compendium of Methods Used in the NOAA National Status and Trends Program. National Ocean Service, Office of Ocean Resources Conservation and Assessment, 1993

- Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples, EPA-600/8-80-038

C. Screening Sites and Confirming Toxic Hot Spots

In order to identify known toxic hot spots we have developed a two tier process. The first tier is a screening step where a suite of toxicity test is used at a site. In order to differentiate effects found in screening from natural factors, we perform measurements of sediment grain size, TOC and H_2S. We will also perform chemical analyses (metals and organics) on a subset of the screening samples.

If effects are found at sites by these screening steps, we will retest sites to confirm the effects. In the confirmation step we shall replicate measurements and compare to reference sites. Chemical measurements (metals, organics, TOC, H_2S) and other factors (sediment grain size) will be measured. Measurements of benthic community structure and, perhaps, bioaccumulation will also be made.

These concepts will be expanded upon in this and the next section. The factors addressed in this section are: (1) selection criteria for the screening tests, (2) quality assurance updates, (3) regional diversity in approach, and (4) sequences of problem identification and remediation.

1. A Battery of Screening Tests

Selecting a battery of toxicity screening tests can improve cost-effectiveness by both reducing costs and expanding the range of impacts evaluated. Although recurrent toxicity must be demonstrated to qualify a site as a "known" toxic hot spot, the degree of certainty for each of the measurements does not necessarily have to be equivalent. The cost of a confirming toxicity at a site can be prohibitively high, especially if it includes a large number of field replicates and extensive reference site testing. The screening tests should allow for a relatively rapid lower cost assessment of a site or waterbody.

The battery of toxicity tests for enclosed bay and estuarine water requires a selective design. First, test organisms should be chosen which are adequately (but not excessively) sensitive to the pollutants expected to be present. Similarly, test systems should be selected to reflect the media (bedded sediment, pore water, or overlying water) thought to be contaminated. A variety of endpoints should be included to ensure that less subtle, non-lethal effects such as changes in form, function, behavior, reproductive success, and genetic makeup are evaluated. Additionally, a mix of phyla or trophic levels should be tested since different toxicants can exert their influence at many different points in the food web.

Beyond these basic concerns, administrative and developmental issues will also influence the test choices. Tests should have a written protocol, be in or beyond the interlaboratory comparison stage, and be widely used.

Reasonable cost and short-term are important. Finally, preference should be given to tests which have been given regulatory status in statewide water quality control plans and which are capably conducted by accessible contractors.

2. Quality Assurance

Standardized quality assurance and quality control methods of the BPTCP are described in the draft QAPP (DFG, 1993). However, if these methods require further development, the QAPP will be updated to reflect any changes.

3. Regional Diversity in Monitoring Approach

Beyond the scientific criteria that were considered in designing the Regional monitoring programs, several administrative issues also influenced their development. Diversity in approach was encouraged among the various Regional Water Boards. Even though the Regional Water Boards had implemented the SMW monitoring programs prior to initiation of the BPTCP, the monitoring strategies for qualifying marine and estuarine sites as toxic hot spots needed further development. Each of the Regions has special monitoring needs due to important differences in the causes of toxicity and other environmental impacts, differences in comprehensiveness of existing monitoring data, and the availability of monitoring tools. Therefore, design and approach flexibility is needed. Also, the pollutants that may cause toxicity vary greatly. The pollutants of concern include currently used pesticides dissolved in water, banned pesticides bound to sediment, metals and organic chemicals from point sources, metals released from a variety of nonpoint sources, and many other causes. Consequently, the BPTCP will benefit from Region-specific approaches to implementation of monitoring programs. Some Regions (Region 2 and Region 5) have used alternative approaches adapted to their unique situations.

4. Sequence of Problem Identification and Remediation

Although the primary intent of the BPTCP is to identify and plan for the remediation of toxic hot spots, the Water Code also requires that remediation also be implemented to the extent feasible (Section 13392). Even though some sites may have been studied sufficiently, they must meet the qualifications of a toxic hot spot. Also, a cleanup plan must be completed before remediation efforts can begin. Generally, identification of polluted conditions (i.e. the presence of a known toxic hot spot) is necessary before any remediation action will be contemplated. However, actions that are informative and reversible (pretreatment, prevention, waste minimization, etc.) will be promoted.

Remediation is not limited to cleanup. The BPTCP is not to be regarded as merely an "underwater Superfund program" with responsibility limited to the clean up of contaminated sediments. The Program includes site characterization, source identification and prevention, and mitigation as well. Pollution prevention consists of "[amendments to] water quality control plans and policies, ... adoption of more stringent waste discharge requirements, development of onshore remedial actions, and adoption of regulations to reduce urban and agricultural runoff" (Section 13392). Prevention efforts will also be combined with a watershed approach to control point and nonpoint sources whenever possible. The program will emphasize and promote prevention of toxic conditions in waters of the State.

D. Site Selection

1. Regional Monitoring Designs

Three somewhat different designs are used in BPTCP monitoring. Five of the coastal regions have used a design (summarized in Table 10 and Table 11) that combines toxicity testing, chemical analysis, and benthic community analysis in a two-phased screening/confirmation framework. A similar version of this design has been implemented by the San Francisco Bay Regional Board. Components of the San Francisco Bay program include (1) a wet weather/dry weather ambient survey of water column chemistry and sediment chemistry and toxicity, which is to provides a point of comparison for the identification of hot spots; (2) a survey of critical marsh habitat for both water column and sediment chemistry and toxicity; (3) an evaluation of toxicity test, sensitivity of biomarkers, and benthic community analysis along chemical gradients; and (4) a wet weather/dry weather study of bioaccumulation in fish and shellfish.

The Central Valley Region, with jurisdiction over the Sacramento-San Joaquin Delta, has designed its program to respond to Delta conditions and to the water quality problems characteristic of that area. Fresh water toxicity testing combined with water chemistry analysis constitutes the main program components, which include metals and currently used pesticides. Later, sediment toxicity testing could be added to the design.

Table 10
Types of Data Collected in Regional Monitoring Programs
for the Identification of Toxic Hot Spots

Type of Data	Screening	Confirmation
Toxicity testing	Suite of 4 tests	Repeat of positives
Lab replicates	Five	Five
Field replicates	None	Three
Reference sites	None	Several
Physical analysis	Grain size	Grain size
Chemical analyses	Ammonia, hydrogen sulfide, TOC, pesticides, PCB, PAH, TBT, metals	Ammonia, hydrogen sulfide, TOC, pesticides, PCB, PAH TBT, metals
Benthic community analysis	None	Five replicates
Bioaccumulation	None	Occassionally (sites with no pre-existing bioaccumulation data)

Table 11

Screening Tests for
Toxic Hot Spot Identification

TEST ORGANISM	TYPE	END POINT
Rhepoxynius, *Eohaustorius* (Amphipod)	Bedded Sediment	Survival
Haliotus, *Mytilus*, *Crassostrea*	Overlying Water	Shell Development
Strongylocentrotus (sea urchin)	Sediment Pore Water	Fertilization, Development, and anaphase aberration
Neanthes (polychaete worm)	Bedded Sediment	Survival and Growth

Table 12
Sequence of Tasks for Designating Toxic Hot Spots

1. Select toxicity screening sites.
2. Sample screening sites.
3. Conduct battery of five toxicity screening tests; analyze for hydrogen sulfide, ammonia, TOC, and grain size.
4. Determine whether quality assurance requirements have been met.
5. Report on items 3 and 4.
6. Select and match hits and potential reference sites for ammonia, hydrogen sulfide, and grain size.
7. Conduct metals and organic chemical analysis on subset of screening sites from item 6.
8. Determine whether auality assurance requirements have been met.
9. Report on items 7 and 8.
10. Select sites and toxicity tests for confirmation and reference.
11. Sample confirmation and reference sites.
12. Conduct subset of the battery of toxicity tests which were screening hits; analyze for hydrogen sulfide, TOC, conduct benthic community analysis.
13. Conduct metals and organic chemical analyses.
14. Determine whether quality assurance requirements have been met.
15. Report on items 12 through 15.
16. Conduct statistical and other analyses to determine whether sites qualify as toxic hot spots.

Four different categories of sites have been identified for sampling in the BPTCP monitoring: (1) potential toxic hot spots, (2) high risk sites, (3) stratified random sites, and (4) reference sites. Potential toxic hot spots are the highest priority sites because we have some indication already that these sites have a pollution-related problem (please refer to Table 3). These data are usually chemical contamination of mussel tissue, data documenting water and sediment toxicity, measurements of metals of organic chemicals in sediments, and occasionally, biological impairment. These sampling efforts are typically point estimates.

There are many other sites that considered "high risk" even though we have no monitoring information to support this contention. High risk sites are locations where a nearby activity (e.g. marinas, storm drain, industrial facility, etc.) are thought (hypothetical) to carry a risk of toxicity. The measurements at high risk sites are either point estimates or selected probabilistically.

When we know little about the quality of a waterbody or waterbody segments the BPTCP will employ a stratified, random sampling approach. These random sites will be useful in determining the quality of larger areas in the State's enclosed bays and estuaries. This probabilistic approach will allow the BPTCP to make better estimates percentage of waterbodies that are impacted. The BPTCP will use the techniques used by the EPA Environmental Monitoring and Assessment Program (EMAP) (Overton, et al., 1990; White et al., 1992; Stevens, 1993).

The fourth type of site is reference sites. Locating reference sites requires identification and testing of a variety of potential reference sites encompassing the expected range of grain size, TOC, and other characteristics. Existing data sets that describe chemical contamination, grain size, and TOC at marine and estuarine sites have been reviewed. Since these sources yielded an insufficient number of sites, fine-grained areas presumed to be relatively free of contamination are also being examined. These sites may likewise prove to be rare, so sites with some increased likelihood of contamination, but experiencing low energy tidal flushing will also be sampled. Sites previously demonstrating absence of contamination, and those lacking sediment toxicity will also be sampled. Finally, random selection of sites (as described above) may prove useful in locating reference sites.

2. Toxicity Screening

The four toxicity tests that will be used initially for screening are listed in Table 11. If these tests are not suitable for the program, some will either be dropped or replaced. For example, some investigators question the value of the urchin fertilization test, but no other reproductive test is currently available to replace it. Consequently, it will be dropped from the screening battery of tests only if the data firmly demonstrate that it is ineffective. A replacement test might be the urchin development test, since it would serve to validate the urchin genotoxicity test as well as screen for non-genetic developmental toxicity.

All of the tests in the battery include controls which are conducted in media known to exert minimal stress on test organisms. Both positive (toxicant present) and negative (toxicant absent) controls are often used to ensure that test organisms are responding within expected limits.

The screening step begins with a single field sample being collected from each site (Table 12, steps 1 and 2). Five laboratory replicates are performed as required to accommodate statistical comparison with the control. Although the lack of field replicates restricts statistical comparisons with other sites this approach allows the BPTCP to test more locations for toxicity within the allocated funding. Ammonia and hydrogen sulfide analyses are then performed on the media of all tests (Table 11 step 3). Grain size and TOC values are determined on all sediment samples to evaluate the presence of naturally occurring toxicity.

All these data, along with an assessment of quality assurance (QA) performance, are then reviewed by program staff. Toxicity hits and potential reference sites are selected and matched for ammonia, hydrogen sulfide, grain size, and TOC. A subset of the sites is selected for analysis of metals and organics but analysis is not required before conducting confirmation testing (Table 12, steps 4-9). Chemical analysis of screening sites is performed primarily to supplement the apparent effect threshold (AET) database (refer to Chapter VIII). Toxicity at a site with low levels of naturally occurring toxicity will be presumed to result from metals and organics. These sites will be revisited for confirmation.

3. Confirmation (i.e. Qualification as Known Toxic Hot Spots)

With the identification and sampling of acceptable reference sites all screening sites (Table 12, steps 10 and 11), with at least one positive test result will be candidates for revisitation to evaluate both the recurrent nature of the toxicity and impacts on the benthic community. This may require repeat testing of potential toxic hot spots to ensure that toxicity is absent. Confirmation testing (Table 12, step 12) is of more intensive because of the (1) addition of field replicates (three to a site); (2) comparison to reference sites (unless water toxicity is the focus); and (3) benthic community analysis.

For each positive toxicity test at a screening site, confirmation will be performed on the same test or tests. Benthic analysis will also be performed and added to an ever-enlarging nearshore benthic community database which will be periodically evaluated to determine whether impacted and nonimpacted sites can be distinguished (Table 12, step 12). When either recurrent toxicity is demonstrated with a positive confirmation test or benthic impacts are suspected, chemical analysis will also be performed (Table 12, step 13). Careful review of all quality assurance procedures will be conducted and, upon approval, will be followed by statistical analysis of the data. Compared to screening, this analysis will be more comprehensive and will include measures of field variability in toxicity, benthic data, and reference site conditions.

Once both toxicity and benthic impacts have been confirmed through comparison with an appropriate reference site and appeared to be human-caused pollution (Table 12, steps 14-16), the site will be declared a known toxic hot spot. When toxicity is present, but benthic impacts are lacking, careful analysis will be performed to determine whether the two results are in conflict (e.g., the test organism may not be an important component of the benthos). Similarly, when toxicity is not demonstrated, but benthic impacts are, careful review will be conducted to determine whether the same explanation prevails or whether some factor other than toxicants may be responsible. Further characterization of the site (e.g., areal extent, range of effects, and source determination) will be described in the remediation plan and is not intended under this phase of the program except in rare circumstances. Please refer to Chapter IV for a summary of the Regional Monitoring Plans.

CHAPTER IV

REGIONAL MONITORING: TOXIC HOT SPOT IDENTIFICATION

Introduction

The Regional Water Boards, in cooperation with the State Water Board, have developed Regional Monitoring Plans (RMP) for implementing the BPTCP. Summaries of these plans, the monitoring activities, the numbers of sites visited and tests performed are presented below.

A. Regional Monitoring Plan Summaries

This section summarizes the RMPs and the task orders developed to implement them. Generally, the RMPs provided prioritized lists of waterbodies and sites to be sampled. The sites were categorized as potential hot spots, high risk sites, and reference sites. Reports and databases were provided to describe the sources of information used to qualify sites as potential hot spots (Table 3). High and low risk sites were selected by Regional Water Board staff most familiar with the various water bodies. Tissue sampling and analysis will also be performed at a few sites to evaluate the likelihood of collecting fish in nearshore areas and detecting significant levels of pesticides, PCB, and mercury. Maps of the screening sites are provided in Figures 6-9.

1. North Coast Regional Water Board (Region 1)

Although the North Coast Region is probably less contaminated overall than the other regions, it has significant localized problems, such as TBT contamination, that warrant closer inspection. The RMP identified the following water bodies as highest priority for BPTCP monitoring:

Humboldt Bay
Bodega Bay
Crescent City Harbor
Smith River estuary
Klamath River estuary
Mad River estuary
Eel River estuary
Noyo River estuary
Russian River estuary
Estero de Americano estuary
Estero de San Antonio estuary

Within these water bodies three sources of information were used to document the potential toxic hot spots listed in the consolidated database. These are the State Mussel Watch results (SWRCB, 1991), DFG tributyltin (TBT) data (Stephenson et al., 1988), and U.S. Army Corps of Engineers' sediment bioassay results (NCRWQCB, 1992). Additional sites were specified as either high risk (due to the presence of industrial facilities, storm drains, and other nonpoint sources) or relatively uncontaminated, low risk sites. This information was combined with the region's FY 1991/92 and 1992/93 budget allocation of $183,500 to produce the following list of sites to be screened for toxicity. Figure 6 in Chapter II shows the location of these sites.

Site	Already Sampled	Purpose
1. Crescent City - Inner Marina		Potential Hot Spot
2. Crescent City - Bayside Marina		"
3. Crescent City - Near STP outfall		"
4. Arcata Bay - McDaniel Slough	+	"
5. Russian River mouth (SMW 280.0)	+	"
6. Bodega Bay - Mason's Marina	+	"
7. Bodega Bay - Spud Point Marina	+	"
8. Noyo River - Inside marina		High risk site
9. Noyo River - Boat dry dock		"
10. Smith River - Cattle crossing		"
11. Smith River - Ship Ashore		"
12. Klamath River - Near Requa		"
13. Klamath River - Boat dock		"
14. Mad River - County boat ramp		"
15. Arcata Bay - Mad River Sl.	+	"
16. Arcata Bay - Jolly Giant Sl.	+	"
17. Arcata Bay - Eureka Sl.	+	"
18. Humboldt Bay - Union Oil plant	+	"
19. Humboldt Bay - Coal/oil/gas plant	+	"
20. H. Bay - Old Pacific Lumber site	+	"
21. Humboldt Bay - Chevron terminal	+	"
22. Humboldt Bay - Eureka stormdrain	+	"
23. Humboldt Bay - Eureka stormdrain	+	"
24. Humboldt Bay - Fields Landing	+	"
25. Humboldt Bay - Hookton Sl.	+	"
26. Humboldt Bay - PG&E discharge		"
27. Eel River - McNutty Sl.		"
28. Bodega Bay - Porto Bodega Marina	+	"
29. Estero Americano - Valley Ford Rd.	+	"
30. Estero de San Antonio - Valley Ford Rd.	+	"
31. Mouth of Estero Americano	+	Reference site
32. Mouth of Estero de San Antonio	+	"
33. Relatively uncontaminated channels in Humboldt and Bodega Bays where some tidal flushing occurs but is not strong enough to remove fine grained sediment	+ + + +	"
34. Relatively uncontaminated coastal lagoons and river mouths		"
a. Smith River		"
b. False Klamath Cove		"
c. Klamath River		"
d. Redwood Creek		"

e. Patrick and Strawberry Creeks "
f. Mad River "
g. Eel River and adjacent sloughs "
h. Small lagoons south of Ferndale "
i. Pudding Creek "
j. Big River "
k. Russian River "
l. Salmon Creek + "

Lower priority potential hot spots and high risk sites will be sampled in upcoming years on a funds available basis.

2. San Francisco Regional Water Board (Region 2)

The San Francisco Bay Regional Board was funded by the BPTCP to develop a pilot regional monitoring and surveillance program (RMP) with the intent to adapt it the six other Regions having bays and estuaries. Consequently, the Bay Region's monitoring program is progressing more quickly than RMPs in other Regions. The general program design is consistent with the Pollutant Policy Document (SWRCB Resolution No. 90-67), Chapter 5 (Bay-Delta Pollutant Monitoring and Assessment Program) and the BPTCP Program design (Chapter III).

To adequately convey the status of the Bay Region's RMP, the Executive Summary from the report, "San Francisco Bay Pilot Regional Monitoring Program: 1991-1992 Summary Progress Report" (Taberski, et al. 1992) is presented below: The full report is presented in Appendix C.

"This . . . is a summary of the progress to date on the San Francisco Bay Regional Water Quality Control Board's Pilot Regional Monitoring Program (RMP). The RMP was funded by the Bay Protection and Toxic Cleanup Program. The main goal of this program was to develop a regional monitoring and surveillance program that could be used as a prototype in other bays and estuaries in the state. This was accomplished by setting up monitoring programs and special studies to evaluate various techniques and protocols used to sample water, sediment and tissue and to measure chemical contamination and toxicity. A second purpose of the program was to identify toxic hot spots in the Bay and in critical habitats (marshes, creeks and mudflats) around the Bay.

This was a multi-media program in which chemical contamination and toxicity was measured in water and sediments and bioaccumulation of contaminants was measured in tissues. The program was divided into two major monitoring programs two special study programs and a data management component. The two monitoring components were the Bay Monitoring Surveys and the Critical Habitat Investigations.

In the Bay Monitoring Surveys, chemistry and toxicity was measured in the water and sediments at stations ranging from the South Bay to the Sacramento and San Joaquin Rivers. The purposes of the Bay Monitoring Surveys were to: 1) monitor stations that in a longterm monitoring program would indicate spatial and temporal trends in toxicity and chemistry throughout the Estuary, 2) determine background for different basins in the Estuary and 3) determine if there was toxicity or high levels of contaminants at Bay stations.

Critical Habitat Investigations were conducted primarily to determine if there were high levels of contaminants or toxicity "hot spots" in the marshes, mudflats or creeks surrounding the Estuary. Toxicity was measured in the sediments. Chemical analyses was performed on sediment samples for a suite of metals and organics. Investigations of toxicity in the water column of critical habitats focused on stormwater runoff in two systems: 1) The Crandall Creek and Demonstration Urban Stormwater Treatment (DUST) marsh (DUST system) which retains stormwater in a freshwater marsh and 2) Arrowhead Marsh where stormwater is discharged into San Leandro Bay.

A special study was performed on a sediment gradient to: 1) determine which toxicity tests or type of toxicity tests (solid phase, elutriate, or pore water) could best distinguish between highly contaminated, moderately contaminated, and relatively uncontaminated sites, 2) evaluate the degree to which field replication increases the ability to distinguish between sites, 3) determine the effect of sample depth, 4) determine the relationship between toxicity and factors that may effect toxicity including the levels of chemical contaminants, total organic carbon, grain size, ammonia and sulfides and 5) determine the relationship between toxicity test results and benthic community analysis. Shallow and deep samples were collected at stations in Castro Cove, which has been historically contaminated with effluent from an oil refinery. Five field replicates were collected at each station. Toxicity tests were performed on whole sediment, elutriates and porewater. Chemical analyses were performed on whole sediment and porewater. Samples for benthic community analysis were collected from these stations. In addition, for another program, biomarkers were measured in fish exposed to the sediment in the laboratory.

A bioaccumulation study was performed in order to: 1) describe the distribution of trace metals and organics in organisms in the San Francisco Estuary, 2) determine the differences in contaminants in organisms collected in wet and dry seasons, 3) determine the differences between mussels transplanted to shallow and deep water column depths at the same station, 4) determine the effect of depurating sediment from the guts of organisms on the contaminant levels in the whole bodies, 5) determine the optimum length of exposure for transplant organisms and 6) determine the differences in uptake in three species, each with their own salinity tolerances.

To manage the data for the entire RMP a common format was developed for all laboratories participating in the program. This allowed data to be more easily interpreted, analyzed and thoroughly checked for quality assurance. All laboratories in the program were provided with consistent formats with QA programs integrated into the data input system to insure accurate data entry. Data were generated at each of the laboratories and sent to EcoAnalysis for review.

For the sediment portion of the Bay Monitoring Surveys and Critical Habitat Investigations, stations were identified where sediment was toxic or showed elevated levels of metals or organics (see results). Sediment was monitored at 15 stations baywide during wet and dry seasons. For the Critical Habitat Investigations 32 sediment stations were monitored. Preliminary studies and data from the monitoring programs indicated that: 1) for the amphipod test Eohaustaurius estuarius seemed more sensitive than Hyalella azteca and Rhepoxinius abronius, even when a 28 day growth test was conducted with Hyalella, 2) the Menidia growth and survival test, using an elutriate, is not sensitive and should not be used in a monitoring program, 3) diver cores seemed to be the best way to collect undisturbed sediment samples, next best was the box core and 4) chemical analysis indicated that the technique used for homogenizing samples was adequate. Eohaustaurius seems to be an excellent organism for estuarine monitoring because it is tested in solid phase, is sensitive and can be tested at ambient salinity.

Only preliminary analyses have been completed on data from the gradient study but these analyses seem to indicate that: 1) toxicity was greater in deep samples, 2) this toxicity was not caused by high levels of ammonia or hydrogen sulfide, 3) toxicity tests were able to distinguish between stations, 4) field replicates were more variable than laboratory replicates, 5) three laboratory replicates may be sufficient to distinguish between stations, 6) in the bivalve larvae test, porewater samples were much more toxic than elutriate samples from the same sediment, 7) abnormality in the bivalve larvae test was highly correlated with abnormality in the sea urchin test, 8) abnormality in neither the urchin or bivalve test were correlated with the sea urchin fertilization test, and 9) sampling cores may be suitable containers for conducting amphipod tests.

For the water column portion of the Bay Monitoring surveys, monitoring of organic contaminants and toxicity was conducted at 15 and 12 stations, respectively, within the Estuary in June 1991 and April 1992. The results of the organic contaminant monitoring will be available in January 1993. Toxicity testing indicated statistically significant toxicity during the first sampling event at two stations. Each station had significant toxicity in one toxicity test. There was no significant toxicity in the second sampling event.

Investigations of toxicity in the water column of critical habitats detected toxicity in both the DUST system and Arrowhead Marsh following storm events. The DUST system was further investigated to study the fate of toxicity in the receiving waters following storm events of different intensity.

Bioaccumulation results indicated that: 1) bivalves at most of the stations within San Francisco Bay accumulated contaminant levels that were significantly higher than the controls collected at sites in more pristine locations outside of the Bay, 2) stations in the South Bay, especially Coyote Creek, were significantly higher than the Central or Northern Bay stations for DDT, PCBs, chlordane and PAHs, 3) Stations in the South and Central Bays were significantly higher than the North Bay for silver, 4) there were no significant differences in contaminant levels between wet and dry seasons, 5) there were no significant differences between mussels deployed near the surface and those deployed near the bottom, 6) a small number of metals at each station were significantly different between depurated and undepurated mussels, 7) an equilibrium appeared to be reached in mussels during the three and four month transplants for copper, mercury, lead, selenium, and chlordane, but no equilibrium was reached for silver, PCBs and possibly DDT after 120 days, 8) the patterns exhibited for DDTs, PCBs, and chlordanes for deploment time experiments were similar indicating a similar source of these compounds and 9) oysters and mussels exhibited similar concentrations of chlordane, DDT and PCBs but PAHs differed and all metals differed greatly between the two species.

Although all of the data from the program has not been thoroughly analyzed, there are already several major accomplishments of the RMP: 1) a Baseline Program has been established which will start in 1993, using the techniques and protocols evaluated during the RMP, to measure temporal and spatial trends in chemistry, toxicity and bioaccumulation throughout the San Francisco Estuary on an ongoing basis, 2) toxic hot spots were identified throughout the Bay and in critical habitat areas, 3) most of the marshes and mudflats in the Estuary were surveyed for chemical contamination and toxicity, 4) as the first step in setting up a statewide database, a format was generated for data and laboratories in the Bay Protection Program were trained to use these formats so that data could be easily checked for quality assurance, and integrated for statistical analysis, 5) data generated in this program can be combined with other data to generate Apparent Effects Threshold (AET) values for San Francisco Bay and 6) problems in identifying toxic hot spots and generating sediment quality criteria were identified and future studies were recommended to make the program more scientifically rigorous and provide more certainty in the final results (see Recommendations for Future Studies).

Besides the Regional Monitoring Program, studies are also underway supporting the development of a wasteload allocation for South San Francisco Bay. In the first phase, a predictive water quality model was developed based on available water quality and hydrodynamic data, using EPA model WASP4. The second phase includes collection of time series of suspended sediment data to improve the ability to model transport of pollutants associated with sediments.

3. Central Coast Regional Water Board (Region 3)

The Central Coast Region contains a highly valued water body Monterey Bay, that, in places, has been contaminated by pesticides. It is also the only region which will test ocean waters for toxic hot spots. The RMP identified the following water bodies as highest priority for BPTCP monitoring:

Monterey Bay
Morro Bay
San Lorenzo River estuary
Soquel lagoon
Pajaro River estuary
Bennett Slough
Elkhorn Slough
Salinas River lagoon
Santa Ynez River estuary
Santa Maria River estuary
Goleta Slough
Carpinteria Marsh
Santa Cruz Yacht Basin
Monterey Yacht Club
San Luis Harbor
Santa Barbara Harbor

Four sources of information were used in listing potential toxic hot spots: (1) State Mussel Watch results (SWRCB, 1991); (2) DFG TBT data (Stephenson et al., 1988); (3) Toxic Substances Monitoring Program (TSMP) data (SWRCB, 1992); and several pesticide studies conducted by Moss Landing Marine Laboratories for the regional board (Oakden and Oliver, 1988; CCRWQCB, 1992). Additional sites were specified as either high risk (e.g., storm drains) or low risk. Two sites were also sampled to measure contamination in fish tissue. Figure 7 in Chapter II illustrates the location of these sites. The following list of sites will be screened for toxicity.

Site	Already Sampled	Purpose
1. Santa Cruz Yacht Basin	+	Potential Hot Spot
2. Monterey Yacht Club	+	"
3. Santa Barbara Harbor	+	"
4. M. L. Yacht Harbor (SMW 401.3)	+	"
5. M. L. South Harbor (SMW 403.5)	+	"
6. Pajaro River estuary (SMW 401.2)	+	"
7. Sandholt Bridge (SMW 404.0)	+	"
8. San Luis Harbor Trans (SMW 445.0)	+	"
9. Goleta Sl. (SMW 460.2)	+	"
10. Carpinteria Marsh (SMW 475.0)	+	"
11. Salinas River lagoon	+	"
12. Monterey stormdrain no. 1	+	High risk site
13. Monterey stormdrain no. 2	+	"
14. Monterey stormdrain no. 3	+	"
15. Fort Ord stormdrain no. 1		"
16. Fort Ord stormdrain no. 2		"
17. Fort Ord stormdrain no. 3		"
18. Fort Ord stormdrain no. 4		"
19. San Lorenzo River estuary		"
20. Santa Maria River estuary	+	"
21. Santa Ynez River estuary	+	"
22. Soquel lagoon	+	"
23. Bennett Sl./estuary	+	"
24. Morro Bay	+	"
25. Relatively uncontaminated channels in Elkhorn Slough and Morro Bay where some tidal flushing occurs but is not strong enough to remove fine grained sediment	+ + +	Reference site

26. Relatively uncontaminated coastal lagoons, river mouths, etc. (e.g.,		
a. Bennett Slough		"
b. Watersheds above Santa Cruz unimpacted by pesticides	+	"
c. Northeastern Monterey Bay	+	"
d. Watersheds south of San Simeon	+	"

Lower priority potential hot spots and high risk sites will be sampled in upcoming years on a funds available basis. Monitoring will occur over several years.

4. Los Angeles Regional Water Board (Region 4)

Given the presence of pesticides, metals, and other synthetic organic chemicals in Los Angeles Harbor, this area probably contains the greatest mix of contaminants of any Region. Monitoring here will occur over several years. Mugu Lagoon, a site contaminated almost exclusively by pesticides, is located here. The RMP identified the following water bodies as highest priority for BPTCP monitoring:

Los Angeles Inner Harbor
Long Beach Inner Harbor
San Pedro Bay
Mugu Lagoon
Port Hueneme
Marina Del Rey Harbor
Malibu Lagoon
Alamitos Bay
Los Angeles River estuary
Queensway Bay
King Harbor
Colorado Lagoon
Los Cerritos Channel tidal prism and wetlands
Shoreline Marina
Ventura Marina
Ventura River estuary
Channel Islands Harbor
Ballona Creek
Santa Clara River estuary
Sim's Pond
McGarth Lake estuary

Within these water bodies a variety of sources of information were used to document potential toxic hot spots, (1) including State Mussel Watch results (SWRCB, 1991); (2) DFG TBT data (Stephenson et al., 1988); (3) OEHHA chemical analysis of fish tissue (Pollock et al., 1991); and (4) histopathological analysis of fish surface water microlayer toxicity, chemical analysis of sediment cores and surface samples, benthic community analysis, chemical analysis of water column samples, and sediment toxicity (LARWQCB, 1992). Additional sites were specified as either high risk (due to marina and agricultural activies) or relatively uncontaminated, low risk sites. One site was also sampled to measure contamination in fish tissue. Figure 9 in Chapter II illustrates the location of these sites. The following list of sites will be screened for toxicity:

Site	Already Sampled	Purpose
1. Southwest Slip, LA Harbor (SMW 602.5)*		Potential Hot Spot
2. GATX Berth 120, LA Harbor (SMW 621.0)*		"
3. West Basin, LA Harbor (SMW 602.0)*		"
4. Turning Basin, LA Harbor (SMW 603.0)*		"
5. East Basin, LA Harbor (SMW 601.0)*		"
6. Consolidated Slip, LA Harbor (SMW 616.0)*		"
7. Commercial Marine, LA Harbor (SMW 622.0)*		"
8. Inner Harbor, LB Harbor (SMW 613.0)*		"
9. Queensway Bay, LB Harbor (SMW 609.4)*		"
10. Los Cerritos Channel, Alamitos Bay (SMW 626.0)*		"
11. Los Cerritos Channel tidal prism and wetlands	+	"
12. Port Hueneme - Wharf B (SMW 506.1)	+	"
13. Port Hueneme - Wharf 1 (SMW 506.2)	+	"

14. Marina Del Rey (site of 1987 chronic toxicity)	+	"
15. King Harbor (Basin 1 boatyard site of high levels of metals and TBT in 1987)		"
16. Mugu Lagoon, Main Lagoon (SMW 507.3)	+	"
17. Colorado Lagoon (SMW 701.2)	+	"
18. Malibu Lagoon (site of USGS findings of pesticides in sed)	+	"
19. Los Angeles River estuary (site of 1988 dredge data)		"
20. Shoreline Marina (site of late 1980s reports of metals and TBT sediment contamination)	+	"
21. Ventura Marina	+	High risk site
22. Ventura River estuary	+	"
23. Channel Islands Harbor	+	"
24. Ballona Creek (wet and dry period)	+	"
25. Santa Clara River estuary	+	"
26. Sim's Pond	+	"
27. McGarth Lake estuary	+	"
28. Anderson et al. (1988) site 12 (60m, low fines, low TOC)		Reference site
29. Swartz et al. (1986) site 9 (60m, high fines, low TOC)		"
30. Thompson et al. (1987) site R15 (30m, high fines, low TOC)		"
31. Thompson et al. (1987) site R15 (60m, high fines, low TOC)		"
32. Word and Mearns (1979) site 12 (60m, high fines, low TOC)		"
33. Word and Mearns (1979) site 13 (60m, low fines, low TOC)		"
34. Word and Mearns (1979) site 14 (60m, high fines, low TOC)		"
35. Word and Mearns (1979) site 15 (60m, high fines, low TOC)		"
36. Word and Mearns (1979) site 16 (60m, high fines, low TOC)		"
37. Relatively uncontaminated coastal lagoons (e.g., Santa Monica Mts Nat'l Rec. Area)	+	"

* Pending the results of other testing (i.e. if NOAA samples do not demonstrate toxicity, screening will be conducted at the more appropriate SMW site as indicated; if they do, these sites will be replaced with additional stations).

Lower priority potential hot spots and high risk sites will be sampled in upcoming years on a funds available basis.

5. Central Valley Regional Water Board (Region 5)

The portion of the Sacramento-San Joaquin Delta in the Central Valley Region is predominantly a freshwater system. The RMP identified as high priority water bodies (1) all major river inputs to the Delta; (2) many minor inputs; (3) areas critical to an understanding of the movement of pollutants across the Delta; and (4) areas adjacent to within-Delta that contain sources of contaminants. Within these water bodies, a variety of sources of information (summarized in Montoya, 1991) were used to document the potential toxic hot spots listed in the consolidated database discussion: (1) TSMP results; (2) metals levels in water from the U.S. Geological Survey (USGS); (3) California Department of Water Resources (DWR) and other sources; (4) pesticide levels in water from DWR and the Regional Board; (5) butyltin levels in water; (6) water toxicity data; and (7) sediment contaminant levels. Additional sites were specified as high risk due to the presence of agricultural activities and point and nonpoint sources of metals. The following list of sites will be screened for either water toxicity or metals levels in water (a sediment toxicity screening task order is currently under development). Figure 8 in Chapter II illustrates the location of these sites.

Site	Purpose: Potential Hot Spot	Purpose: High Risk
1. Sacramento River at Hood (t,m)*	x	
2. Mokelumne River at New Hope Rd. (t,m)		x
3. San Joaquin River at Vernalis (t,m)	x	
4. Elk Slough (t)		x
5. Ulatis Creek (t)		x
6. Hog Slough (t)		x
7. Bear Creek at Shima Tract (t)		x
8. San Joaquin River downstream of Mormon Slough (t,m)	x	
9. French Camp Slough (t)		x
10. Paradise Cut (t)	x	
11. Ryer Island main drain (t)		x
12. Twitchell Island main drain (t)		x
13. Bouldin Island main drain (t)		x
14. Middle Roberts Island (t)		x
15. Old River at Tracy Road (t)		x
16. Sacramento River downstream of Rio Vista (t,m)	x	
17. Sacramento River at Isleton (t)		x
18. Cache Slough between Prospect Slough and the Sacramento Deep Water Ship Channel (t,m)		x
19. North Bay Aqueduct at pumping plant (t)		x
20. Franks Tract (t,m)		x
21. Middle River at Woodward Island (t)		x
22. Delta Mendota Canal at pumping plant (t)		x
23. California Aqueduct at pumping plant (t)		x
24. Mokelumne River upstream of Cosumnes R. (m)		x
25. Cosumnes River upstream of Mokelumne R. (m)		x
26. Calaveras River (m)		x
27. Clifton Court Forebay (m)		x
28. Marsh Creek (m)		x
29. San Joaquin River downstream of Antioch (m)		x

* t = water toxicity testing
m = water metals analysis

6. Santa Ana Regional Water Board (Region 8)

The Santa Ana Region is distinguished by having the heaviest concentration of toxicity testing on a per-area basis. The RMP identified Anaheim Bay, Newport Bay, and Huntington Harbour as the water bodies with the highest priority for BPTCP monitoring. Within these water bodies several sources of information (summarized in SARWQCB, 1991) were used to document the potential toxic hot spots listed in the consolidated database discussion above: (1) sediment contamination data; (2) TSMP results; (3) other tissue contaminant levels, (4) State Mussel Watch; and (5) DFG TBT levels. Additional sites were specified as either high risk (due to the presence of exploratory oil drilling and urbanization), low risk, or random sites. One site was also sampled to measure contamination in fish tissue. Figure 9 in Chapter II illustrates the location of these sites. The following list of sites will be screened for toxicity.

Site	Already Sampled	Purpose
1. Anaheim Bay - Navy Marsh (SMW 708.0)	+	Potential Hot Spot
2. Anaheim Bay - Navy Marsh #2 (SMW 708.5)	+	"
3. Anaheim Bay - Entrance (SMW 709.0)	+	"
4. Anaheim Bay - Fuel Docks South (SMW 710.2)	+	"
5. Huntington Harbour - Launch Ramp Docks (SMW 711.0)	+	"
6. Huntington Harbour - Peter's Landing (SMW 712.0)	+	"
7. Huntington Harbour - Edinger St. (SMW 713.0)*		"
8. Huntington Harbour - Warner Ave. Bridge (SMW 715.0)*		"
9. Huntington Harbour - Harbor Lane (SMW 717.0)	+	"
10. Newport Bay - Entrance (SMW 721.0)		"
11. Newport Bay - Police Docks (SMW 722.0)		"
12. Newport Bay - El Paseo Drive (SMW 722.4)		"
13. Newport Bay - Bay Island (SMW 723.0)		"
14. Newport Bay - Turning Basin (SMW 723.4)		"
15. Newport Bay - Highway 1 Bridge (SMW 724.0)		"
16. Newport Bay - Dunes Dock (SMW 724.4)		"

17. Newport Bay - Rhine Channel (SMW 726.4)		"
18. Newport Bay - Bahia Corinthian Yacht Club (SMW 735.0)		"
19. Upper Newport Bay (San Diego Creek sediment depositional area)		"
20. Seal Beach NWR - Nasa Is.	+	High risk site
21. Seal Beach NWR - Hog Is.	+	"
22. Seal Beach NWR - Sunset Aquatic Pk.	+	"
23. Seal Beach NWR - Bolsa Ave.	+	"
24. Bolsa Bay - Mouth of East Garden Grove-Wintersburg Flood Control Ch.	+	"
25. Mouth of Huntington Beach Channel		"
26. Mouth of Santa Ana River		"
27. Newport Beach - Prospect Street		"
28. Newport Bay - mouth of Delhi Ch.		"
29. Newport Bay - Newport Is.		"
30. Anaheim Bay - Naval Reserve	+	"
31. Thompson et al. (1987) site R50 (30m, high fines, low TOC)		Reference site
32. Thompson et al. (1987) site R54 (30m, high fines, low TOC)		"
33. Thompson et al. (1987) site R57 (30m, low fines, low TOC)		"
34. Word and Mearns (1979) site 50 (60m, high fines, low TOC)		"
35. Word and Mearns (1979) site 55 (60m, high fines, low TOC)		"
36. Word and Mearns (1979) site 56 (60m, high fines, low TOC)		"
37. Word and Mearns (1979) site 57 (60m, high fines, low TOC)		"
38. Word and Mearns (1979) site 58 (60m, high fines, low TOC)		"
39. Bolsa Chica Ecological Reserve	+	"
40. Seal Beach NWR	+	"
41. Relatively uncontaminated channels in Anaheim and Newport Bays where some tidal flushing occurs but is not strong enough to remove fine grained sediment		"
42. Newport Bay		Random site
43. Newport Bay		"
44. Newport Bay		"

* Pending the results of other testing (i.e. if NOAA samples do not demonstrate toxicity, screening will be conducted at the more appropriate SMW site as indicated; if they do, these sites will be replaced with additional stations).

Lower priority potential hot spots and high risk sites will be sampled in upcoming years on a funds available basis.

7. San Diego Regional Water Board (Region 9)

The San Diego Region is noteworthy for the large presence of the U.S. Navy shipyard facilities. Another distinguishing factor is that considerably more sediment chemistry data has been produced by this region than the others. The RMP identified 28 water bodies, ranging from high to low risk of contamination, for BPTCP monitoring. Within these water bodies a variety of sources of information (summarized in SDRWQCB, 1992) were used to document the potential toxic hot spots listed in the consolidated database discussion above: (1) State Mussel Watch results; (2) DFG TBT data; (3) sediment toxicity testing results; (4) sediment chemistry data; and (5) tissue contamination results. One site was also sampled to measure contamination in fish tissue. Figure 9 in Chapter II illustrates the location of these sites. The following list of sites will be screened for toxicity (the description of the site is often a citation to an earlier study and site ID number):

Site	Already Sampled	Purpose
1. 11 (Swartz et al., 1987)	+	Potential Hot Spot
2. 12 "	+	"
3. 14 "	+	"
4. 15 "	+	"
5. 21 "	+	"
6. 23 "	+	"
7. 25 "	+	"
8. 27 "	+	"
9. 28 "	+	"
10. 31 "	+	"
11. 33 "	+	"
12. 34 "	+	"
13. 37 "	+	"
14. 38 "	+	"
15. 41 "	+	"
16. 42 "	+	"
17. C (de Lappe et al., 1988)	+	"
18. D "	+	"
19. E "	+	"
20. G "	+	"
21. K "	+	"
22. P "	+	"
23. NM (SANDAG, 1992)	+	"
24. SDNI-N1 "	+	"
25. SDNI-N5 "	+	"
26. SDNI-N18 "	+	"
27. NSB-S1 "	+	"
28. NSB-M1 "	+	"
29. NSB-R1 "	+	"
30. BF (Schroeder, 1989 site F)	+	"
31. BG " G	+	"
32. BM " M	+	"
33. Dana Pt. Boatyard (SMW 740.0)		"
34. Oceanside Boatyard (SMW 748.0)		"
35. M. Bay Harbor Police (SMW 873.5)		"
36. Stormdrain EA (Rohr Channel)	+	"
37. Stormdrain EM (Grape Street)	+	"
38. CC	+	"
39. CL	+	"
40. Sweetwater Marsh, SD Bay	+	High risk site
41. South SD Bay wetlands (Otay R.)	+	"
42. Central Mission Bay		"
43. Coronado Wharf	+	"
44. Kendall-Frost Mission Bay Marsh		"
45. Del Mar Boat Basin		"
46. San Diego River estuary		"
47. Famosa Slough		"

48. 6 (Swartz et al., 1987)	+	Reference site
49. 8B "	+	"
50. 10 "	+	"
51. 16 "	+	"
52. 32 "	+	"
53. 35 "	+	"
54. 36 "	+	"
55. 43 "		"
56. 8A "	+	"
57. 5 (SDG&E, 1992)	+	"
58. 7 "	+	"
59. Anderson et al. (1988) site 22 (high fines, low TOC)		"
60. Thompson et al. (1987) site R60 (30m, low fines, low TOC)		"
61. Thompson et al. (1987) site R71 (30m, low fines, low TOC)		"
62. Thompson (unpublished) site 203 (60m, high fines, ?)		"
63. Thompson (unpublished) site 205 (60m, high fines, ?)	+	"
64. Word and Mearns (1979) site 62 (60m, high fines, low TOC)		"
65. Word and Mearns (1979) site 63 (60m, high fines, low TOC)		"
66. Word and Mearns (1979) site 64 (60m, high fines, low TOC)		"
67. Word and Mearns (1979) site 65 (60m, high fines, low TOC)		"
68. Word and Mearns (1979) site 68 (60m, high fines, low TOC)		"
69. Word and Mearns (1979) site 69 (60m, high fines, low TOC)		"
70. Word and Mearns (1979) site 71 (60m, low fines, low TOC)		"
71. Relatively uncontaminated channels in San Diego and Mission Bays where some tidal flushing occurs but is not strong enough to remove fine grained sediment	+ + +	"
72. Relatively uncontaminated coastal lagoons (see random sites below)		"
73. San Dieguito Lagoon		Random site
74. Los Penasquitos Lagoon		"
75. San Elijo Lagoon		"
76. Batiquitos Lagoon		"
77. Santa Margarita Lagoon		"
78. Buena Vista Lagoon		"

79.	Agua Hedionda Lagoon	"
80.	Tijuana River Estuary	"
81.	Loma Alta Slough	"
82.	San Onofre Creek	"
83.	San Mateo Creek estuary	"
84.	San Juan Creek	"
85.	San Luis Rey River estuary	"
86.	Las Flores Creek estuary	"
87.	Aliso Creek	"
88.	Stratefied random site in SD Bay	"
89.	"	"
90.	"	"
91.	"	"
92.	"	"
93.	"	"
94.	"	"
95.	"	"
96.	"	"
97.	Strat. random site in Mission Bay	"
98.	"	"
99.	"	"
100.	"	"

B. Preliminary Results of Monitoring

Table 13 summarizes BPTCP monitoring activities that have been performed through March, 1993 for both screening and NOAA cooperative agreement sites. As indicated, toxicity test results have been reported for a large number of stations while chemistry data are available for a somewhat smaller number. Due to both the agreement with NOAA and the additional test results that are required to qualify sites as Toxic Hot Spots, release of specific unverified data at this time is premature.

Table 13

Monitoring Activities as of March, 1993*

Monitoring Activity	Number
Number of stations sampled**	> 400
Toxicity tests completed	> 1100
Chemical analyses completed (stations)	45
Benthic analyses begun (stations)	93
Bioaccumulation analyses begun (stations)	14
Biomarker analyses begun (stations)	6

* Exclusive of the San Francisco Bay Region.
** Includes repeated collections at a few stations for quality assurance purposes.

CHAPTER V

CONSOLIDATED DATABASE FOR TOXIC HOT SPOTS

Introduction

The Water Code requires the BPTCP to: (1) develop a database of water and quality data; (2) identify the location of toxic hot spots based on the database; and (3) develop sediment quality objectives, also based on data stored in the database. To comply, the State Water Board staff and Regional Water Board staff are developing a comprehensive statewide computer database that identifies existing and potential toxic hot spots.

A. Consolidated Database Functions

The proposed BPTCP consolidated database includes:

- An automated system that includes known and potential toxic hot spots. Data in the database will be reviewed periodically, and lists of potential or known toxic hot spots produced, from analysis of bioassay work, and/or biological community investigations. Geographical Information System (GIS) maps will be produced showing all monitoring stations with elevated data levels, impacted marine communities, and impaired organisms, health closures, and other toxicity indicators.

- Hot spot ranking criteria. The system could provide draft ranked lists of toxic hot spots. Regional and State Water Board reviewers of the ranked hot spot lists will receive BPTCP data system reports summarizing the characteristics of each identified hot spot, as well as GIS illustrations of the respective site's location, areal extent (if available), and toxicity or other environmental impacts.

- Quantitative and qualitative analysis of data, including statistical analysis of chemical, biological, and ecological data.

- Support for customized reports. The reports will contribute to the development of sediment quality objectives, Regional Monitoring Plans, and prevention and remediation strategies.

- Summary reports detailing the analytical results of both 'historic' and more recent monitoring efforts. These reports will provide critical and timely information for public review and for use in program progress reports.

- The system will be used to help identify the most likely sources of discharge and for diagnostic and cleanup planning. The GIS will be used to assess geographical and hydrographic relationships, and to identify potential sources contributing to toxic hot spots.

- Formal BPTCP reports. Illustrated reports with BPTCP system-derived GIS maps will be provided, showing the location, areal extent, and toxicity problems related to individual toxic hot spots. Additional tabular or graphical data summarizing important attributes of each toxic hot spot will also be provided by the system.

- The capability to interface with data management and information needs of other State and Regional Water Board programs.

- Support for development of wasteload allocations and to identify relative contributions from multiple sources. This information will be useful in geographic areas requiring regulatory action. These analyses will be supported by geographic and hydrographic reviews of the watersheds influencing the bays and estuaries in question.

B. Analysis of System Alternatives

State Water Board and Teale Data Center (TDC) staff completed the BPTCP consolidated database Feasibility Study Report (FSR) in February, 1992 (SWRCB, 1992c). After reviewing the program's data, quality assurance, and GIS needs, three possible system designs (with one variation), were proposed:

1. Independent Regional and State Water Board stand-alone (personal computer) database systems;

2. STORET mainframe database;

3. Centralized database server with remote clients;

A. A database server at the State Water Board with clients at the Regional Water Boards; or

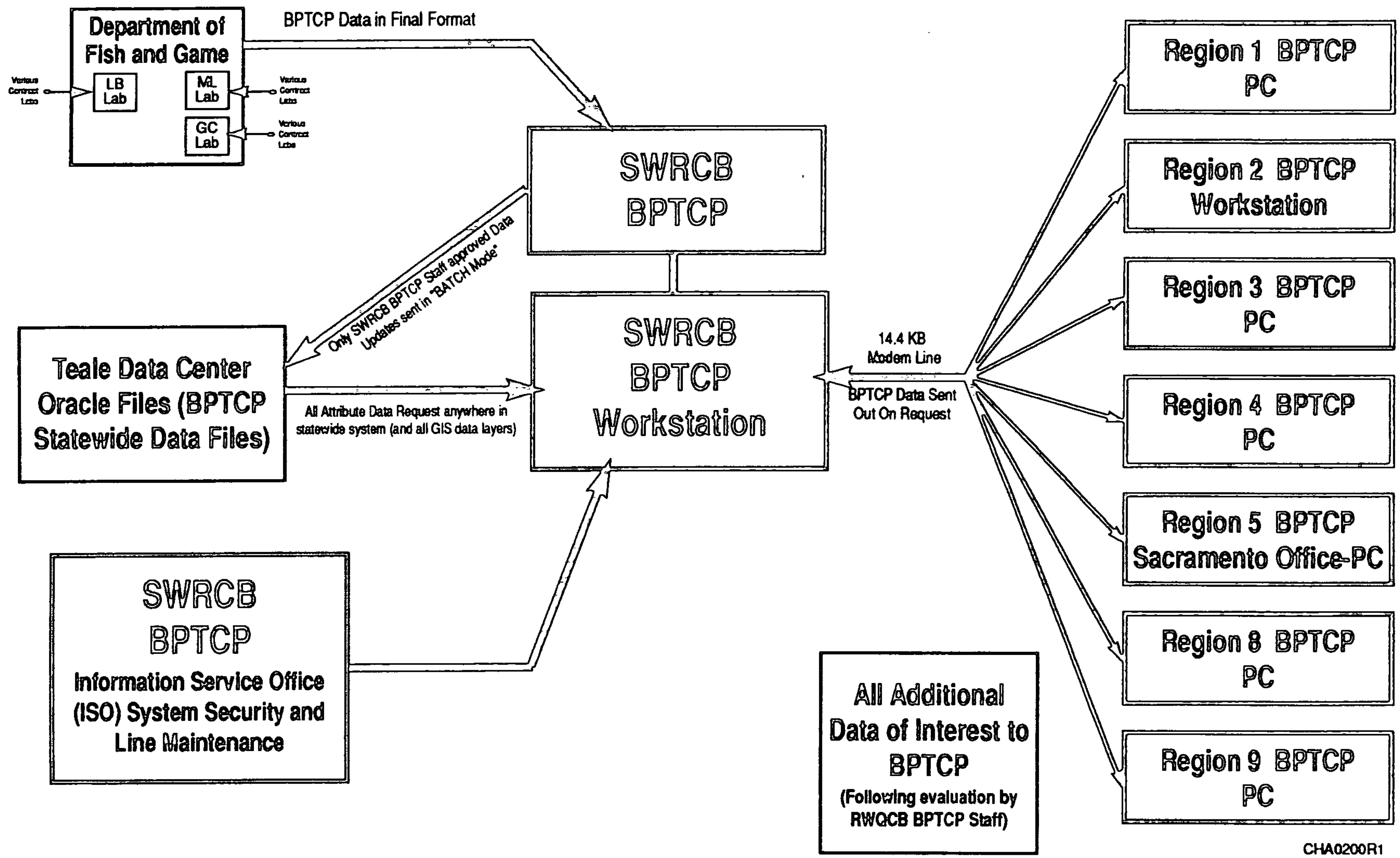
B. A database server at TDC with clients at the State and Regional Water Boards.

Option 3B was chosen above Alternatives 1 and 2 because of their inherent coordination and limited data access problems. Option 3B includes workstations at the State Water Board and San Francisco Bay Regional Water Board and 486 modem-equipped PCs at the other Regional Water Boards (Figure 10). For GIS capability, a network connection to TDC a subscription to the TDC GIS library, and purchase of ARC/INFO GIS software was chosen. The network connections include a dedicated line from TDC to the State Water Board BPTCP and modem connections to the Regions and to the Department of Fish and Game's Marine Pollution Studies Laboratory. Most of the BPTCP-generated analytical results will be sent by modem from the DFG Granite Bay Laboratory to the State Water Board for quality assurance review before being uploaded onto the BPTCP data files located at TDC.

With this system, State and Regional Water Board offices in the program will have full access to all data in the system, including use of efficient and customized query and analytical tools. The State Water Board and the San Francisco Bay Regional Water Board staff will have full GIS capability, while other Regions will be able to view and analyze geographic and hydrographic data on screen. All offices will be able to view and analyze monitoring data in a hydrographic context.

Figure 10

Statewide Bay Protection and Toxic Cleanup Program Consolidated Data System Data Flow Diagram



C. Services to be Provided by the Teale Data Center

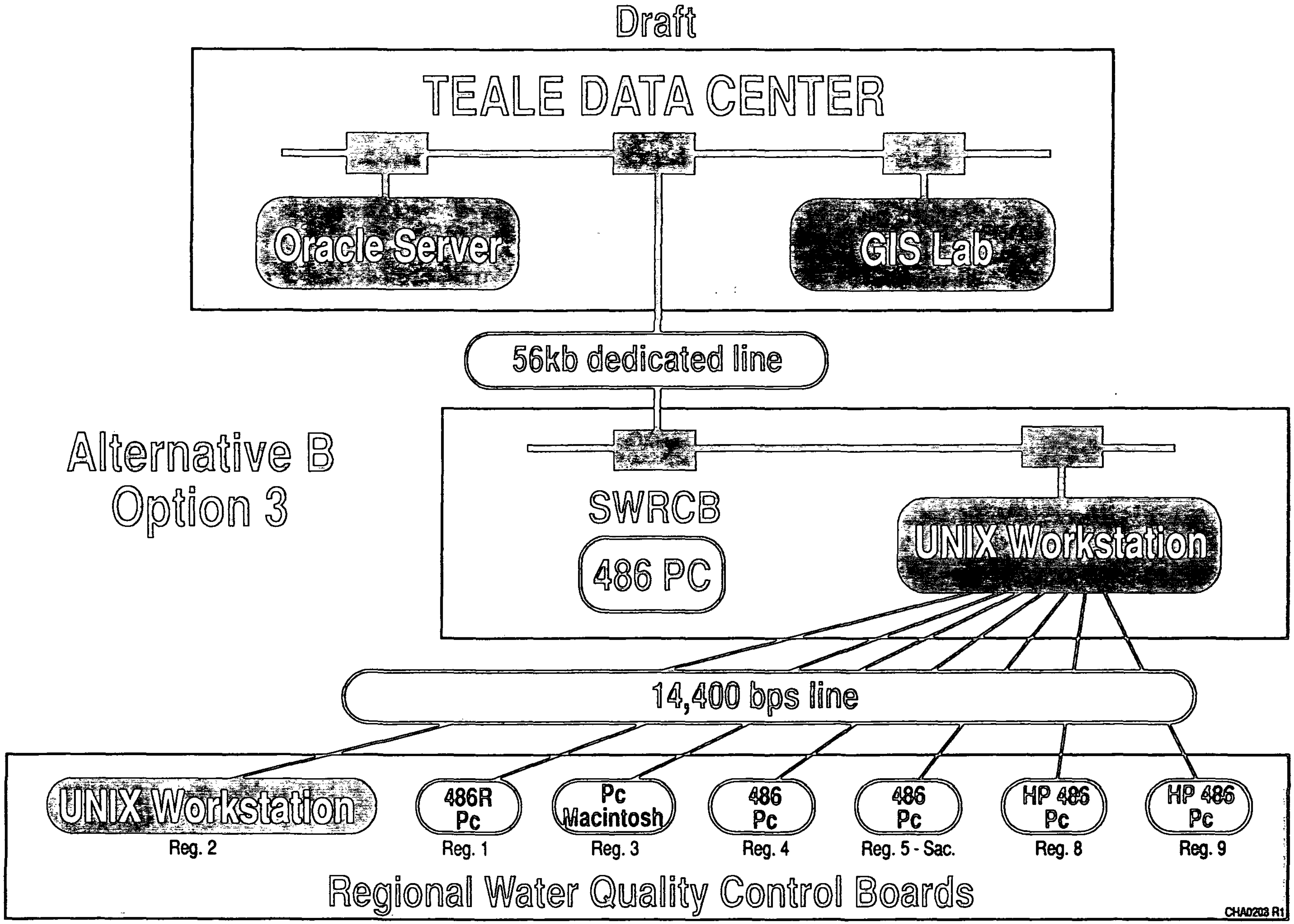
In February 1993, the State Water Board and the TDC entered into an interagency agreement to procure the necessary hardware, software and technical assistance to implement the BPTCP data system (Figure 11). The following tasks will be performed by TDC in the BPTCP/TDC technical services interagency agreement:

1. TDC will provide expert design review and practical evaluation of the proposed data structure for the consolidated database. This proposed design will be developed by State Water Board and San Francisco Bay Regional BPTCP staff and contractor(s). TDC staff's greater familiarity with Oracle software (TDC's Relational Database Management System) (RDBMS) will allow TDC to provide an oversight role in the BPTCP consolidated database design stages.

2. TDC is procuring the necessary workstation hardware and GIS/RDBMS software and licenses to implement the statewide BPTCP system. Lower cost, compatibility of equipment, access to TDC staff experience are some of the advantages for the BPTCP to participating in group equipment purchases and software licenses.

3. All State Water Board water quality monitoring data germane to the BPTCP program has already been acquired by the BPTCP staff and converted to a single data structure. This data includes monitoring data from the Toxic Substances Monitoring Program (TSMP) and the State Mussel Watch (SMW) Program. In addition, TDC and other contractors will continue to assist

Figure 11


Draft
TEALE DATA CENTER
Oracle Server
GIS Lab
56kb dedicated line
Alternative B
Option 3
SWRCB
486 PC
UNIX Workstation
14,400 bps line
UNIX Workstation
Reg. 2
486R Pc
Reg. 1
Pc Macintosh
Reg. 3
486 Pc
Reg. 4
486 Pc
Reg. 5 - Sac.
HP 486 Pc
Reg. 8
HP 486 Pc
Reg. 9
Regional Water Quality Control Boards
CHA0203 R1

BPTCP staff in converting all the expected types of analytical data generated by specific BPTCP monitoring efforts into standardized data file formats to be uploaded to Oracle tables at TDC. These data files will be maintained by Teale Data Center. Additional relevant bay and estuary water quality data continues to be identified and assembled statewide by Regional Water Board BPTCP staff. Eventually, this data will also be uploaded onto the data files housed at TDC. Efforts to build the consolidated statewide BPTCP data files will include a majority of data conversion (automated revisions to data format), and some data entry.

4. TDC is be responsible for bringing the statewide BPTCP network on line. After procuring needed equipment and software, TDC will install the dedicated line to the State Water Board offices. The SWRCB Information Services Office (ISO) will oversee the dedicated line installation and continue to provide troubleshooting and maintenance services for the line. TDC and ISO staff will configure and install Unix workstations at both the BPTCP State Water Board and San Francisco Bay Regional Water Board offices. The ISO will also maintain the BPTCP workstations, except for those activities which cannot be performed from a remote site (in Sacramento) for the San Francisco Bay Regional Water Board workstation.

   TDC will install ARC/INFO (GIS software) and Oracle tools (RDBMS) software on the workstations at the State Water Board and the San Francisco Bay Regional Water Board. The other Regional Water Board offices will have access to Oracle software for data retrieval and analytical work with water quality monitoring data. Regional Water Boards will also have PC ARCVIEW, a GIS software suitable for viewing geographic data and performing simple to intermediate GIS analyses.

5. TDC will oversee implementation of the GIS applications. Responsibilities include managing BPTCP access to and use of data layers in Teale's GIS library. TDC will also manage the connection between the specific GIS data layers and BPTCP monitoring data stored on the Oracle tables. Specific GIS application menus for use by BPTCP statewide staff will be designed by BPTCP staff and EcoAnalysis, Inc. TDC and the ISO will provide local technical support staff to assist State Water Board and Regional staff with any problems encountered in using ARC/INFO or PC ARCVIEW, Oracle, or the dedicated line which connects the system to TDC. ISO will maintain the Unix workstations and advise on system security.

6. State Water Board staff, with the assistance from contractors, will develop user interfaces and custom routines to standardize and simplify Regional and State Water Board use of the RDBMS and GIS capabilities of the BPTCP consolidated data system. TDC will provide some oversight for these applications, as well as the connection between TDC's GIS library data layers and specific BPTCP monitoring data.

   The BPTCP GIS system user interfaces will include standard data entry screens for use by Regional Water Board staff, and menu driven GIS routines for the most frequently requested maps, plots, and related data queries.

7. The TDC will provide GIS and RDBMS training for State Water Board and San Francisco Bay Regional Board staff. TDC will establish training schedules and cost estimates for Unix, Oracle and ARC/INFO classes. State Water Board BPTCP staff will provide BPTCP program-related in-house training to BPTCP staff from the other Regions included in the program.

8. TDC will provide cost estimates for equipment and software to BPTCP State and Regional Water Board staff for GIS and/or RDBMS upgrades. The equipment includes, but is not limited to, higher speed modems, dedicated lines, X-Terminals, and desk-top pen plotters. The software includes, but is not limited to, PC ARC/INFO.

9. TDC will manage the BPTCP data files resident at TDC. File management tasks include performing data updates after data has passed quality assurance checks, keeping back-up copies of the data files, and providing BPTCP monitoring data and GIS data sets on demand over the dedicated line to the State Water Board. The data will either be used at the SWB or sent out over the network to the requesting Regional Water Board.

10. TDC will provide ongoing consulting services and general assistance for the overall implementation and management of the statewide BPTCP system. The ISO will provide system security advice, and maintain the dedicated line between TDC and the State Water Board Unix workstation.

11. TDC will provide State Water Board staff with the outline of a BPTCP Consolidated Database Operations Manual and will complete the appropriate technical chapters. This Manual will provide a detailed explanation of the operation and use of the entire BPTCP system, along with roles of TDC, DFG, State and Regional Water Board staff.

D. Database Funding

The interagency agreement with the TDC extends for a period of two years (latter half of FY 1992-93 and FY 1993-94) for a total of $201,000 ($155,000 in FY 1992-93; and $46,000 in FY 1993-94) from the Bay Protection and Toxic Cleanup Fund.

CHAPTER VI

TOXIC HOT SPOT RANKING CRITERIA

Introduction

The California Water Code, Section 13393.5, requires the State Water Board to develop and adopt criteria for the priority ranking of toxic hot spots in enclosed bays and estuaries. The criteria are to "take into account pertinent factors relating to public health and environmental quality, including but not limited to potential hazards to public health, toxic hazards to fish, shellfish, and wildlife, and the extent to which the deferral of a remedial action will result or is likely to result in a significant increase in environmental damage, health risks or cleanup costs." The role of the ranking criteria is to establish the order that work will be done at identified sites. Therefore, the exercise of ranking is not meant to provide exhaustive information on a site, but rather to use existing information to order the work yet to be done. This chapter reports the progress on developing site ranking criteria for the BPTCP.

The ranking criteria are not to be used to define a toxic hot spot. The determination of whether a site qualifies as a toxic hot spot is a separate and previous step. The BPTCP has established a detailed working definition of a toxic hot spot (Chapter II), which is consistent with the statutory definition contained in Water Code Section 13391.5. The working definition presented above is not proposed for adoption by the State Water Board at this time.

A. Approach for Developing Criteria

State Water Board staff reviewed various systems for prioritizing sites, including the Hazard Ranking System used by the U.S. Environmental Protection Agency and the Clean Water Strategy used by the State Water Board. None of the existing ranking systems served well to order the sites in light of the needs of the BPTCP. A new ranking system has been devised which more effectively serves the purposes of the program.

The site ranking criteria proposals were first discussed at the January 7, 1993 State Water Board Workshop. At that workshop, the State Water Board directed the staff to solicit public comment at a staff workshop. Staff workshops were held on January 26 and 28, 1993. The staff report (Appendix E) and the proposed ranking criteria have been revised to reflect comments received. The ranking criteria could be revised further and proposed as amendments to the California Enclosed Bays and Estuaries Plan.

B. Assumptions and Limitations of the Ranking Criteria

The Water Code Section 13393.5 requires that the ranking criteria take into account "pertinent factors relating to public health and environmental quality, including but not limited to, potential hazards to public health, toxic hazards to fish, shellfish, and wildlife, and the extent to which the deferral of a remedial action will result or is likely to result in a significant increase in environmental damage, health risks or cleanup costs."

In addition to the considerations stipulated in Water Code Section 13393.5, several assumptions were applied to the evaluation of the various alternative ranking systems:

1. Criteria should address broad programmatic priorities;

2. Criteria are to be used to organize internal work and program activities (i.e., the evaluation of the need to adjust permit limits or monitoring priorities);

3. Criteria are not designed to determine regulatory enforcement actions;

4. Ranking should be based on existing information at the time of ranking. Additional studies should not be required to prioritize known or potential toxic hot spots. Potential toxic hot spots will be identified and additional information will be needed before a potential site can be ranked as a known toxic hot spot;

5. Assessment of cost and feasibility of remedial actions for a site will be specifically considered in toxic hot spot cleanup plans. The types of actions and their presumed costs will also be considered;

6. The priority list will be revised periodically;

7. All other factors being equal, sites that are well characterized (i.e., significant amounts of available data) will rank higher than sites that are less well characterized (i.e., few available data and greater uncertainty about the site);

8. The best available scientific information will be used to evaluate the data available for site ranking;

9. Sites for which cleanup or remediation has been implemented but which retain toxic hot spot characteristics will only be considered for reranking if circumstances change that would allow for further reducing adverse impacts at the site. A list of sites that have been remediated without complete removal of toxic hot spot characteristics will be maintained; and

10. A site that has been remediated will be removed from the priority list.

These ranking criteria are intended to provide the relative priority of a site within the group of sites considered to be known toxic hot spots. Since not all sites will have the same scope and quality of information available at the time of ranking, this relative placement should be founded in measures of the potential for adverse impacts. The determination that some adverse impacts are occurring at the sites will have been made prior to the ranking and in accordance with the definition of a toxic hot spot. While the ranking should reflect the severity of the demonstrated adverse impacts, the full scope of ecological and human health impacts will likely not be characterized at the time of ranking, and therefore, should not be the goal of the ranking criteria. These impacts may be addressed as part of the activities conducted pursuant to the cleanup plans. The ranking criteria should provide a mechanism to discriminate among all those sites considered to be toxic hot spots (using the Water Code definition or other more specific definition) and thereby provide for a placement of each site relative to other sites under consideration.

The ranking criteria are not to be used to define cleanup actions or establish cleanup levels. The actions to be undertaken to cleanup or remediate a site will be developed on a case-by-case basis for each site. The considerations to be addressed at all sites, together with special considerations for each site, will be described in the cleanup plans required by Water Code Section 13394.

C. Preliminary Ranking Criteria

The State Water Board has revised the original proposal (SWRCB, 1993) for ranking criteria in response to comments received. The revised ranking criteria and the rationale for each section follow:

1. Weighted Ranking Criteria

a. Human Health Impacts

Potential Exposure:

(Select one of the following values)
Human Health Advisory issued for consumption of aquatic life from the site (5); Human Health advisory issued for sensitive populations consuming aquatic life from the site (4); Tissue residues in aquatic organisms exceed FDA/DHS action level or OEHHA trigger level (if available for the location) (3); Tissue residues in aquatic organisms exceed MTRL (2)

Potential Hazard: Multiply the exposure value selected by one of the following factors:

Pollutant(s) of concern is(are) known or suspected carcinogen[2] with a cancer potency factor or an other pollutant of concern with a reference dose (assign a value of 5); Pollutant(s) of concern is(are) not known or suspected carcinogens without a cancer potency factor or pollutant of concern without an RfD (3); other pollutants of concern (1).

B. Other Beneficial Use Impacts

i) Rare, threatened, or endangered species present: Select from the following the applicable circumstance with the highest value and one other value if applicable. Do not use any species twice:

Endangered species present at the site (assign a value of 5),
Threatened or rare species regularly present at the site (4),
Threatened or rare species occasionally present at the site (3).

Multiply each identified value by 2 if multiple species are present in any category. Add all resultant values for final score for this criterion.

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2 These are substances suspected of being carcinogenic as classified in the EPA Integrated Risk Information System (IRIS), by the Office of Environmental Health Hazard Assessment or by the Department of Health Services. A list of the substances proposed for use in the ranking system is provided in Appendix E.

ii) Demonstrated aquatic life impacts: Select one or more value(s):

Community impairments associated with toxic pollutants (assign a value of 5), Statistically significant toxicity demonstrated in chronic toxicity tests acceptable to the BPTCP (4) statistically significant toxicity demonstrated with acute toxicity tests acceptable to the BPTCP (3) Population or reproductive impairments documented (2) toxicity is demonstrated only occasionally and does not appear severe enough to alter resident populations (1).

Multiply each value by 2 if the demonstrated effects exceed 80 percent of the organisms in any given test or 80 Percent of the species in the analysis.

iii) <u>Chemical measures</u>[3]:

- o Tissue residues exceed NAS guideline (assign a value of 3), at or above State Mussel Watch Elevated Data Level (EDL) 95 (2), greater than State Mussel Watch EDL 85 but less than EDL 95 (1).

- o Water quality objective: Exceeded regularly (assign a value of 3), infrequently exceeded (2).

- o Sediment values (sediment weight of evidence guidelines recommended for State of Florida)[4]: Above the Probable Effects Level[5] (PEL) (3), between the NOEL[6] and PEL (2).

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3 The tissue residue guidelines and sediment values to be used in the ranking system should be the most recent version available. The guidelines and sediment values proposed for use in the ranking system are included in Appendix E. Water quality objectives to be used are found in the California Enclosed Bays and Estuaries Plan, Inland Surface Waters Plan or California Ocean Plan (depending on which plan applies). Where a regional water quality control plan (Basin Plan) contains a more stringent value than the statewide plan. In such a case, the regional water quality objective will be used.

For a substance with no calculated PEL: Above the effects range median[7] (ER-M) (2), between the effects range lowest 10 percent[7] (ER-L) and ER-M (1).

If multiple chemicals are above their respective EDL 85, water quality objective or sediment value, select the chemical with the highest value for each of the criteria. Add the values for the above to derive the initial value. Multiply the initial value by 2 if multiple chemicals are suspected of contributing to the toxic hot spot.

c. Areal Extent of Toxic Hot Spot

Select one of the following values:

More than 250 acres (assign a value of 10), 50 to 250 acres (8), 10 to less than 50 acres (6), less than 10 acres (4).

d. Pollutant Source

Select one of the following values:

Source of pollution identified (assign a value of 5), Source partially accounted for (3), Source unknown (2), Source is an historic discharge and no longer active (1).

Multiply by 2 if multiple sources are identified.

e. Remediation Potential

Select one of the following values:

Site is unlikely to improve without intervention (4), site may or may not improve without intervention (2), site is likely to improve without intervention (1).

Multiply the selected value by one of the adjustment factors listed below:

Potential for immediate control of discharge contributing to the toxic hot spot or development of source control/waste minimization programs (assign a value of 4), potential for implementation of an integrated prevention strategy involving multiple dischargers (3), site suitable for implementation of identified remediation methods (2). Not able to classify.

f. Involvement of multiple agencies

If government agencies other than the State or Regional Water Boards have interests in assessing or managing the site, assign a value of 10.

2. Rationale for Criteria

This section describes the rationale for each of the six criteria listed above:

a. Human Health Impacts

The human health impacts criterion has two parts: (1) an estimate of potential exposure; and (2) an estimate of potential hazard. For the exposure estimate the highest score is given if a general human health advisory has been issued. This type of advisory is an indication that aquatic life used for consumption is severely contaminated (i.e., the beneficial use is severely impaired). A human health advisory issued for a sensitive population (e.g., pregnant women, subsistence fisherpersons, etc.) is less severe than the general advisory because fewer people would generally be affected. The FDA/DHS action levels receive a lower score because these values do not take into consideration the site-specific factors of the risk assessments used for human health advisory issued for a site. A tissue residue level above the MTRL does not in itself demonstrate a water body impairment. MTRLs receive the lowest scores because they are established for a specific consumption rate (6.5 g/day for the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan and 23 g/day for the California Ocean Plan) and at a cancer risk level of one in one million.

The potential hazard factor assumes that the risk posed by known or suspected carcinogens with a cancer potency developed, or another pollutant of concern with a reference dose available, is greater than the risk posed by pollutants without a cancer potency or reference dose available. This is consistent with the approach taken in the Enclosed Bays and Estuaries Plan, the California Ocean Plan, and the Inland Surface Waters Plan, EPA methods for calculating water quality criteria, and the approaches of OEHHA and DHS.

b. Other Beneficial Use Impacts

This criterion combines the various factors that should be considered in evaluating impacts on water quality, sediment quality, aquatic life and wildlife.

i) Rare, threatened or endangered species

This criterion evaluates the occurrence of rare, threatened or endangered species at a known toxic hot spot. The highest value is assigned if an endangered species is present. Lower scores are assigned if threatened or rare species are regularly or occasionally present at the site. Association with endangered species is considered more severe than regular or occasional presence of rare or threatened species.

If multiple species in the specified categories are present, the value is multiplied by 2. This value was selected to reflect the additional complexity of the situation when more than one rare, threatened or endangered species is present.

ii) Demonstrated Aquatic Life Impacts

This criterion is a measure of aquatic life impact from the most severe conditions to less severe conditions. Measurements of actual marine or bay community or population reproduction impairment indicates that there is a direct impact. These kinds of impairments are difficult to measure and would only be measurable at the most highly impacted sites. Lower values are assigned to acute (short-term) and chronic toxicity (long-term or sensitive life stage tests) which serve as indicators of actual impacts. Occasional toxicity is given the lowest value because of the difficulty in interpreting these effects on aquatic life populations.

If multiple species are affected the value is multiplied by 2 to reflect a more severe condition. This multiplier is also applied if over 80 percent of the test organisms are affected. This factor will allow for distinctions to be made between moderate and more severe responses of organisms.

iii) Chemical Measures

This criterion has three parts: tissue residues, water quality objectives, and sediment values. As described in section ii of this criterion, if multiple chemicals are suspected of contributing to the known toxic hot spot then the sum of (i) through (iii) is multiplied by "2".

o Tissue Residues

Tissue residue levels are very difficult to evaluate in terms of impact on aquatic life, but some measures exist that can aid in interpreting chemical bioaccumulation in fish or shellfish tissue. The NAS (1972) has evaluated tissue residues for several chemicals. In this criterion, if an NAS guideline is exceeded the highest score is received. Elevated data levels (EDLs) from State Mussel Watch, are given lower values depending on whether the EDL is above 95 percent or 85 percent. EDLs are given lower scores because they do not measure actual effects on organisms. EDLs are included because State Mussel Watch information is generally available and these data are valuable in assessing the relative exposure of organisms to toxic pollutants.

- Water Quality Objectives

The "water quality objective" criterion gives a higher value when a water quality objective from the appropriate water quality control plan is exceeded frequently relative to the number of times sampled. If an objective is infrequently exceeded a lower score is given.

- Sediment Values

The inclusion of sediment values in evaluating chemical constituent concentrations deserves some clarification. A major focus of the Bay protection statutes is the assessment of sediment quality. Presently, a comprehensive collection of numeric values for toxic pollutants in sediment similar to water quality objectives does not exist. However, two related efforts have been completed that provide an overview of sediment quality: the National Oceanic Atmospheric Administration (NOAA) technical memorandum NOS OMA 52 (Long and Morgan 1990), and the sediment weight-of-evidence guidelines (Florida Coastal Management Program, 1993).

Long and Morgan (1990) assembled data from throughout the country for which chemical concentrations had been correlated with effects. These data included spiked bioassay results and field data of matched biological effects and chemistry. The product of the analysis is the identification of two concentrations for each substance evaluated. One level, the Effects Range-Low (ER-L) was set at the 10th percentile of the ranked data and was taken to represent the point below which adverse effects are not expected to occur. The second level, the Effects Range-Median (ER-M), was set at the 50th percentile and interpreted as the point above which adverse effects are expected. A direct cause and effect linkage in the field data was not a requirement for inclusion in the analysis. Therefore, adverse biological effects recorded from a site could be attributed to both a high concentration of one substance and a low concentration of another substance if both substances were measured at the site. The adverse effect in field data could be caused by either one, or both, or neither of the two substances of concern. This introduces a certain degree of ambiguity into the analysis.

Additionally, both fresh and salt water sites were included in the analysis and no attempt was made to distinguish between these two types of sites. Finally, sites not demonstrating any adverse effects were excluded from the derivation of the ER-L and ER-M.

The project funded by the State of Florida (1993) revised and expanded the Long and Morgan (1990) data set and then identified two levels of concern for each substance: the "NOEL" or no observable effect level, and the "PEL" or probable effect level. Some aspects of this work represent improvements in the original Long and Morgan analysis. First, the data was restricted to marine and estuarine sites, thereby removing the ambiguities associated with the inclusion of freshwater sites. Second, a small portion of the original Long and Morgan (1990) database was excluded, while a considerable increase in the total data was realized due to inclusion of new information. The basic criteria for data acceptance and for classifying the information within the database were essentially the same as used by Long and Morgan (1990).

The development of the NOEL and PEL differ from Long and Morgan's development of ER-L and ER-M in that data showing no effects were incorporated into the analysis. In the weight-of-evidence approach recommended for the State of Florida, two databases were assembled; a "no-effects" database and an "effects" database. The PEL was generated by taking the geometric mean of the 50th percentile value in the effects database and the 85th percentile value of the no-effects database. The NOEL was generated by taking the geometric mean of the 15th percentile value in the effects database and the 50th percentile value of the no-effects database and dividing by a safety factor of 2. By including the no effect data in the analysis, a clearer picture of the chemical concentrations associated with the three ranges of concern; no-effects, possible effects, and probable effects, can be established. The ER-M values from Long and Morgan (1990) and PEL values from the weight-of-evidence approach recommended for the State of Florida are presented in Appendix E. The weight-of-evidence approach recommended for the State of Florida has not yet established guidelines for five substances included in the Long and Morgan (1990) analysis (Appendix E). Even though the Long and Morgan (1990) approach may have limitations, it is important to include it in evaluating ranking for the six pollutants listed in Appendix E (Table 3) if the data are available. Because of the limitations in using the ER-M and ER-L, lower values have been assigned as compared to when a PEL and NOEL are available.

c. Areal Extent of Toxic Hot Spot

The rationale for this criterion is to discount smaller sites because these sites will be difficult, or possibly impractical, to characterize and then remediate. This criterion is an estimate only. If the areal extent is completely unknown this criterion should be assigned a value of zero. While this estimate may either over-or under-estimate the size of the toxic hot spot, we assume that one of the first steps in planning for cleanup of a known toxic hot spot will be a characterization of the size of the hot spot before any remedial activity occurs.

d. Pollutant Source, Remediation Potential and Involvement of Multiple Agencies

These three criteria involve judgments of whether the sources of pollutants are identified, the likely remediation potential, and whether the State and Regional Water Boards are likely to be joined in site remediation by other agencies and the responsible parties. These criteria are based on the experience and judgement of the State and Regional Water Board staff.

The "pollutant source" criterion scores a site on the basis of knowledge of whether the source of pollutant is known. If the source is a result of a historic discharge (no longer active), a site is given the lowest score because it will be impossible to improve the site by modifying existing practices. The "remediation potential" criterion is an estimate of whether the site is amenable to intervention and whether waste minimization or prevention programs (implemented through permits) could be used to solve identified problems. Sites requiring sediment or other remediation or other expensive approaches receive a lower score. The "involvement of other agencies" criterion is an estimate of the potential for other agencies to assist the State and Regional Boards in implementing or initiating site cleanup or characterizing a site. The rationale of this criterion is that, if other agencies are involved in addressing the problem at a site, the State and Regional Board's involvement may more expeditiously clean up the site.

CHAPTER VII

REGIONAL AND STATEWIDE TOXIC HOT SPOT CLEANUP PLANS

Introduction

A major focus of the Bay Protection and Toxic Cleanup Program is to plan for the cleanup of known toxic hot spots. Each aspect of the program (as described in Chapters II through VII) will be essential for the completion of toxic hot spot cleanup plans. This chapter describes the BPTCP approach for developing cleanup plans.

A. Water Code Requirements

When SB 475 was enacted in 1989, the Water Code required that each Regional Water Board must complete a toxic hot spot cleanup plan by July 1, 1993, and the State Water Board must prepare a consolidated toxic hot spot cleanup plan by January 1, 1994 for submittal to the Legislature. These deadlines were extended to January 1, 1995 by AB 2824 (Chapter 710, 1992). SB 1084 (Calderon) modified the deadlines further to: January 1, 1998 for the regional cleanup plans and June 30, 1999 for the statewide cleanup plan.

Under the Water Code, each cleanup plan must include:

1. A priority ranking of all known toxic hot spots covered by the plan;

2. A description of each hot spot including a characterization of the pollutants present at the site;

3. An assessment of the most likely source or sources of pollutants;

4. Estimate of the total costs to implement the cleanup plan;

5. An estimate of the costs that can be recovered from parties responsible for the discharge of pollutants that have accumulated in sediments;

6. A preliminary assessment of the actions required to remedy or restore a toxic hot spot; and

7. A two-year expenditure schedule identifying State funds needed to implement the plan.

B. Activities for FY 1993-94

Fiscal Year 1993-94 will be the first fiscal year that the program is funded and staffed for the preparation of Regional and Statewide Toxic Hot Spot Cleanup Plans. In FY's 1989-90, 1990-91, and 1991-92 no State or federal funds were made available to complete these plans. The State Water Board initiated work on sediment quality objectives, water quality control planning activities, consolidated/database monitoring and ranking criteria because each of these tasks is necessary to adequately characterize toxic hot spots in California enclosed bays and estuaries. FY 1993-94 is the first year that the

BPTCP had adequate funding and information (e.g., draft ranking criteria, existing monitoring information, etc.) to begin plan development.

Beginning in FY 1993-94, development of the toxic hot spot cleanup plans will be initiated at two levels: (a) activities common to all cleanup plans, and (b) activities specific to a plan or a specific site described in the plan.

a. Activities common to all plans include:

   1. Development of strategies and a framework for detailed assessment of site impacts, source identification, and guidelines for selection of remediation and cleanup options;

   2. Identification of source control options, including a strategy for selecting a control measure from various control options for point and nonpoint sources; development of an approach for enlisting or requiring the participation of dischargers; and

   3. Identification of contaminated sediment remediation and restoration methods. Methods for removal, treatment, and stabilization of contaminated sediments will be identified and their relative benefits assessed. Disposal options will also be considered.

b. Activities specific to a particular cleanup plan, which, subsequent to the first level of activities (subsection a), will be completed by the State and Regional Water Board staff, include:

1. Detailed site characterizations including areal extent of the known toxic hot spot, and identification of various sources contributing to each hot spot;

2. Selection of pollutant source control strategies to be applied to the toxic hot spot;

3. Schedules of activities to be undertaken as part of the corrective actions; and

4. Identification of responsible parties and descriptions of the tasks each party will be required to undertake to alleviate the adverse impacts of the toxic hot spot.

C. Completion of Cleanup Plans

If no new intervening tasks are initiated, the information necessary to complete the cleanup plans will be available to meet the 1998 and 1999 statutory deadlines. To prepare adequately defensible cleanup plans it is necessary to allow approximately four years to complete this task.

CHAPTER VIII

ADOPTION AND AMENDMENT OF THE CALIFORNIA BAYS AND ESTUARIES PLAN*

Introduction

The State Water Resources Control Board is required by the Water Code (Section 13391) to formulate and adopt a statewide water quality control plan for the enclosed bays and estuaries of California (the California Enclosed Bays and Estuaries Plan; EBEP). This Chapter describes the State Water Board's efforts in adopting the EBEP and presents our methods for (1) incorporating the Enclosed Bays and Estuaries Policy into the Plan and (2) amending other portions of the Plan.

A. Adoption of the EBE Plan

In January 1990, the State Water Board released a draft Functional Equivalent Document (SWRCB, 1990) describing the proposed development of two new water

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*Postscript: On October 15, 1993, The Sacramento County Superior Court issued a tentative decision in a lawsuit challenging the California Enclosed Bays and Estuaries Plan (State Water Board Resolution No. 91-33). The tentative decision invalidates the Plan. **As of the date this staff report was printed, a final court decision had not been issued and, consequently, the State Water Board has not determined its own course of action.**

quality control plans for the (1) Enclosed Bays and Estuaries of California and (2) Inland Surface Waters of California. After consideration of the many comments received at a hearing and several workshops, the State Water Board adopted the new plans on April 11, 1991 [SWRCB 1991(a); SWRCB 1991 (b)].

The EBEP establishes statewide water quality objectives for California's bay and estuarine waters and establishes the basis for regulation of waste discharges into these State waters including both point and nonpoint discharges. The State Water Board adopts the EBEP; both the State Water Board and seven coastal Regional Water Quality Control Boards (Regional Water Boards) including the Central Valley implement and interpret the EBEP.

In the past, water quality objectives for bay and estuarine waters have been developed and adopted by the seven Regional Boards in separate regional water quality control plans (basin plans). The EBEP is organized in a similar manner as the basin plans, but as a Statewide plan, it is more general in scope. It is intended not to replace the efforts of the Regional Water Boards, but to supplement them.

The EBEP contains three major sections. Chapter I describes the beneficial uses of California's bay and estuarine waters that should be protected. It incorporates by reference the waterbody-specific beneficial use designations contained in the basin plans and other statewide plans. Chapter II, describes narrative, toxicity, and numerical water quality objectives to protect these beneficial uses. It also contains provisions to establish site-specific water quality objectives. Chapter III provides a program for implementing water quality objectives. Provisions include the application of mixing zones, calculation of effluent limitations, compliance monitoring requirements, determination of compliance with effluent limitations, water quality-based toxicity control, and toxicity reduction requirements. Provisions also apply to stormwater, reclaimed water, and agricultural drainage and other nonpoint sources.

B. Amendments to the EBE Plan

When the State Water Board adopted the EBEP in April 1991, the Board declared its intent to consider the adoption of additional water quality objectives within one year after the adoption of the Plan (State Water Board Resolution No. 91-33). The new water quality objectives considered were the priority pollutants [Clean Water Act Section 307(a)] for which EPA has published water quality criteria [under Section 304(a)] and which were not included in the April 1991 adoption of EBEP.

The modification is the addition of water quality objectives for protection of aquatic life and protection of human health from consumption of contaminated aquatic life. Alternatives and recommendations were also presented for several other changes to various provisions of the EBEP to provide clarification.

In November 1992, the State Water Board approved EBEP amendments that expanded the list of numerical objectives in the EBEP to fully comply with Section 303(c)(2)(B) and fulfill the State Water Board's commitment to consider adopting water quality objectives for the remaining priority pollutants (SWRCB Resolution No. 91-33).

The amendments were sent to the Office of Administrative Law (OAL) in March 1993. If approved by OAL the amendments will be submitted to EPA Region 9 for their consideration.

C. Enclosed Bays and Estuaries Policy Review

The State Water Resources Control Board received a CWA Section 201(g) grant from the USEPA Region 9 in 1990 to review the Enclosed Bays and Estuaries Policy and to incorporate the most important updated policy statements into the California Enclosed Bays and Estuaries Plan.

The Water Quality Control Policy for Enclosed Bays and Estuaries of California (EBE Policy) was adopted by the State Water Board by Resolution No. 74-43. The EBE Policy established guidelines and prohibitions to protect the beneficial uses of waters of enclosed bays and estuaries of California. While it established policy on discharge prohibitions to bays and estuaries, the document is now almost 20 years old and requires a thorough review and update.

D. Sediment Quality Objectives

In 1991 the State Water Board adopted a workplan for develop sediment quality objectives (SQOs) for enclosed bays and estuaries (SWRCB, 1991). This section describes (1) the statutory authority for developing SQOs; (2) the Sediment Quality Workplan; (3) studies in progress; (4) development of apparent effects thresholds (AET), (5) a description of special studies and progress; and (6) the development of sediment quality objectives.

1. Statutory Authority

Water Code Section 13391.5 defines a sediment quality objective as ". . . that level of a constituent in sediment which is established with an adequate margin of safety, for the reasonable protection of beneficial uses of water or prevention of nuisances." Section 13393 adds detail stating ". . . sediment quality objectives shall be based on scientific information, including but not limited to, chemical monitoring, bioassays or established modeling procedures, and shall provide adequate protection for the most sensitive aquatic organisms." The protection of human health is also a major consideration and the water code requires that sediment quality objectives be based on a health risk assessment if there is a potential for exposure of humans to pollutants through the food chain (section 13393). The protective character for objectives is an interpretation of the general policy established in Water Code Section 13000, which states, in part, ". . .activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible."

These statutes taken together require that, to the greatest extent possible, sediment quality objectives should strive to protect all species, their frequency of occurrence, and the abundance of individuals. This mandate encompasses an array of organisms that include benthic (living within bottom muds) and epibenthic (living on the sediment surface) organisms living in the water, waterfowl and shorebirds, and animals which may be exposed to food polluted through sediment exposure.

2. The Sediment Quality Objectives Workplan

The State Water Board's approach for development of sediment quality objectives is described in the Workplan for the Development of Sediment Quality Objectives for Enclosed Bays and Estuaries of California (SWRCB, 1991). This work plan was required by Water Code Section 13392.6.

The work plan addresses integrating the measures of assessment to produce a single value, which is the crux of the technical problems encompassed in the derivation of sediment quality objectives. Despite considerable scientific effort, understanding of the relationships between physical, chemical, and biological characteristics are somewhat limited, making the evaluation of sediment quality is a difficult, technical task. The assurance that a particular chemical concentration is not causing adverse impacts is constrained by these technical limitations. Consequently, the efforts to develop sediment quality objectives include both a basic strategy for assessment of sediment quality and attempts to characterize the robustness of some of the tools available for assessment.

The assessment follows from the working definition of a toxic hot spot (Chapter II) that has been developed by the BPTCP which emphasizes adverse impacts on various levels of biological organization. The approach taken in the work plan is to generate a broad body of information to bring several estimators of sediment quality together in a single sediment quality objective. The estimators of sediment quality to be used are the EqP approach developed by the EPA, the AET approach developed for the State of Washington, and the Spiked Bioassay approach, which is used to develop dose-response relationships. Several work elements are associated with each of these estimators. These tasks initially focus on the calibration and verification of the efficacy of selected methods. Subsequent work is devoted to building the body of information needed to establish sediment quality objectives.

3. Studies in Progress

The following sections describe specific projects underway that are designed to address sediment objectives. In most cases these projects are structured in phases, allowing critical examination to evaluate the likelihood that the project will provide useful and cost effective information to the program.

a. Evaluation of Goby Species for Monitoring Carcinogenic Effects

Hystopathology is an important area of evaluation. One problem in evaluating hystopathological information for use in sediment quality objective development is identifying a geographic location for the sample of fish. Since many fish species commonly move around throughout water bodies, it is difficult to associate the pollutants in a particular sediment sample with lesions or abnormalities in fish. However, some fish species have very localized ranges, in some cases encompassing only a few hundred square yards. Gobies exhibit such behavior, and are therefore, a potentially useful species. In addition, gobies are found throughout California's near coastal waters. A negative aspect of using gobies is that their hystological responses to pollutants are not well characterized. Therefore, to employ gobies in the program requires some initial characterizations.

Three phases of evaluating gobies are planned. In the first phase, two field sites will be sampled, one exhibiting toxicity to the amphipod *Rhepoxynius abronius* and one not exhibiting toxicity to *R. abronius*. fifteen to twenty-five fish will be collected from each site. The species of goby collected will depend on catch availability, but will be the same for both sites. An array of histopathological measures (liver and kidney), enzyme induction, and general condition of the fish will be measured for individual fish. Tissue residues of trace metals, PCBs, PAHs, and pesticides will be measured in pooled samples. After assembling the data, a determination will be made whether gobies are a suitable species for routine measurement of these characteristics. If measurement of these characteristics is feasible then phase II will be undertaken.

In phase II nine additional sites which exhibit a range of toxicity will be sampled, following the same procedures as used in phase I. Statistical comparisons of the sites will be undertaken, and a general characterization of the degree of impact will be formulated.

In phase III, laboratory dose response experiments may be undertaken to clarify goby response to selected pollutants and to define the intensity and range of responses. This information will be compared to other common species, such as sanddabs, which have previously been measured. Costs of monitoring gobies will be analyzed. A determination of the long term usefulness in monitoring gobies will be made at the conclusion of phase III. This work is partially funded by NOAA.

b. Use of the Reporter Gene System for Environmental Evaluations

Contemporary uses of genetically engineered cell lines offer potentially great economies to the program by allowing the quantitation of pollutant concentrations at very low cost per sample, and by providing valuable information regarding molecular and cellular level responses to pollutant exposures.

One such genetically engineered system is the reporter gene system (RGS) developed at the University of California, San Diego, Department of Medicine. The RGS was originally developed to evaluate cellular threshold responses to exposures of dioxin. The system exploits the normal cellular mechanisms to elicit an increased production of enzymes in response to exposure to dioxins. The engineered component of the system replaces the indigenous enzyme that would normally be produced with a luciferous enzyme that, yields a light reaction when exposed to an appropriate substrate. The intensity of the light reaction can be measured and related quantitatively to both the amount of enzyme produced and the amount of dioxin causing the enzyme production. The cellular mechanism that leads to enzyme production is not specific for dioxin, but can be used by the cell in response to exposure to many arylhydrocarbon (conjugated carbon ring structures with functional group attachment directly to the ring) pollutants.

An important characteristic of the cellular mechanism which is used in the RGS is that it binds directly to DNA, therefore, representing a measure of potential genotoxicity as well as a quantitative measure of exposure to pollutants. An RGS measurement represents a quantitative measure of the total exposure of the cell to aromatic hydrocarbons that are potentially carcinogenic.

A significant benefit of the RGS is its costs. A single sample can be measured using the RGS for approximately $75. This measure yields a quantitative assessment of biologically active arylhydrocarbons, whereas, conventional analytical chemistry requires the separate analysis of the many possible arylhydrocarbons. By isolating these pollutants into separate measurements, quantitation may be compromised by matrix effects and instrument limitations. The costs of conventional chemical analysis that would provide individual measurements could run into thousands of dollars per sample. In addition, conventional chemical analyses do not distinguish biologically active concentrations from concentrations that may be sequestered and inactive. Therefore, the RGS offers a potentially great economy in the quantitative analysis of some pollutants.

The emphasis placed on the RGS would be somewhat different for sediment quality objectives development compared to surveillance work. For objectives development the RGS would be applied primarily for its quantitative characteristics. For monitoring work, the RGS could be used as a site screening tool, relying on its character as a descriptor of cancer potential.

Considerable effort has been expended to integrate the monitoring program with the work on sediment quality objectives. A core of biological test methods have been identified for use in the monitoring efforts which will also support sediment quality objectives (Chapter III and IV). Therefore, monitoring data can be used directly in the development of objectives, greatly expanding the available information which will be used to support the objectives. Conversely, the work required for the development of sediment quality objectives will provide insight into the meaning of the monitoring information and give a clearer picture of the overall impacts from toxic pollutants. The monitoring data will also be used to evaluate candidate sites for further work. Careful selection of sites following screening will provide a high degree of assurance for sediment objective development to be successfully.

c. Standard Sampling and Handling

A number of questions relating to the impacts of sample handling on the outcome of toxicity tests have been raised. The questions of greatest concern are, (1) Does mixing of the sediments to homogenize the sample significantly influence the outcome of toxicity tests? (2) What influence does the anoxic layer have on test outcome? Strong speculative arguments can be formed to support any of several answers. An experiment to evaluate these questions is described below.

<u>Background</u>

The BPTCP is investigating the effects of sampling depth and homogenization of sediments on the outcome of selected sediment toxicity tests. The experiment will be completed in three phases: a procedural development phase, an initial testing phase at a single site, and a final testing phase at remaining sites. Sediments will be sampled at five grained sites using a boxcorer. Subcores will be used as bioassay test chambers and sediments within the subcores will either be used intact, without further disturbance, or removed, homogenized, and replaced in the subcore tube. Various combinations of depth of the toxic layer and sediment handling will be evaluated.

Major tasks to be completed before the experiments can be undertaken include:

- Design and testing of the subcorers, including measurement of normalizers (ammonia, sulfides, etc.) in toxicity tests, and appropriate management of predator species;
- Development of an operational definition of the toxic layer based either on redox potential (Eh probe) or sulfide and oxygen concentrations (sulfide and/or oxygen probes);
- Evaluation of transport and storage of samples for toxicity testing and chemical analysis;
- Evaluation of sampling techniques for analysis of normalizing factors and chemical constituents:
- Fabrication of subcorers;
- Development of Quality Assurance guidance; and
- Test site reconnaissance.

d. Reference Site Study Proposed Study Design

In the past, high levels of sediment toxicity (up to 100% mortality in amphipod tests and high levels of abnormality in the bivalve larvae tests) have been found in areas with few sources of contamination and low levels of contaminants. These areas have included Tomales Bay, Bolinas Lagoon and Drakes Estero. We feel that it is essential to determine the causes of toxicity in these areas in order to identify toxic hot spots based on sediment toxicity tests. In addition, we need to identify a fine grain reference with which to compare other sites when conducting sediment toxicity tests.

The purposes of this study are to: (1) identify a fine grain reference site in the San Francisco Bay area for sediment toxicity tests and (2) determine the causes of toxicity in areas that have few sources of contamination, low levels of contaminants and no known factor that may be causing toxicity. The tests to be completed are:

1. Develop guidelines for conducting estuarine sediment Toxicity Identification Evaluations (TIEs) will be developed for the amphipod test using Eohaustorius and the bivalve larvae development test.

2. Sediment samples from six sites that meet the criteria of a fine grain reference site (fine grain sediment, low levels of contaminants and not near any know sources of contamination) will be collected on a quarterly basis. Two filed reps will be collected at each stations. Sites will be located in Tomales Bay, Drakes Estero, Bolinas Lagoon and San Pablo Bay.

3. Sediment will be analyzed for metals, organics, TOC, grain size, ammonia and hydrogen sulfide. At least two toxicity tests, including

the 10 day amphipod test using Eohaustorius and the bivalve development test, will be performed on each sample. The bivalve larvae test will be performed on pore water.

4. Samples will be split with other researchers for positive interference studies. If a sediment sample is toxic and there is no apparent cause for the toxicity a TIE will be performed.

4. Development and Verification of Apparent Effects Threshold (AET) Values

An AET is the concentration of a pollutant in sediments above which adverse effects are expected. AETs require that both chemical and biological response data be collected from a single sample. These matched data are termed "synoptic." The BPTCP monitoring programs are designed to obtain synoptically collected chemical and biological response data necessary to calculate AETs.

5. Evaluation of Spiked Bioassays

To begin the spiked bioassay work three preliminary steps must be completed: (1) identification of the pollutants to be used for spiking; (2) selection of bioassay tests to be applied; and (3) selection of techniques for spiking. The first two steps depend on a review of the first year field data. The third task requires a review of pertinent literature. These three steps are discussed below. The spiked bioassay work is expected to will begin in late 1993 if funding is available.

a. Identification of Pollutants of Concern

A small group of pollutants will be identified for application in the spiked bioassay work. Among considerations for selecting pollutants are: (1) an emphasis on pollutants that are currently being used or generated, and (2) single pollutants representative of groups of chemically similar substances; (3) emphasis will be on substances for which a fairly large amount of information exists, but the body of information is not sufficient to allow description of relevant dose response data, and (4) data from the monitoring programs will be reviewed to determine if particular pollutants are consistently identified at sites demonstrating toxicity. Important pollutants historically discharged, such as DDT and PCBs, will be considered but not given the highest priority, since one goal of the BPTCP is to develop prevention strategies. Regulating actively used/generated pollutants creates the greatest potential for implementing successful prevention strategies. Clean up strategies for contaminated sites without pollutant inputs can be successful for preventing further contamination.

Both the physical chemistry and the toxicology of related compounds will be considered. Selecting single substances will facilitate both the management of the spiking studies and their interpretation. One adverse consequence of studying individual substances is that sediment quality objectives will be limited to those substances. However, by carefully selecting representative substances, it is likely that control of a single substance will, in practice, result in control of many similar substances. Consequently, the active regulation of a single substance will have greater practical impact than might otherwise be expected. Several basic groupings can be assumed to be important.

Substances that have been highly studied and where data on spiked bioassays exists, will receive lower priority for additional study. Information on some substances may already contain sufficient spiked sediment results to be used in the development of sediment quality objectives. Substances with little available information will not be used unless strong evidence from the field suggests they play a significant role in generating field effects.

Additional field data from cleanup efforts may also be reviewed. Any pollutant consistently identified at toxic sites may be considered as a candidate for spiking work.

Given these considerations, some likely groups of substances can be identified. PCBs, DDT and its metabolites, and PAHs are all candidate groups. Of these three groups, PAHs have the highest priority for investigation. PAHs can be divided into several subgroups that may be investigated separately. Another significant group is the chlorinated ring compounds (PCBs, dioxin, and furans among them). Representatives of each of these groups are likely to be evaluated. In addition, toxic trace metals must be evaluated. However, the metals vary sufficiently in their environmental chemistry that it may not be possible to consider them as a group. Mercury and selenium are likely candidates for evaluation due to their bioaccumulative characteristics, even though they may not be frequently associated with field toxicity.

b. Selection of Bioassays for use in Spiked Sediment Tests

Selection of tests will be largely based on data from the monitoring program. At least one bedded sediment test (e.g., <u>Rhepoxinius abronius</u>, *Euohaustorius estuarius* or *Neanthes* spp.) and one pore water test (e.g., bivalve larvae) will be selected. Considerations for test selection include the relative sensitivity demonstrated in field collected sediments, ease of conducting the tests, and costs of the tests. The monitoring data will be evaluated to determine likely ranges of variation associated with each test. Those tests that provide less variability will receive higher priority for use in spiked sediment assessments since they will allow for greater statistical power for a given number of replications.

c. Selection of Spiking Techniques

The literature will be reviewed and techniques for spiking sediments selected. It is important to maintain the same method of spiking throughout the series of tests to be conducted for a given substance. Depending on the substances selected, more than one spiking technique may be selected. Therefore, this activity will be undertaken following review of the monitoring data and selection of substances of concern.

6. Verification of Equilibrium Partitioning Approach

Some preliminary work from San Diego Bay sediments has been completed under a cooperative agreement with EPA. This work measured chemical concentrations in sediment, pore waters, and dissolved organic carbon fractions of samples taken from three sites. The purpose of the work was to evaluated whether theory was correctly predicting concentrations in the field. Critical evaluation of data has not been completed.

Evaluation of Equilibrium Partitioning has been assigned a low priority for the BPTCP since the EPA is involved in a considerable effort to perform this work. Potential sites for collaborative work will be identified through the monitoring results. Of particular interest to EPA are sites demonstrating toxicity due to metals contamination and gradients of PAH pollution.

7. Human Health Risk Assessment

A strategy for developing sediment quality objectives based on human health considerations has been developed by the Office of Environmental Health Hazard Assessment (OEHHA) under contract to the State Water Board (Appendix D). The strategy consists of the following six elements:

1. Select and prioritize contaminants of concern in California, based on California monitoring data and EPA lists;

2. Identify appropriate cancer potency factors and reference doses for the prioritized contaminants;

3. Develop standardized seafood consumption scenarios for determinations of exposure;

4. Combine potency/reference dose information with consumption information to establish target levels of tissue residues in fish and shellfish;

5. Use several different approaches to modeling bioaccumulation to generate predictions of sediment concentrations that will lead to the occurrence of target levels in fish and shellfish; and

6. Select the most appropriate model for predicting target tissue levels by comparing the predictions to monitoring data.

The sediment quality objectives can be established using the appropriate model and professional judgement regarding the accuracy in the estimate. A model which predicts tissue burdens with great accuracy can be used directly, whereas a model with a considerable amount of uncertainty in the estimate may have to be used in conjunction with a safety factor.

8. Development of Aquatic Life Sediment Quality Objectives

Three types of sediment objectives can be developed: (1) narrative Sediment Quality objectives (SQO); (2) a toxicity SQO, and (3) chemical specific numerical sediment quality objectives. The objectives of each type can be developed and proposed as amendments to the California Enclosed Bays and Estuaries Plan. Narrative objectives will be proposed first because they are the most general and provide the basic framework for more specific objectives. Toxicity objectives may be proposed once toxicity tests methods are sufficiently refined to allow general application by the discharger community. Finally, chemical specific numerical objectives will be developed. The first objectives may be drafted in 1993.

Chemical specific numerical objectives will be biologically-based and supported by extensive field information. The objectives will be based on weight-of-evidence that combines three estimates of concentrations of pollutants in sediments that adversely affect either human health or aquatic life beneficial uses. The various biological measurements can be used to judge the suitability of the proposed objectives using information on adverse effects at several of biologically important levels of organization from subcellular to community structure. Specific methods suitable for routine monitoring of objective attainment will be developed or identified during objective development.

Much of the conceptual and planning work associated with sediment quality objective development has been completed.

E. Issues and Expectations for Future EBE Plan Amendments

There are many issues that will be reviewed during the EBE Policy update process. The issues that have been identified for consideration are presented in Table 14.

Some of the issues will be addressed first in a draft Functional Equivalent Document (FED), using the same process as was used for the adoption and amendment of the Statewide Plans. Once a draft FED is circulated, a hearing will be scheduled to comply with the California Environmental Quality Act (CEQA) (14 California Administrative Code Section 15251[g]). Comments will be addressed and a Final FED will be produced.

Table 14

Topics that the State Water Board will consider in future amendments of the California Enclosed Bays and Estuaries Plan.

ISSUE	EBE PLAN SECTION	REASONS
"Due diligence" (toxicity test implementation)	Chapter III	Section disapproved by EPA
Category a,b,c waterbodies	Chapter III	Section disapproved by EPA
Total vs. dissolved metals	Chapter II	New EPA guidance for implemention of metals water quality criteria
Triennial review		CWA Section 303 requirement
The influence of ammonia on toxicity testing	Chapter III	Issue identified by the San Francisco Bay Region
Discharge prohibitions	Chapter III	EPA grant to update EBE Policy
Definition of toxic hot spot	New Chapter	Needed to consistently implement the BPTCP
Site Ranking Criteria	New Chapter	Needed to consistently implement the BPTCP
Definition of enhancement	Appendix	EPA grant to update EBE Policy.
Sediment quality objectives (SQO)	Chapter II and III	Required by SQO Workplan
Monitoring guidance	New Chapter	Needed to consistently implement the BPTCP
Coastal zone management (Nonpoint Source Control)	Chapter II and III	EPA grant to update EBE Policy.

CHAPTER IX

BPTCP ANNUAL FEES

Introduction

To provide continued funding for the BPTCP, legislation in 1990 (Chapter 1294; SB 1845 Torres) added Section 13396.5 to the Water Code. This section requires the State Water Board to establish fees beginning in FY 1991-92 and continuing into 1994 to fund the BPTCP responsibilities contained in Chapter 5.6 of the Water Code. The program was funded in FY 1989-90 and FY 1990-91 by $5 million from the Hazardous Waste Control Account. This chapter describes (1) the fee program; (2) the program expenditure plans; (3) fee collection; (4) adequacy of the fees; and (5) fee extension (SB 1084).

A. Implementation of the Fee Program

To implement Section 13396.5, the State Water Board staff proposed regulations specifying fees for dischargers into enclosed bays and estuaries or the ocean in April 1991. The Water Code required the State Water Board to establish a fee schedule setting at an amount sufficient to fund the program, but not exceeding a total revenue of $4 million per year. The Water Code also required that the fees create incentives for reducing discharges to the State's ocean, bays, and estuaries.

The State Water Board adopted regulations on October 24, 1991, to distribute the cost of the BPTCP among the point and nonpoint dischargers who directly impact enclosed bays and estuaries and the ocean. The fee regulations were approved by the Office of Administrative Law (OAL) on December 21, 1991.

The adopted regulations (Title 23, Section 2236 of the California Code of Regulations) implemented an annual fee system assessing point and nonpoint dischargers who discharge directly into bays, estuaries, or the ocean. The fee system was aimed at equitably spiltting the costs of the program among point and nonpoint dischargers to the water bodies affected by the program. Examples of point source dischargers include NPDES permit holders (publicly owned treatment works, industry and storm water), while examples of nonpoint dischargers include agricultural dischargers, marinas, and dredgers. The specific fees for each category are presented in Table 15.

B. Expenditure Plans

The annual expenditure plans for FY 1991-92 and FY 1992-93, as well as information on the fees necessary to support those plans, are discussed separately below. Table 16 summarizes the budget plans for these two years.

C. Expenditures

1. FY 1991-92 Annual Expenditure Plan

The Program objectives for FY 1991-92 were: (1) continue development of regional comprehensive databases; (2) develop toxic hot spot ranking criteria; (3) complete development of fee system; (4) begin development of sediment quality objectives; (5) implementation of Pollutant Policy Document in Sacramento-San Joaquin Bay-Delta; (6) coordinate pollutant-related monitoring in bays and estuaries; and (7) begin review of the Enclosed Bays and Estuaries Policy.

Table 15
BPTCP Annual Fee Ratings

TYPE OF DISCHARGE	DISCHARGE DESCRIPTION	ANNUAL FEE
Storm drain	Less than 10,000 population	1,000.00
Storm drain	10,000 to 99,000 population	2,500.00
Strom drain	100,000 to 249,999 population	5,000.00
Strom drain	250,000 and greater population	10,000.00
Agricultural drainage	Less than 100 acres	0.00
Agricultural drainage	100 to 999 acres	500.00
Agricultural drainage	1,000 to 9,999 acres	1,500.00
Agricultural drainage	10,000 to 50,000 acres	5,000.00
Agricultural drainage	10¢/acre for acres over 50,000	5,000.00
Boat construction, repair, or hull cleaning facility		300.00
Marinas	Less than 300 slips	0.00
Marinas	300 to 499 slips	300.00
Marinas	500 to 999 slips	500.00
Marinas	1,000 and greater slips	1,000.00
Harbor or Port Operator		5,000.00
New dredging	Less than 30,000 cubic yards	0.00
New dredging	30,000 to 99,999 cubic yards	1,000.00
New dredging	100,000 to 299,999 cubic yards	3,000.00
New dredging	300,000 & greater cubic yards	10,000.00
Maintenance dredging	Less than 30,000 cubic yards	0.00
Maintenance dredging	30,000 to 99,999 cubic yards	1,500.00
Maintenance dredging	100,000 to 299,999 cubic yards	4,500.00
Maintenance dredging	300,000 & greater cubic yards	15,000.00
Beach replenishment	Less than 30,000 cubic yards	0.00
Beach replenishment	30,000 to 99,999 cubic yards	0.00
Beach replenishment	100,000 to 299,999 cubic yards	1,000.00
Beach replenishment	300,000 & greater cubic yards	3,000.00
All other regulated NPDES or NON15 (TTWQ-1,CPLX-A)		11,000.00
All other regulated NPDES or NON15 (TTWQ-1,CPLX-B)		8,000.00
All other regulated NPDES or NON15 (TTWA-1,CPLX-C)		5,000.00
All other regulated NPDES or NON15 (TTWQ-2,CPLX-A)		4,000.00
All other regulated NPDES or NON15 (TTWQ-2,CPLX-B)		2,000.00
All other regulated NPDES or NON15 (TTWQ-2,CPLX-C)		1,000.00
All other regulated NPDES or NON15 (TTWQ-3,CPLX-A)		500.00
All other regulated NPDES or NON15 (TTWQ-3,CPLX-B)		400.00
All other regulated NPDES or NON15 (TTWQ-3,CPLX-C)		300.00

Water bodies identified under 303(d) of the Federal Clean Water Act represent Water Quality Limited Segments and are subject to twice the base fee amount.

Table 16

State Water Resources Control Board

Bay Protection and Toxic Cleanup Program

Annual Expenditure Plans FY 1991-92 and FY 1992-93

	HWCA[1]	Federal Funds	Fee Revenue[2]
FY 1991-92	$1,547,000	$295,717	$2,439,000
FY 1992-93	0	$523,301	$3,975,000[3]

1 = Hazardous Waste Control Account.

2 = Fee revenue is deposited into the Bay Protection and Toxic Cleanup Fund.

3 = Anticipated Amount

The BPTCP budget for 1991-92 was $4,281,717, including $1,769,717 for 20.7 personnel years (PYs) at State and Regional Water Boards and $2,512,000 in contracts. Fund sources included of federal funds ($295,717), Hazardous Waste Control Account (HWCA) funds ($1,547,000), and Bay Protection fees ($2,439,000).

Of the federal funds, $165,000 was from a National Oceanic and Atmospheric Administration (NOAA) grant for monitoring and surveillance, and $130,717 was from the U.S. Environmental Protection Agency (EPA) to update the Enclosed Bays and Estuaries Policy. Of the HWCA funds, $550,000 were for contracts and $997,000 supported 9.3 PYs. These funds were available to develop and administer the BPTCP while regulations to implement the fee system were prepared and adopted, however, FY 1991-92 was the last year the HWCA was used to support the program. Of the Bay Protection and Toxic Cleanup Fees, $1,797,000 was used to support contracts and $642,000 to support 9.2 PYs.

2. FY 1992-93 Annual Expenditure Plan

The BPTCP objectives for FY 1992-93 are: (1) continue development of regional comprehensive databases; (2) continue development of sediment quality objectives; (3) implement regional monitoring plans; (4) develop amendments to the Enclosed Bays and Estuaries Policy/Plan; (5) invoice and collect fees to support the program; and (6) begin development of toxic hot spot cleanup plans.

The BPTCP budget for FY 1992-93 is $4,498,301, including $2,055,301 for 30.5 PYs at the State and Regional Water Boards and $2,443,000 in contracts. Fund sources include of federal funds ($523,301) and Bay Protection Fees ($3,975,000).

Of the federal funds, $250,000 is from the NOAA grant and $273,301 is from EPA to support 2.2 PYs. Of the Bay Protection and Toxic Cleanup fees, $2,193,000 supports contracts and $1,782,000 supports 30.5 PYs.

D. Fee Collection

Invoices totalling $3.3 million have been sent to dischargers subject to BPTCP fees during the first calendar year of the Bay Protection and Toxic Cleanup Fee Program (FY 1991-1992). The State Water Board collected $2.7 million. In FY 1992-93, invoices totalling $3 million were issued. Revenue up to March 1993 is $2,588,100 for FY 1991-92 and $2,168,200 for FY 1992-93. We anticipate revenues of at least $2.7 million for FY 1992-93.

E. Adequacy of Fees

SB 1845 (Chapter 1294, 1990) authorized the State Water Board to collect up to $4 million per year to fund activities of the BPTCP. This fee program is scheduled to end on January 1, 1994. The existing fee program does not generate enough revenue to fully fund the BPTCP.

Postscript: SB 1084 (Calderon) was proposed in March 1993 and the bill was signed by Governor Wilson on October 10, 1993. The bill, in part, extended the operation of the fee system until January 1, 1998. The new legislation also exempts all agricultural dischargers from paying BPTCP annual fees.

The anticipated revenue for FY 1993-94 is $2.7 million. The State Water Board has prepared a budget change proposal reflecting this lower-than-expected revenue. We anticipate issuing new invoices in early January 1994.

CHAPTER X

BPTCP ACCOMPLISHMENTS, CONCLUSIONS
AND
RECOMMENDATIONS

The Bay Protection and Toxic Cleanup Program (BPTCP) was created by the Legislature in 1989 (SB 475 Torres and AB 41 Wright). The State and Regional Water Boards initiated implementation of the program in April 1990. In the three years since the program was initiated the BPTCP staff has made progress toward program implementation:

A. ACCOMPLISHMENTS AND CONCLUSIONS

- The State Water Board adopted and amended the California Enclosed Bays and Estuaries Plan in compliance with Section 13391 of the Water Code;

- The State Water Board adopted the Sediment Quality Objectives Workplan as required by Section 13390 of the Water Code;

- State Water Board staff has begun implementing the Sediment Quality Objectives Workplan by initiating monitoring activities to collect data so apparent effects thresholds can be calculated;

- State Water Board staff has drafted criteria for the priority ranking of toxic hot spots;

- Regional Water Board staff has assembled available information that can be used to identify toxic hot spots;

- The State Water Board staff has completed planning for a computer data system to store and analyze existing and new monitoring data;

- The State Water Board is purchasing equipment and software to implement the data system for the State and Regional Boards;

- The San Francisco Bay Regional Water Board has completed a pilot regional monitoring program (FY 1991-92);

- The State Water Board has implemented an interagency agreement with the California Department of Fish and Game (DFG) initiating monitoring in all coastal regions of California. DFG is using standard methods for the regional monitoring program;

- In FY 1992-93, monitoring activities were implemented in each coastal region;

- The State or Regional Water Board will begin to develop toxic hot spots cleanup plans in FY 1993-94;

- The BPTCP has received three federal grants (one from EPA and two from NOAA) to implement program activities;

- The BPTCP developed and implemented a fee system to support the program;

- Fee revenue is less than expected; and

B. Recommendations

- Continue to develop amendments to (or redevelopment of) the California Enclosed Bays and Estuaries Plan in order to improve regulation of bay and estuary water quality (Please note that action will depend on the final court decision);

- Initiate development of narrative sediment quality objectives and contract to perform spiked sediment bioassays with selected chemicals;

- Use adopted site ranking criteria to set priorities for permit actions at toxic hot spots;

- Begin operation of the consolidated database so toxic hot spots can be clearly identified;

- Continue monitoring enclosed bays and estuaries so problems can be identified early so preventive actions can be initiated;

- Continue monitoring enclosed bays and estuaries in priority order;

- Consider revision of the fee system to more equitably split program costs among point and nonpoint dischargers; and

- Collect BPTCP annual fees until January 1, 1998 so the toxic hot spot cleanup plans can be completed and implemented.

- Initiate development of the regional and statewide toxic hot spot cleanup plans.

CHAPTER XI

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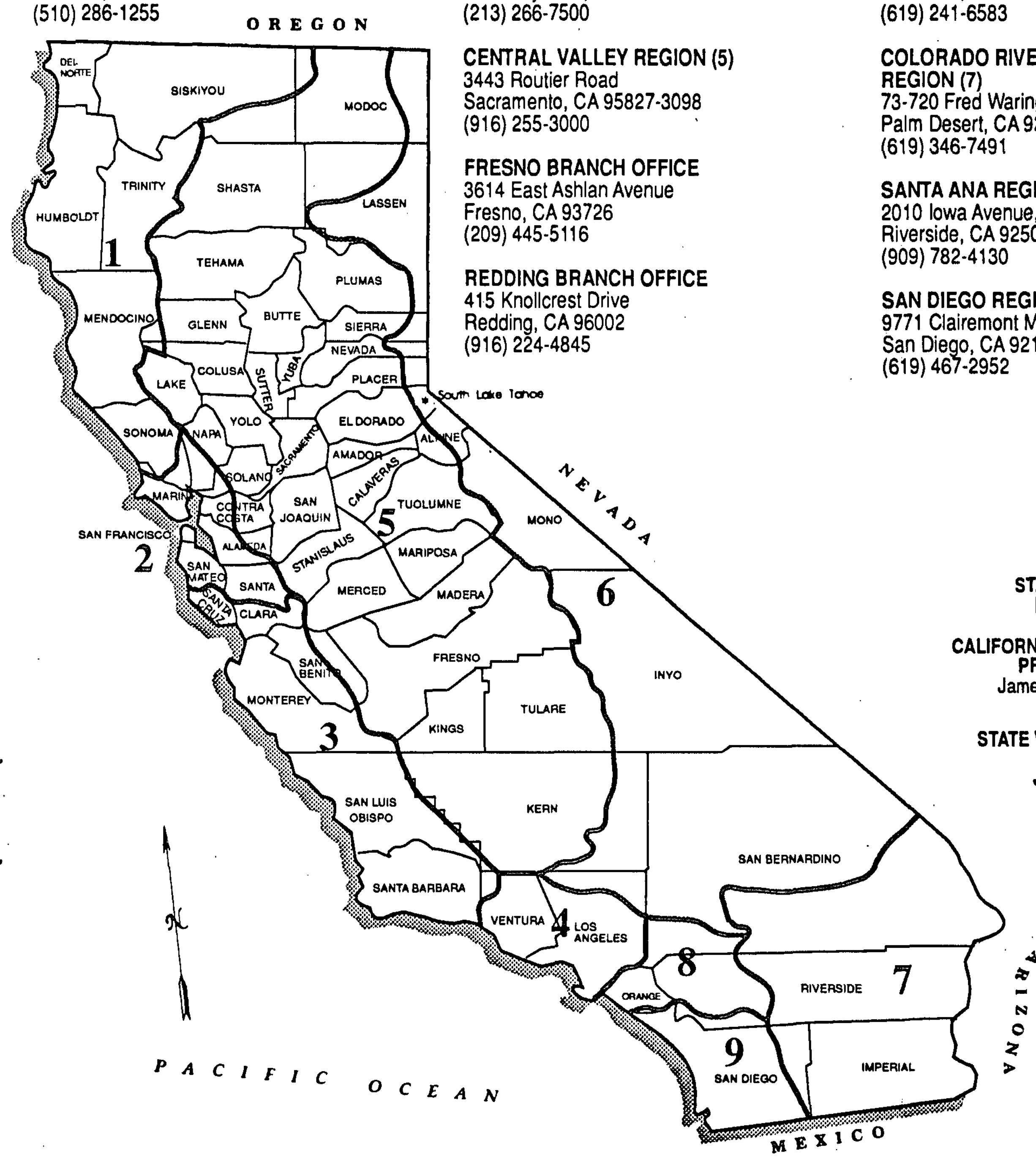

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