FUNCTIONAL EQUIVALENT DOCUMENT:

DEVELOPMENT OF THE WATER QUALITY CONTROL POLICY FOR IMPLEMENTATION OF THE BAY PROTECTION AND TOXIC CLEANUP PROGRAM

DIVISION OF WATER QUALITY
DECEMBER 1994

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER QUALITY

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DRAFT

DECEMBER 1994

PREFACE

This Functional Equivalent Document (FED) explores various alternatives, provides options and recommendations, and establishes the general format for the adoption of a Policy to implement the Bay Protection and Toxic Cleanup Program. This Policy will provide guidance to the Regional Water Quality Control Boards (RWQCBs) on development of Toxic Hot Spot (THS) Cleanup Plans. The State Water Resources Control Board (SWRCB) will accept evidence at a public hearing on the proposed Policy and the FED. After responses to comments are developed, the SWRCB will consider approval of the FED and adoption of the Policy. The RWQCBs will implement the Policy subsequent to approval of the regulatory provisions of the Policy by the Office of Administrative Law.

This document is subject to revision and has not been reviewed by SWRCB Management, the SWRCB or the RWQCBs. The contents of this draft report do not necessarily reflect the views of the SWRCB or the RWQCBs.

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LIST OF ABBREVIATIONS

AET	Apparent Effects Threshold
Ag	Silver
APA	Administrative Procedure Act
As	Arsenic
ASTM	American Society for Testing Materials
BCDC	Bay Conservation and Development Commission
BCF	bioconcentration factor
BMP	Best Management Practice
BPTCP	Bay Protection and Toxic Cleanup Program
CalEPA	California Environmental Protection Agency
CCC	Criteria Continuous Concentration
CCR	California Code of Regulations
Cd	Cadmium
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CMC	Criteria Maximum Concentration
Cr	Chromium
Cu	Copper
CWA	Clean Water Act (federal)
cy	cubic yard
CZARA	Coastal Zone Act Reauthorization Amendments
DDT	1,1,1-trichloro-2,2,2-bis(p-chlorophenyl)-ethane
DFG	Department of Fish and Game
DTSC	Department of Toxic Substance Control
DHS	Department of Health Services
EIR	Environmental Impact Report
EBE	Enclosed Bays and Estuaries
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
EDL	Elevated Data Level
ERL	Effects Range Low
ERM	Effects Range Median
EqP	Equilibrium Partitioning
FC	Fish Consumption
FAV	Final acute value
FED	Functional Equivalent Document
FDA	U.S. Food and Drug Administration
g	gram(s)
H_2S	Hydrogen sulfide
Hg	mercury
HRS	Hazard Ranking System
IRIS	Integrated Risk Information System
kg	kilogram(s)
l	liter(s)
lf	linear foot
LTMS	Long Term Management Strategy
mg	milligram(s)
MAA	Management Agency Agreement
MOU	Memorandum of Understanding

MGD	million gallons per day
mg/l	milligrams per liter (parts per million)
MTRL	Maximum Tissue Residue Level
NAS	National Academy of Sciences
ng/l	nanograms per liter (parts per trillion)
Ni	Nickel
NOAA	National Oceanic and Atmospheric Administration
NOEL	No Observed Effect Level
NPDES	National Pollutant Discharge Elimination System
OAL	Office of Administrative Law
OEHHA	Office of Environmental Health Hazard Assessment
PAH	Polynuclear Aromatic Hydrocarbon
Pb	Lead
ppb	Parts per billion
PCB	Polychlorinated biphenyl
PEL	Probable effects level
ppm	Parts per million
POTW	publicly owned treatment work
PRP	Potential Responsible Party
q*	cancer potency factor
RCP	Resource Conservation Plans
RfD	reference dose
RMP	Regional Monitoring Program
RWQCB	Regional Water Quality Control Board (Regional Board)
SCAG	Southern California Association of Governments
Se	selenium
sf	square foot
SQO	Sediment quality objective
SRF	State Revolving Fund
SMW	State Mussel Watch
SWPPP	Storm Water Pollution Prevention Plans
SWRCB	State Water Resources Control Board (State Water Board)
TBT	tributyl tin
TBD	to be determined
TEL	Threshold Effects Level
THS	Toxic Hot Spot
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TPH	total petroleum hydrocarbons
ug/l	micrograms per liter
Unk	unknown
Zn	zinc

EXECUTIVE SUMMARY

The Staff of the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB) have prepared this draft Functional Equivalent Document for SWRCB consideration of a proposal to develop a new Statewide Water Quality Control Policy for implementation of the Bay Protection and Toxic Cleanup Program (BPTCP). A hearing is scheduled for ____________, 1995.

This report documents the justification and recommended policy statements contained in the draft policy (Appendix A) including:

1. Authority and Reference for Guidance Regarding Implementation of the BPTCP

2. A specific definition of a toxic hot spot

3. Narrative sediment quality objectives

4. Criteria to rank toxic hot spots

5. Monitoring procedures for toxic hot spot identification including selection of biological monitoring methods, selection of sampling strategy, and toxic hot spots data analysis

6. Development process for regional toxic hot spot cleanup plans

7. Mandatory requirements for regional and Statewide toxic hot spot cleanup plans

8. Process to remediate polluted sediment at toxic hot spots

9. Responsibility for suggesting methods for toxic hot spot cleanup

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11. Remediation actions (with descriptions of both cleanup methods and costs)

12. Optional use of an expedited cleanup process

13. Toxic hot spot prevention strategies

14. Program of Implementation (including a schedule for completion of the cleanup plans).

FUNCTIONAL EQUIVALENT DOCUMENT:

WATER QUALITY CONTROL POLICY
FOR IMPLEMENTATION OF THE BAY PROTECTION
AND TOXIC CLEANUP PROGRAM

INTRODUCTION

In 1989, The California State legislature established the Bay Protection and Toxic Cleanup Program (BPTCP). The BPTCP has four major goals listed in statute: (1) to provide protection of present and future beneficial uses of the bays and estuarine waters of California; (2) identify and characterize toxic hot spots; (3) plan for toxic hot spot cleanup or other remedial or mitigation actions; (4) develop prevention and control strategies for toxic pollutants that will prevent creation of new toxic hot spots or the perpetuation of existing ones within the bays and estuaries of the State. Among other things, the Bay Protection and Toxic Cleanup Program is require to develop Statewide and Regional Toxic Hot Spot Cleanup Plans, Ranking Criteria, standard method for monitoring and sediment quality objectives.

The purpose of this Functional Equivalent Document (FED) is to present alternatives and State Water Resources Control Board (SWRCB) staff recommendations for the development of a Water Quality Control Policy to implement the BPTCP. The topics addressed in the FED include: Toxic Hot spot definition, narrative sediment quality objectives, Toxic Hot Spot Ranking Criteria, standard monitoring and assessment methods, data analysis, Toxic Hot Spot cleanup planning (e.g., site characterization, source identification, remedial action alternatives, cleanup levels, etc.) and Toxic Hot Spot prevention (e.g., watershed management).

The SWRCB must comply with the requirements of the California Environmental Quality Act (CEQA) and the Administrative Procedure Act (APA) when adopting a plan, policy of guideline. CEQA provides that a program of a State regulatory agency is exempt from the requirements for preparing Environmental Impact Reports (EIRs), Negative Declarations, and Initial Studies if the agency process is certified as functionally equivalent by the Secretary of the Resources Agency. The process the SWRCB is using to develop the Water Quality Control Policy to Implement the Bay Protection and Toxic Cleanup Policy has received certification form the Resources Agency to be "functionally equivalent" to the CEQA process [Title 14 California Code of Regulations Section 15251(g)]. Therefore, this FED fulfills the requirements of CEQA for preparation of an EIR. The environmental impacts that may occur as a result of the development of the Policy are summarized in an Environmental Checklist (Appendix B) and are outlined in greater detail through out the FED.

The SWRCB is also required to comply with the requirements of the APA. .....

The regulatory process the SWRCB will follow to develop the Policy to implement the BPTCP is presented in Figure 1. As presented in the Figure, the SWRCB staff has developed the draft FED with the review of the BPTCP advisory committee (please refer to Water Code Section 13394.6). A public hearing is scheduled for __________, 1995 to receive formal public comment on this draft FED and the Policy. The public notice for the hearing is included as Appendix D.

<u>Background</u>

The legislative deadlines for completion of Regional Toxic Hot Spot Cleanup Plans by January 1, 1998 by each RWQCB. Each Regional Toxic Hot Spot Cleanup Plan will be submitted to the SWRCB (Figure 2). By June 30, 1999, the SWRCB will in turn submit to the Legislature a consolidated statewide THS Cleanup Plan (Figure 3). The THS cleanup plans shall be the final products of the BPTCP. The Plans shall identify and rank toxic hot spots throughout the state and outline remediation actions for cleanup, mitigation, and prevention of toxic hot spots. RWQCBs will then implement the cleanup plans under their existing Water Code authority. The SWRCB will seek funding for those sites with no identified responsible party.

Figure 1: Regulatory process the SWRCB will follow to develop the Water Quality Control Policy for Implementation of the Bay Protection and Toxic Cleanup Program

Figure 2: Regulatory process the RWQCB will follow to develop the Regional Toxic Hot Spot Cleanup Plans

Figure 3: Regulatory process the SWRCB will follow to develop the Consolidated Statewide Toxic Hot Spot Cleanup Plans

Environmental Impacts of Policy Document

This FED contains staff recommendations on the issues related to the development of the Water Quality Control Policy for Implementation of the BPTCP. A discussion of the specifics of each issue is presented in the FED and the potential environmental impacts which would occur as a result of the Policy are addressed in the Environmental Checklist (Appendix B) and throughout the FED.

....

If the SWRCB adopts the staff-recommended Policy to implement the BPTCP, direct significant adverse effects on the environment are not expected. However, there may be significant or potentially significant indirect adverse effects on the environment. Alternatives to the proposed provisions of the Policy are considered in the FED. In addition the SWRCB has established some flexibility in the Policy language so the RWQCBs can adapt the use of the Policy to site-specific conditions and circumstances, if appropriate. Given the time that it would take and the speculation on the specific impacts, the SWRCB would not be able to fulfill its statutory responsibility to protect the quality of waters of the State for beneficial uses if it waited for each site-specific circumstance to be resolved. RWQCBs shall, under the provisions of the Policy, consider site-specific impacts during the implementation of the Regional Toxic Hot Spot Cleanup Plans. Environmental impacts which would occur as a result of adopting Regional THS Cleanup Plans will be addressed when an actual THS cleanup plans are proposed for adoption.

Site-specific mitigation measures are not proposed because the potential impacts identified are too speculative to assess and should, therefore, be considered on a site-by-site basis during the regional cleanup planning process or when a responsible party evaluates the impacts of cleanup technology implementation, prevention technology installation, or no action at a site. Because the proposed Policy are necessary to ensure reasonable protection of beneficial uses, prevention of nuisance in California enclosed bays and estuaries and consistent implementation of the BPTCP, we recommend the SWRCB adopt the proposals, even though some adverse impact may occur.

ISSUE ANALYSIS

The staff analysis of each issue addressed during the development of the Water Quality Control Policy for implementation of BPTCP is formatted consistently to provide the SWRCB with a summary of the topic or issue as well as alternatives for their action.

Each issue analysis contains the following sections:

Issue:	A brief description of the issue or topic.
Present Policy:	A summary of any exist Statewide SWRCB policy related to the issue or topic.
Issue Description:	A more complete description of the issue or topic plus (if appropriate) any additional background information, list of limitations and assumptions, and descriptions of related programs.
Comments Received:	All substantial comments raised in the hearing record will be addressed in this section after the public hearing on the proposed Policy. The comments not pertinent to the list of issues being considered will be listed in a separate section. The Environmental Checklist will be revised, if needed, as a result of the response to comments received.
Alternatives for SWRCB Action:	For each issue or topic, at least two alternatives are provided for SWRCB consideration.
Staff Recommendation:	In this section, a suggestion is made for which alternative should be adopted by the SWRCB.
Proposed Policy Language:	Policy language is proposed, if appropriate. The Draft Water Quality Control Policy for Implementation of the BPTCP, with all the proposed language, is included in Appendix A.

Issue 1:	Authority and Reference for Guidance Regarding Implementation of the Bay Protection and Toxic Cleanup Program
Present Policy:	Water Code Sections 13390 et seq.; 13140, 13143
Issue Description:	In order to be developed fairly and consistently, the Statewide and Regional THS cleanup plans should be developed and implemented consistent with existing Plans and Policies of the SWRCB and RWQCBs. The only way to ensure consistency is for the SWRCB to require the conformance of the plan development to a set of guidelines. If the guidance is mandatory then the SWRCB must adopt the guidance (e.g., a Statewide Plan or Policy) in accordance with the requirements of CEQA and the APA. The SWRCB should consider the format of the guidance it wil issue tot he RWQCBs.
Alternatives for SWRCB Action:	1. The State Water Board should consider incorporating the guidance for implementing the Bay Protection and Toxic Cleanup Program into a Statewide Water quality Control Plan. The State Water Board is required to adopt a Water Quality Control Plan for the Enclosed Bays and Estuaries of California (the California EBE Plan). This plan was first adopted in 1991 and was subsequently amended in 1992. The Plan contained requirements for beneficial use designations, water quality objectives, guidance on development of site-specific water quality objectives, a program of implementation, and other regulatory provisions. In 1994, the EBE Plan was nullified by the California Superior Court. The State Water Board anticipates redevelopment of the Plan over the next two to three years. Even though the Plan could be modified to contain BPTCP guidance, the EBE Plan redevelopment schedule would put the BPTCP seriously behind schedule (Cleanup plans have to be completed in 1998). This alternative would not allow the State and Regional Water Boards to meet the legislatively mandated deadlines.

2. The State Water Board should adopt a stand-alone policy for implementation of the BPTCP. The State Board should adopt an introduction that identifies the statutory authority to adopt a policy, a commitment to triennial review of the Policy, where the Policy applies, and relationships to existing plans and policies.

The State Water Board has the authority to adopt Policy for Water Quality Control (please refer to Sections 13140 and 13142 of the Water Code). Section 13142 states in part:

> "State policy for water quality control shall consist of all or any of the following:
> (a) Water quality principles and guidelines for long-range planning, including ground water or surface water management programs and control and use of reclaimed water.
> (b) Water quality at key locations for planning...and for water quality control activities.
> (c) Other principles deemed essential by the state board for water quality control...."

Implementation of a clearly worded Policy with limited flexibility in interpretation would ensure consistent implementation Statewide. However, if the Policy is too specific it may preclude circumstances encountered by the Regional Water Boards on a site-specific basis. If a Policy is developed, it should allow for site-specific variances similar to the exception process in the California Ocean Plan (1990) or site-specific variances allowed pursuant to the California Underground Storage Tank Regulations (Title 23, Article 8, CCR Sections 2680 through 2681). the proposal presented below presents this more specific process.

The process required to develop a policy is presented in Figure 1. This is generally the same process used to develop or amend the Regional Basin Plans or the Statewide Water Quality Control Plans.

3. The State Water Board should not adopt any formal guidance to implement the BPTCP.

This alternative provides the most flexibility of any of the alternatives presented. This flexibility is advantageous with the variety of conditions that will be encountered by the Regional Water Boards. However, it is also likely that the Regional Cleanup Plans developed without mandatory specific guidance would be have variable formats, incomplete information, among other problems due to varying interpretations of the Water Code (Sections 13390 et seq.).

Staff Recommendation: Adopt Alternative 2.

Proposed Policy Language: INTRODUCTION

The Water Quality Control Policy for the Implementation of the Bay Protection and Toxic Program is intended to provide guidance on the development of Regional and Statewide Toxic Hot Spot Cleanup Plans (Water Code Sections 13390 et seq.)(Stats. 1989, Chapter 269; Stats. 1989, Chapter 1032; Stats. 1990 Chapter 1294; Stats. 1993, Chapter 1157). Pursuant to Sections 13140 and 13143 of the Water Code, the State Water Resources Control Board (SWRCB) finds and declares that Cleanup Plans are required to protect the quality of waters and sediments of the State from discharges of waste, in-place sediment pollution and contamination, any other factor that can impact beneficial uses of enclosed bays, estuaries and coastal waters. The SWRCB finds further that this policy shall be reviewed at least every three years to ensure that the guidance is adequate to complete the mandates of the Bay Protection and Toxic Cleanup Program (Water Code Section 13390 et seq.).

This Policy establishes requirements for the development of Toxic Hot Spot Cleanup Plans which includes a more specific definition of a Toxic Hot Spot, site ranking criteria, guidelines for standard monitoring methods and data reporting, contents of regional and Statewide Toxic Hot Spot Cleanup Plans. The guidelines, principals and water or sediment quality objectives contained in this policy apply to all enclosed bays, estuaries and coastal waters. The provisions of resulting cleanup plans shall apply to all dischargers (point and nonpoint) in whatever location in the State as long as the discharger can be reasonably linked to the identified Toxic Hot Spot.

Regional Water Quality Control Boards shall comply with this policy except as otherwise specifically provided in the Policy. Regional Water Boards shall develop Regional Toxic Hot Spot Plans in accordance with this Policy. Any site-specific variance from the Policy shall be approved by the State Water Resources Control Board.

Definitions

ENCLOSED BAYS means indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works (refer to Water Code Section 13391.5(a) for complete definition).

ESTUARIES means waters, including coastal lagoons, located at mouth of streams which serve as areas of mixing for fresh and ocean waters (refer to Water Code Section 13391.5(b) for complete definition). Coastal lagoons and mouths of streams which are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters a re considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and sea water.

OCEAN WATERS are the territorial marine waters of the State as defined by California law to the extent these waters are outside enclosed bays and estuaries as well as adjacent waters in the "contiguous zone" or "ocean" defined in Section 502 of the Clean Water Act (33 U.S.C. 1362).

SITE-SPECIFIC VARIANCES

A site-specific variance allows an alternate approach for developing a cleanup plan for one or more sites within the jurisdiction of the Regional Water Board. Application of a site-specific variance shall be made by a Regional Water Board to the State Water Resources Control Board.

An application for a site-specific variance shall include but not limited to:

1. A description of the provision from which the variance is requested.

2. A detailed description of the approach to be used. The proposed alternative program, method, or process shall be clearly identified.

3. Any specific circumstances on which the Regional Water Board relies to justify the finding necessary for the variance.

4. Clear and convincing evidence that the alternative approach will better protect beneficial uses.

5. Documentation that shows compliance with the California Environmental Quality Act.

The Regional Board shall hold a hearing on the site-specific variance application. The Regional Water Board shall notify all interest parties and responsible parties of the hearing. Subsequent the hearing, the Regional Board shall submit the revised application to the Sate Water Resources Control Board for approval.

Issue 2: Toxic Hot Spot Definition

Present Policy: None

Issue Description: One of the fundamental tasks of the Bay Protection and Toxic Cleanup Program is the identification of toxic hot spots. The SWRCB needs to consider whether a specific definition of toxic hot spots is warranted. The issue is should the SWRCB implement a general definition of a toxic hot spot or should another definition that is more focussed be used.

<u>Background</u>

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."

Identification of toxic hot spots is a critical first step in the assessment, cleanup or remediation of polluted sites in California's enclosed bays and estuaries. The criteria evaluated and adopted in the process of defining a toxic hot spot will also lay the foundation for the eventual development of sediment quality criteria.

To assist the State and Regional Water Boards' staff, the State Water Board sponsored a technical workshop in February of 1991 in an effort to determine the criteria necessary to develop 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 country, as well as observers from state and federal agencies, discharger organizations, and environmental groups. The participants' recommended higher and lower priorities for criteria that an ideal sediment quality assessment strategy should meet are presented in Table 1.

Toxic Hot Spot Definition Considerations

One of the most important views expressed by the sediment quality assessment workshop participants was the adoption of a weight-of-evidence approach for 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. In order to implement this approach it is necessary for the toxic hot spot definition to include assessment of biological response as well as analysis of the chemical contamination of various media.

Various indicators of environmental impacts will have to be selected according to which measures are available and provide the most information. The selection of measures will be made in such a way that adequate protection of as many ecosystem components as possible is achieved in the most practical, efficient, and cost-effective manner.

These measures focus on several levels of biological organization from subcellular to community, from single celled organisms to the highest order predators. Any of these measures taken singly can provide limited insight into the quality of the estuarine environment. When used together they will provide a much more comprehensive characterization of the environment of interest than any one measure used alone.

There are other programmatic and regulatory elements that also need to be considered in the development of a specific toxic hot spot definition, and include:

1. The definition must be able to distinguish between sites with either significant or little information on environmental impacts of toxic pollutants.

TABLE 1

Prioritized Criteria Recommended for a Sediment Quality Assessment Strategy. [1]

Higher Priority

- Differentiate between effects due to toxic substances and changes due to natural factors (describe the significant variability of exposure and response, including identification of major sources of variability).
- Be of broad and local ecological relevance.
- Detect the effects on biota from long-term exposures.
- Consider the bioavailability, exposure potential, and/or bioaccumulation of toxic agents.
- Be a tiered approach that utilizes multiple assessment tools and/or approaches, including a first tier that is rapid, sensitive, and overprotective.
- Use of a suite of appropriate sensitive species.
- Identify agent(s) causing toxicity in the field.
- Clearly identify range above which impairment occurs and below which no impairment is predicted.
- Identify and quantify potentially toxic agent(s).
- Include a mechanism to evaluate efficacy and incorporate improvements.
- Be scientifically defensible.

Lower Priority

- Detect effects on biota from short-term exposures.
- Be clearly described.
- Specify the degree of certainty of protection which will be attained for sensitive organisms.
- Be of low or moderate cost.[2]

notes

1 Priorities assigned based on information presented at the State Water Resources Control Board sponsored Sediment Quality Assessment Workshop held in February 1991.

2 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.

2. The definition must be testable using interpretable scientific procedure, i.e., either indicators of stress or actual measurements of impacts on beneficial uses).

3. The definition should be usable with existing monitoring information as well as with any new monitoring information that may become available.

4. The definition should allow for the use 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. Biological response(s) of organisms is of greater importance than chemical measurement alone.

6. Biological response should be associated with the presence of non-naturally-occurring toxic pollutants (association of biological response with exposure to other physical or chemical agents alone, e.g., hydrogen sulfide (H_2S), grain size, total organic carbon (TOC), etc., is not sufficient to identify a toxic hot spot).

7. Actual loss of beneficial use is not necessary to designate a site as a toxic hot spot (i.e., indicators of pollutant effects are sufficient for the designation).

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.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives for State Board Action:

1. <u>Allow Regional Water Boards to apply only the statutory definition of toxic hot spot provided in Section 13391.5 of the Water Code.</u> The statutory definition of a toxic hot spot gives the Regional Water Boards significant latitude in considering which locations in the State are considered toxic

hot spots. Using this definition would give the same "toxic hot spot" designation to sites with little information available and sites that are well studied. The RWQCBs would then be required to develop a cleanup plan that planned for the remediation or further prevention of toxic pollutants at these sites.

The statutory definition of a toxic hot spot is quite general, and could be subject to an interpretation that would allow large portions (if not all) of California's coastline, including enclosed bays and estuaries, to be designated as a toxic hot spot. A very broad interpretation would not help the State and Regional Water Boards in planning for the cleanup or remediation of toxic hot spots, because it would be difficult to focus efforts where regulatory response is needed most. It is very unclear how many toxic hot spots would be identified using the statutory definition. Conceivably, every water body that has been previously sampled could be designated as a toxic hot spot.

2. <u>Apply a more specific definition of a toxic hot spot that is consistent with the intent of Section 13391.5 of the Water Code.</u> One of the most critical steps in the development of toxic hot spot cleanup plans is the identification of hot spots. Once they are identified the parties responsible for the sites could be liable for the cleanup of the site or further prevention of the discharges or activities that caused the hot spot. Because the cost of cleanup or added prevention could be very high, the SWRCB should consider categorizing toxic hot spots to distinguish between sites that we have little information (potential toxic hot spots) and areas with significantly more information (known toxic hot spots). The SWRCB should also consider that before a site is considered a known toxic hot spot that, before the Regional Water Quality Control Boards have formally adopted a cleanup plan the known site should be considered a Candidate Toxic Hot Spot. If a candidate toxic hot spot is adopted by a RWQCB in a Regional Toxic Hot spot Cleanup Plan then the toxic hot spot becomes a known toxic hot spot.

The specific definition of a toxic hot spot that follows combines consideration of sediment quality assessment criteria, programmatic and regulatory criteria, and tools either currently available or in the process of being developed to identify toxic hot spots.

Under this alternative, the definition of a toxic hot spot is separated into three parts, potential, candidate and known, based on the amount of information available and the confidence we have in the interpretation of the information and whether the RWQCBs have adopted cleanup plans identifying the site as a known toxic hot spot. A site should be considered a candidate toxic hot spot (and after adoption by the RWQCBs as a known toxic hot spot) if it exhibits significant toxicity, high levels of bioaccumulation, impairment of resident organisms, degradation of biological resources, or water or sediment quality objectives are exceeded.

In all cases, repeated or recurrent and replicated measurements are needed to characterize the candidate or known hot spots. The test to become a candidate or known toxic hot spot requires a significant amount of information; with the existing information available, relatively few sites are expected to meet the stated requirements at this time.

Sites that are not well characterized (i.e., insufficient data to designate as a candidate toxic hot spot) shall be characterized 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 the 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 bioaccumulation 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.

Human Health

Toxic hot spots can also be caused by pollutants that have the potential to cause impacts on human health. In California, if a fish advisory has been issued for a water body than it is acknowledged that the beneficial use for that water to protect human health via seafood consumption is impaired (i.e., the beneficial use has been lost because the public has been warned that fish tissue concentrations are high enough to be potentially harmful to human health). Several agencies (e.g., the Department of Health Services, Office of Environmental Health Hazard Assessment, and the Food and Drug Administration) have also published chemical specific values for tissue concentrations that are intended to protect human health (FDA, 1984; OEHHA, 1991; EPA, 1993). These values are extremely useful in assessing the quality of fish or other organism tissue for consumption. When used carefully and consistently these considerations can assist in identifying locations where human health may be impacted.

Biological Indicators of Contaminant Effects

There is presently no single method, test, or procedure capable of adequately characterizing the many and varied adverse biological effects and ecological impacts contaminated sediments may cause. The most appropriate and scientifically defensible approach currently available appears to be choosing not one, but an array of tests that determine multiple endpoints using a number of individual species or ecological assemblages, and that can also assess various routes of exposure.

Toxicity Testing

The use of a number of different organisms ensures a greater opportunity to identify problematic conditions than reliance on a single organism. 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 in test systems. The determination of an array of toxicity testing endpoints ranging from lethality, through critical life stages, to genotoxicity, etc., will allow the evaluation of a variety of effects.

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, 1993; De Witt et al., 1989; Nebecker et al., 1984). These amphipods have been used on 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 means of characterizing biological impairment. Several tests developed for the measurement of 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).

Histopathology

Adverse effects may also be determined by visual means, for necropsy or for morphological deformities, defects, or other pathological changes in specific tissues or organs. Lesions in these tissues are often correlated with death, deformity, or poor general fitness (condition indices) of the animal, and include cancerous or precancerous transformations in tissues such as the gills, liver, reproductive organs, etc. (Hinton et al., 1990; Malins et al., 1987). Some abnormalities can, however, appear in the early stages of the development of more damaging pathologies that may be reversible (these are indications of exposure rather than actual adverse effects).

Biomarkers

In addition to measures of effect, measures of exposure of organisms to pollutants can be a powerful tool applied to identification of toxic hot spot. 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 is that many are adaptable to inexpensive, rapid assessment methods.

Several exposure measures focussing on the cellular or subcellular level are available. There are enzyme systems which are induced by the presence of pollutants which can be measured. These include EROD (ethoxyresorufin o-deethylase), the cytochrome P450, AHH (arylhydrocarbon hydroxylase) (Stegman et al., 1988; Leng and Buhman, 1989), and stress protein induction (Sanders, 1990).

Selected enzymes in the P450 system have been shown to be 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 have been used to identify polluted sites. A special application of the P450 system which is under development by the program is the use of a genetically engineered cell line to elucidate exposure to dioxins, furans and related substances.

Another enzyme system of interest is the group of enzymes known as stress proteins (Sanders, 1990). These enzymes appear to be elevated in response to exposure to metals, as well as other stress factors. Stress proteins generally function to stabilize macromolecules during transport within cells and in the repair of damaged enzymes.

Also potentially useful is a group of enzymes that has been associated with the development of cancer. A number of enzymes have been noted to be either depressed or elevated in both tumor cells and in cells identified as precancerous. The measurement of a biochemical alteration in the presence of a disease state which can be associated with, or be considered an effect of contamination, offers a prime opportunity to evaluate these enzymes for little additional cost. Further work is needed to evaluate the utility of this group in environmental monitoring.

A number of tests for genotoxicity have been developed and are in use. 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).

<u>Benthic Community Analysis</u>

Benthic community structure (organisms that live in the sediments) 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 types of measures focus on the population or community level. The results can then be analyzed using ordination techniques, principal component analysis, or other techniques to identify potential causes of any differences detected.

The analysis of community composition will provide not only a direct assessment of impacts, but also an opportunity to identify indicator species, i.e., species that respond predictably or characteristically in the presence or absence of degraded conditions, such as those produced by a contaminated benthic environment. Due to the myriad of forces influencing the composition of a community or population, it is often difficult to determine whether toxic pollutants are responsible for such changes.

To clarify whether toxicants are exerting significant effects, community analysis can be coupled with measures of individual organisms. The integration of community measures and toxicity tests provides for a weight-of-evidence that decreases the possibility of attributing adverse effects to pollutants when, in fact, they are not. The ability for individual toxicity testing methods or suites of toxicity tests to predict community level effects can also be evaluated. Benthic community analysis can also be used to evaluate reference conditions.

An example of an indicator species is the brittle star Amphiodia urtica found at depths greater than 30 meters in the Southern California Bight (Smith et al., 1992). This animal appears to be abundant in areas not impacted by sewage discharge, and scarce or absent in areas influenced by the discharge of sewage. In some areas with exotic species or that are highly variable, the use benthic community analysis may be inappropriate.

Proposed Specific Definition

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 specific definition provides the RWQCBs with a specific working definition and a mechanism for identifying and distinguishing between "potential," "candidate" and "known" toxic hot spots. A Candidate Toxic Hot Spot is considered to have enough information to designate a site as a Known Toxic Hot Spot except that the candidate hot spot has not been approved by the appropriate Regional Water Quality Control Board. Once a candidate toxic hot spot has been adopted into a toxic hot spot cleanup plan then the site shall be considered a known toxic hot spot and all the requirements of the Water Code shall apply to that site.

a. Potential Toxic Hot Spot

The Water Code 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 further as a "candidate" or "known" toxic hot spot are classified as "potential" toxic 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 test other than those specified by the State or Regional Boards;

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 advisory for migratory fish that applies to the whole water body has been issued for the site by OEHHA, DHS, or a local public health agency, the waterbody will be considered a potential toxic hot spot. Further monitoring is warranted to determine if health warnings are necessary at specific locations in the waterbody.

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.

b. <u>Candidate Toxic Hot Spot</u>:

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

1. The site exceeds water or sediment quality objectives for toxic pollutants that are contained in appropriate water quality control plans or exceeds water quality criteria promulgated by the U.S. Environmental Protection Agency.

   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 State Water Resource Control Board or the Regional Water Quality Control Boards.

   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 (e.g., the Bay Protection and Toxic Cleanup Program Quality Assurance Project Plan). 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 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 a health advisory against the consumption of edible resident non-migratory organisms has been issued by OEHHA or DHS, on a site or waterbody, the site or waterbody is automatically classified a "candidate" toxic hot spot if the chemical contaminant is associated with sediment or water at the site or water body.

   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 in tissue are required. Residue levels established for one species for the protection of human health can be applied to any other 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 measured in the environment 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. Each of the test shall be acceptable to the SWRCB or the RWQCBs.

   <u>Growth Measures:</u> Reductions in growth can be addressed using suitable bioassays acceptable to the State or Regional Boards or through measurements of field populations.

   <u>Reproductive Measures:</u> 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 "candidate" 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 the diminished numbers of species 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 "candidate" hot spots after generating information which satisfies any one of the five conditions constituting the definition. To use the working, a list of toxicity tests is presented in this policy. The list identifies toxicity tests for monitoring and surveillance activities partially satisfies the Water Code requirement [Section 13392.5(a)(2)] for standardized analytical methods.

c. Known Toxic Hot Spot:

A site meeting any one or more of the conditions necessary for the designation of a "candidate" toxic hot spot and has gone through a full State or Regional board hearing process, is considered to be a "known" toxic hot spot. A site will be considered a "candidate" toxic hot spot until approved as a known toxic hot spot in a Regional Toxic Hot Spot Cleanup Plan by the Regional Water Quality Control Board.

Numbers of Toxic Hot Spots Using the Specific Definition

Each of the seven RWCQBs participating in the program has assembled a preliminary list of potential and candidate toxic hot spots (SWRCB, 1993). These lists have been updated and are included in this section to show how many sites would be designated as potential or candidate toxic hot spots. Please note that none of the candidate sites should be considered under any circumstances as known toxic hot spots until the sites have been ranked and adopted as a part of a toxic hot spot cleanup plan.

The trigger number listed in Table 2 refers to the various conditions listed under the specific definition of a toxic hot spot that is presented in the "Proposed Language" section. The numbers corresponding to the condition(s) that were met to designate the site as a "potential" or "candidate" toxic hot spot.

For the program as a whole, 19 candidate toxic hot spots and 179 potential toxic hot spots have been identified (Table 2). Each RWQCB maintains files containing the information cited in Table 2. The information listed in Table 2 was developed using existing information. The lists will be updated as new information becomes available from BPTCP monitoring efforts or other ongoing efforts.

Please note that this list is NOT a final list of candidate and potential toxic hot spots. The lists are provided in this document so the SWRCB can evaluate the impacts of adopting the proposed definitions. As the RWQCBs develop the Regional Cleanup Plans the lists will be reevaluated by the RWQCBs.

The lists in Table 2 do not reflect water bodies that have not been sampled or for which the RWQCBs have very little information.

[This Table should be updated by Regional Boards.]

TABLE 2
PRELIMINARY CANDIDATE 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							
Candidate Toxic Hot Spots							
None Reported							
Potential Toxic Hot Spots							
Arcata Bay	McDaniel Slough	SMW 95.0	3	PCB, DDT	10	4	
Pacific 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	Areal Estimate (Acres)	Citation	Comments
SAN FRANCISCO BAY REGION							
Candidate 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	Cu Hg, Ni	>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	Areal 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							
Candidate Toxic Hot Spots							
None Reported							
Potential Toxic Hot Spots							
Carmel Bay		SMW Sites	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		Several Sites	1,2	Cadmium, Copper, TBT	Unk/TBD	4,59,60
Santa Barbara Harbor		SMW Sites	1,2	Mercury, Zinc, Copper in Shellfish	Unk/TBD	4,64,65 66
San Luis Harbor		Several Sites	1,2	Possible Metals and Hydrocarbons and Oil Facilities	Unk/TBD	4,67,68
San Luis Obispo Creek		Several Sites	1	Bacteria, Sulfur, Pesticides, Fertilizers	Unk/TBD	4,5,69,70,71, 72,73,74,75
Monterey Bay	Monterey Harbor	SMW Sites RWQCB Study Sites	1,2,3	Lead in Shellfish and Sediments. Possible TBT in Sediments.	Unk/TBD	4,5,76,77
Morro Bay		SMW Sites	1,2	Possible Pesticides, Bacteria, Metals, TBT	Unk/TBD	4,78,79,80,81
Monterey Bay	Elkhorn Slough	SMW Stations	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	SMW Sites	1,2	Pesticides and bacteria in Shellfish, TBT	Unk/TBD	4,5,85	
Goleta Slough/ Estuary		Several Sites	1	Bacteria in Shellfish and Copper in Water, Metals in Sediments	Unk/TBD	4,5,86,87	
Monterey Bay	Harkins Slough	SMW Sites	1	Pesticides in Fish and Shellfish	Unk/TBD	4,5	
Monterey Bay	Moro Cojo Slough	SMW Sites	1,2,3	Pesticides in Shellfish	Unk/TBD	4	
Monterey Bay	Tembladero Slough	TSM Sites	1,3	Pesticides in Fish	Unk/TBD	5	
Salinas River	Salinas River Lagoon	SMW and TSM Sites	1,2,3	Pesticides in Fish and Shellfish	Unk/TBD	4,5,88,89, 90,91	
Monterey Bay	Espinosa Slough and Salinas Rec. Canal	SMW and TSM Sites	1	Pesticides in Fish and Shellfish	Unk/TBD	4,5,92,93, 94,95	
Salinas River	Old Salinas River Estuary	Several Sites	1,3	Pesticides in Fish and Shellfish	Unk/TBD	4,5,96	
Monterey Bay	Watsonville Slough and Pajaro River Estuary	Several Sites	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							
Candidate 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 candidate 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							
Candidate Toxic Hot Spots							
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	Trigger Number	Pollutant(s) Identified	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 "candidate" list		1	TBT	Unk/TBD		13

Regional Water Board and Water Body Name	Segment Name	Site ID	Trigger Number	Pollutant(s) Identified	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	
Potential Toxic Hot Spots							
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	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	Citation	Comments
SANTA ANA REGION							
Candidate 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	Trigger Number	Pollutant(s) Identified	Areal Estimate (Acres)	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	Unknown	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							
Candidate 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 Rhepoxynius 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 Candidate 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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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. SCE--El Segundo Generating Station CA0001147 M4667.

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3. <u>Apply a more specific of a toxic hot spot definition that is consistent with the intent of Section 13391.5 of the Water Code that does not include the category of "Candidate" toxic hot spot.</u>

As in alternative 2, one of the most critical steps in the development of toxic hot spot cleanup plans is the identification of hot spots. Once they are identified the parties responsible for the sites could be liable for the cleanup of the site or further prevention of the discharges or activities that caused the hot spot. Because the cost of cleanup or added prevention could be very high, the SWRCB should consider categorizing toxic hot spots to distinguish between sites that we have little or no information (potential toxic hot spots) and areas with significantly more information (known toxic hot spots). Under this alternative, sites would be categorized as either known or potential toxic hot spots as presented in SWRCB (1993).

Under this alternative, the definition of a toxic hot spot is separated into two parts, potential and known, based on the amount of information available and the confidence we have in the interpretation of the information and whether the RWQCBs have adopted cleanup plans identifying the site as a known toxic hot spot. A site would be considered a known toxic hot spot if it exhibits significant toxicity, high levels of bioaccumulation, impairment of resident organisms, degradation of biological resources, or water or sediment quality objectives are exceeded.

The disadvantage of this alternative is that responsible parties may be considered to be liable for the hot spot before the RWQCBs have adopted a cleanup plan.

Staff Recommendation: Adopt Alternative 2.

Proposed Language: SPECIFIC DEFINITION OF A TOXIC HOT SPOT

Each region shall identify toxic hot spots within its jurisdictional boundaries according to the following:

Specific Definition of a Toxic Hot Spot

The proposed specific definition presented in Alternative 2 will be used.

To support the specific toxic hot spot definition the following definitions should be adopted:

ADVISORY LEVEL: a level of chemical contamination in seafood tissue found to be a significant potential human health threat based on a risk assessment of adequate tissue contamination data from a specific waterbody. Fish tissue levels are the most common data used when issuing consumption advisories for water bodies. Existing advisory levels for a water body could be applied to specific stations and used to designate toxic hot spots. Cleanup levels might not be the same as advisory levels.

MIGRATORY FISH: Fish species that move between water bodies seasonally or at different life stages. They may move between water bodies to follow favorable feeding or water conditions, or over periods associated with reproductive cycles. These do not make good target species for tissue sampling because the type and concentration of chemicals in tissue is potentially accumulated or diluted in part from sites far removed from where the species is sampled.

MAXIMUM TISSUE RESIDUE LEVELS (MTRLS): tissue level of chemical contaminants in fish or seafood that fully protects beneficial uses. MTRLs are calculated from water quality objectives or water quality criteria intended to protect human health. MTRLs are calculated by multiplying the bioconcentration factor for a chemical by the chemical's water quality criterion or water quality objective.

NON-MIGRATORY FISH SPECIES are fish species that do not move between water bodies seasonally or at different life stages. These species are good targets for tissue sampling because the chemicals present in tissue are accumulated from a more restricted area.

SHELLFISH are organisms identified by the California Department of Health Services as shellfish for for public health purposes (e.g., edible bivalve species or crustacean species such mussels, clams, oysters, and crabs). These species typically have limited mobility. This makes them good sampling targets for detection and identification of local chemical contaminants.

SITE: an area with two or more adjacent stations whose toxicity, benthic community, and/or chemical concentrations are similar or complimentary.

STATION: the discrete point at which media samples are collected.

Issue 3: Sediment Quality Objectives

Present Policy: The State Water Resources Control Board currently has not adopted sediment quality objectives to support the Bay Protection and Toxic Cleanup Program. However, the SWRCB has adopted water quality objectives that are intended to protect beneficial uses associated with marine sediments (California Ocean Plan).

Issue Description: In 1991, the SWRCB adopted a workplan for the development and adoption of sediment quality objectives (California Water Code (Water Code), Section 13392.6). The SWRCB is required to adopt sediment quality objectives developed pursuant to the workplan and in accordance with procedures established in the Water Code for adopting and amending water quality control plans. Sediment quality objectives are needed by the SWRCB and the RWQCBs to assist in the development of toxic hot spot cleanup plans. Sediment quality objectives are needed to assist the RWQCB in establishing sediment cleanup levels (addressed in another issue).

Water quality management of California's enclosed bays and estuaries is directed by the SWRCB and seven of the nine Regional Water Quality Control Boards (RWQCBs). (The other two Regional Boards do not have boundaries that extend to coastal waters). The programs for water quality management are developed and implemented pursuant to both the Federal Clean Water Act (Public Law 92-500 as amended) and the State's Porter-Cologne Water Quality Control Act (Water Code, Division 7). A fundamental responsibility encompassed in these laws is the protection of beneficial uses of the waters of the State from the effects of adverse water quality conditions. In 1989, this responsibility was refined somewhat by the additional of new State statutes specifying, among other things, that the SWRCB develop sediment quality objectives to protect the beneficial uses of bays and estuaries from the adverse affects of toxic substances (Water Code Section 13390 et seq.).

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). Sediment quality objectives to protect designated beneficial uses (e.g., aquatic life or human health) should be based on sound scientific rationale and must represent the highest (i.e., most protective) sediment quality which is reasonable (Water Code Section 13241, 40 CFR

131). Factors to be considered in establishing water quality objectives, including sediment quality objectives, include but are not limited to:

- o Past, present and probable future beneficial uses;
- o Environmental characteristics of the hydrographic unit under consideration;
- o Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect the water or sediment quality of the area;
- o Economic considerations;
- o The need for developing housing within the Region (Water Code, Section 13241); and
- o The need to develop and use recycled water.

Water Code Section 13393 provides further definition of a sediment quality objective: "...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." Sediment quality objectives can be either numerical values based on scientifically defensible methods or narrative descriptions implemented through toxicity testing or by assessing the potential human health concerns.

The responsibility of the State and Regional Boards to reasonably protect beneficial uses requires that an extremely large group of organisms which are affected by water quality conditions be considered. These include benthic (living in sediments) and epibenthic (living on the surface of sediments) organisms, organisms living in the water, waterfowl and shorebirds, and terrestrial animals (including humans) which eat aquatic organisms or drink the water. Aquatic resources can have complex food webs and interactions that are often poorly understood. Therefore, to protect beneficial uses, regulatory mechanisms need to provide confidence that the most sensitive of these organisms are being reasonably protected to ensure environmental integrity is maintained. Implicit in this approach is that the State and Regional Board's determination of the threshold of toxic effects for each substance of concern is not required. However, as part of a compete regulatory program, sediment quality objectives should provide assurance that concentrations of toxic pollutants in the environment reasonably protect beneficial uses.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For State Board Action:

1. Do not adopt sediment quality objectives in any form. Section 13393 of the Water Code requires the SWRCB to adopt sediment quality objectives. This mandate in the Water Code is permissive allowing the SWRCB significant latitude in when sediment quality objective will be adopted. If this alternative is adopted the SWRCB will limit the RWQCBs in their ability to develop reasonable sediment cleanup levels based on sediment quality. The advantage of this alternative is that the RWQCBs will have significant latitude in interpreting the existing water quality objectives (in basin plans and the California Ocean Plan) and applying them to sediment cleanup or prevention activities in enclosed bays and estuaries.

2. Adopt narrative sediment quality objectives only (until chemical-specific numerical sediment quality objectives are adopted).

   When little in known about the impacts of possible pollutants or the pollutants are unknown the SWRCB and the RWQCBs can implement sediment quality objectives that are narrative. Narrative sediment quality objectives can take the form of general statements of protecting sediment beneficial uses. Because this type of objective is non-numerical interpretation of the sediment quality objectives depends on the inclinations of the various regional boards using the objectives and the context of the use.

   An advantage of adopting narrative sediment quality objectives is that RWQCBs have a clear mandate to protect beneficial uses of enclosed bay and estuarine sediments. Another advantage is that the RWQCBs can exercise a great deal of judgement for each instance that the narrative sediment quality objectives are applied. A disadvantage is that one RWQCB may interpret a non-specific narrative objective quite differently than other RWQCBs.

An analysis of the factors that should be considered when adopting sediment quality objectives follows.

- Past, present and probable future beneficial uses;

  The beneficial uses that should be considered in the adoption of narrative sediment quality objectives includes the protection of aquatic life in enclosed bays and estuaries and the protection of human health from the consumption of contaminated seafood. These beneficial uses are lists in great detail in the RWQCB basin plans.

- Environmental characteristics of the hydrographic unit under consideration;

  The full list of water bodies that the sediment quality objectives apply in contained in SWRCB (1993). The types of water bodies to be considered are river mouths, estuaries, coastal lagoons, enclosed bays and the San Francisco Estuary (including the Bay and Sacramento/San Joaquin River Delta).

- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect the water or sediment quality of the area;

  This factor will be considered by RWQCBs in the development of the regional toxic hot spot cleanup plans. The Water Code requires that RWQCBs consider and present the costs of hot spot cleanup, an assessment of sources and how each permitted discharge can be modified to prevent or remediate the toxic hot spot.

- Economic considerations;

  Considerations of economics is extremely difficult when implementing narrative sediment quality objectives. For each cleanup plan the RWQCBs are expressly required to consider the costs of cleanup.

- o The need for developing housing within the Region (Water Code, Section 13241);

  If the narrative sediment quality objectives are implemented in a manner that will require that mass loading be reduced, limits could be placed on dischargers that could limit the development of housing in a region. These types of impacts should be mitigated by comprehensively considering all inputs into the bay or estuary with the toxic hot spot and consider the most cost effective manner to comply with the objective (e.g., manage on a watershed basis).

- o The need to develop and use recycled water.

  In developing toxic hot spot cleanup plans the RWQCBs should consider the need to develop and use recycled water. These consideration should be made at the time the management actions for the toxic hot spot are being developed (i.e., during the development of the toxic hot spot cleanup plan).

Aquatic life protection is not the only consideration in sediment quality objective development. Sediment objectives must protect the most sensitive beneficial use (40 CFR 131.11). In many instances, human health is the most sensitive beneficial use to be protected. State law requires that objectives be based on a human health risk assessment if there is a potential for exposure of humans to pollutants through the food chain (Water Code Section 13393).

In addition to understanding that sediment quality objectives define levels that protect aquatic life and human health, we should explain how sediment objectives are proposed to be used in the regulatory system. There are three uses of sediment quality objectives: (1) evaluating the overall quality of water body, (2) developing effluent limitations, and (3) triggering the need for determining further actions (e.g., toxic hot spot cleanup plans, additional site characterization, etc). Objectives provide a means for evaluating the overall quality of a waterbody. Data from ambient sampling, collected either as part of ongoing monitoring programs or surveillance activities, can be compared to sediment quality objectives to determine if impairment is occurring. If impairment is occurring then corrective actions can be undertaken. Sediment quality objectives also serve as a screening mechanism for setting priorities on resource allocations and corrective actions. Objectives provide a means for identifying where impacts are occurring (e.g., toxic hot spot identification) and, therefore, allow for comparison of the resources at risk and potential costs of corrective actions.

A second use of sediment quality objectives is for the development of control measures including effluent limitations which are enforceable limits placed on individual dischargers and nonpoint source controls including the implementation of Best Management Practices (BMPs). Effluent limits define the contributions of pollutants allowable from a particular discharge. Effluent limitations also establish long term planning goals in the design of facilities and for the evaluation of best management practices and nonpoint source control measures. Established methods for the translation of sediment quality objectives into effluent limitations do not currently exist.

Several approaches will be considered for use in the development of permit provisions. Some examples of what might be considered are: (1) a trial and error approach where effluent limits are repeatedly revised downward until satisfactory sediment quality is attained, (2) multiplication of an effluent concentration by a partitioning ratio (e.g., mass of pollutant in effluent/mass of pollutant in sediment) where the sediment component of the ratio is derived from the sediment quality objective, or (3) application of fate and transport models. Several different methods may be incorporated into the regulatory programs based on specific circumstances.

3. <u>Adopt chemical-specific sediment quality objectives.</u> Several chemical specific approaches for development of sediment quality have been developed. Of these, four are the most appropriate for consideration of development of sediment quality objectives. These approaches are the Equilibrium Partitioning approach (EPA 1989a, EPA 1990) developed by EPA, the Apparent Effects Threshold approach (PTI 1988, EPA 1989b) developed by the State of Washington and EPA Region X, the Spiked Bioassay approach (Giesy and Hoke 1990,

Swartz et al. 1988), and Weight of Evidence approach (Lorenzato and Wilson, 1991).

Equilibrium Partitioning (EqP) Approach

Using this approach, sediment quality objectives would be established at chemical concentrations in sediment that ensure interstitial concentrations do not exceed EPA water quality criteria. The EqP approach assumes that pollutants are generally in a state of thermodynamic equilibrium and that the relative concentration of a pollutant in any particular environmental compartment (sediment, pore water, ambient water, etc.) can be predicated using measured partitioning coefficients for specific substances in equilibrium equations. The development of a regulatory level relies on the assumption that pore water is the dominant route of exposure. In California, adopted water quality objectives would be used as the protective level for pore water concentrations. Acceptable sediment concentrations would be derived using the appropriate partitioning coefficients. The EqP approach is currently limited to nonpolar, nonionic compounds although methods for metals are under development. The protection of sediment ingesting organisms is not addressed in this approach. Also the assumptions stated above have not been adequately tested.

EPA has recently published (EPA, 1993a; 1993b; and 1993c) draft SQC that could be used for this purpose.

Apparent Effect Threshold (AET) Approach

The AET approach is an empirical method applying the triad of chemical, toxicological, and benthic community field survey measures to determine a concentration in sediments above which adverse effects are always expected (statistically significant different of adverse effects are predicted at $p< 0.05$). Each suite of measures consists of chemical and toxicological measures taken from subsamples of a single sample and benthic analysis conducted on separate samples collected at the same time and place. A large suite of chemical measures and a large number of sites are required before an AET value can be estimated. The method assumes a single toxicant is responsible for effects measured at a given site. In addition, the value generated is by design, an effect level rather than a protective level. While above the AET one can expect adverse effects, the method does not recognize that below the AET adverse effects may be attributed to the substance of concern. A major limitation of the method is that the observed relationships between effects and chemical concentrations are based on correlations only (the relationship does not demonstrate cause and effect).

Spiked Sediment Bioassay Approach

The spiked bioassay approach generates an organism's response following the addition of know quantities of a toxicant to a sediment sample and subsequent bioassay. Known mixtures of toxicants can also be tested. The dose response relationship can then be used to identify appropriate effect and no effect levels. Because of a number of complicating factors in the handling and measurement of the sediments and toxicants this approach can only be considered a rough approximation of the in situ effects of toxicants in the environment. Several factors appear to indicate that toxicants in spiked bioassays are more available and, therefore, the test may over estimate toxicity. However, other factors indicate that these tests may not reflect the important routes of exposure (like ingestion of benthic organisms) and, therefore, may under estimate toxicity. In combination with corroborating field information spiked bioassays can be a powerful tool.

Weight of Evidence Approach

This approach relies on a preponderance of evidence to indicate when effects produced by specific pollutants are likely to occur. Chemical-specific sediment quality objectives could be developed as presented in the Workplan for development of sediment quality objectives for enclosed bays and estuaries of California (Lorenzato and Wilson, 1991).

The described method involves combining AET values, equilibrium values and the lowest observed effect level from spiked bioassay studies. These three measures would then be combined by taking the geometric mean of the values and then multiplying by an uncertainty factor which accounts for the concordance of the data. The uncertainty factor would be equal to the inverse of the range of the three measures. For example, if the range of AET, EqP and spiked bioassay values were 2 then the sediment quality objective would be one half of the geometric mean of these values. If the range were 10 the sediment quality objective would be set at one tenth of the geometric mean. If the resulting value does not fall below the lowest of the observed effect levels, then the lowest observed effect divided by 2 will serve as the objective.

The selection of these particular measures allows for the integration of empirical data developed for AETs, theoretical information used in EqP, and cause and effect relationships established by spiked bioassays.

The combination of these three methods balances the uncertainties and limitations of any one method by incorporating the strengths of the other two methods to produce a single value. The use of an uncertainty factor ensures a value below known effect levels , and the use of the inverse of the range of the effects levels encompasses increasing confidence in the prediction which comes with a narrow range of effects values.

Sediment Quality Objectives Based on Human Health Risk Assessment

In 1993, CalEPA's Office of Environmental Health Hazard Assessment developed a strategy for establishing sediment quality objectives based on human health risk assessment (Brodberg et al., 1993). Human exposure to chemical contaminants in contaminated sediments is indirect via the consumption of seafood. Seafood species may directly assimilate the chemical contaminant from sediment or indirectly via the consumption of contaminated organisms from lower levels in aquatic food-webs. This is the primary route through which humans can be exposed to chemicals present in the sediments, potentially leading to adverse health effects.

A standard procedure for setting sediment quality objectives based on human health has not been established within the regulatory community (Shea, 1988). The elements of a procedure to develop sediment quality objectives to protect human health can be developed by combining the risk assessment process and models estimating the movement and bioaccumulation of chemical contaminants in aquatic ecosystems. These models are necessary to establish the sediment concentration of a contaminant that would lead to a given concentration in edible seafood. The relationship between sediment and seafood concentrations of contaminants may also be established empirically and used in models to set SQOs based on human health.

OEHHA has begun to develop the information necessary to complete the calculation of sediment quality objectives to protect human health but the task is not yet complete. At this time, sediment quality objectives to protect human health can not be proposed.

Advantages and Disadvantages

An advantage of this alternative is that each RWQCB will use the same values for evaluating sediments and for developing toxic hot spot cleanup plans. More consistency among the RWQCBs would be assured.

An important disadvantage of this alternative is that we do not know the impacts of implementing these objectives on dischargers and other responsible parties. The BPTCP has been hindered by the lack of funding to develop the necessary information to fully or more fully evaluate sediment quality objectives.

Staff Recommendation: Adopt Alternative 2.

Proposed Language:

Adopt narrative sediment quality objectives as follows:

The concentration of chemical substances in enclosed bay and estuarine sediments shall not impact beneficial uses.

The concentration of chemical substances (both metals and organic substances) in enclosed bay and estuarine sediments shall not increase to levels that would degrade aquatic life.

The concentration of chemical substances (both metals and organic substances) in fish, shellfish, or other enclosed bay or estuarine resources used for human consumption shall not bioaccumulate from sediments to the living resource to levels that are potentially harmful to human health.

Adopt the following program of implementation for the narrative sediment quality objectives:

The narrative sediment quality objectives should be implemented in three ways: (1) to evaluate the overall quality of water body, (2) to develop effluent limitations, and (3) to trigger the need for determining further actions (e.g., cleanup levels in toxic hot spot cleanup plans, additional site characterization, etc).

Narrative sediment quality objectives provide a means for evaluating the overall quality of a waterbody. Data from ambient sampling, collected either as part of ongoing monitoring programs or surveillance activities, should be compared to sediment quality objectives to determine if, in part, impairment is occurring. If appropriate, corrective actions can be undertaken as part of a toxic hot spot cleanup plan or through modification or issuance of waste discharge requirements. These narrative objectives should also be used in assessing if a site is a toxic hot spot (refer to the definition for candidate and known toxic hot spot).

The second use of sediment quality objectives is for the development of control measures including effluent limitations which are enforceable limits placed on individual dischargers and nonpoint source controls including the implementation of Best Management Practices (BMPs). Effluent limits define the contributions of pollutants allowable from a particular discharge. Effluent limitations also establish long term planning goals in the design of facilities and for the evaluation of best management practices and nonpoint source control measures. Established methods for the translation of sediment quality objectives into effluent limitations do not currently exist and the Regional Boards should use best professional judgement when establishing an effluent limit based on a narrative sediment quality objective. Regional Boards are not required to develop effluent limits to implement narrative sediment quality objectives unless there is substantial evidence that there is a substance in sediments that is impacting beneficial uses.

The third use of the sediment quality objective is for the development of cleanup levels or to study the areal extent of sediment pollution at a toxic hot spot or other known or suspected polluted site. These uses of narrative sediment quality objectives is described in the Cleanup Section of this policy.

Issue 4:	Criteria to Rank Toxic Hot Spots in Enclosed Bays and Estuaries of California
Present Policy:	None.
Issue Description:	The development of criteria for the priority ranking of toxic hot spots in enclosed bays and estuaries is required by statute. This section reviews the statutory requirements, programmatic considerations, various ranking systems, and presents a recommended system for use in the Bay Protection and Toxic Cleanup Program (BPTCP).

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 conduct a staff workshop to solicit public comment. Staff workshops were held on January 26 and 28, 1993.

<u>Background</u>

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 provide a prioritized list of sites based on the severity of the identified problem. The Water Code calls for waste discharge requirements to be reevaluated in the ranked order. Water Code Section 13395 states, in part, that the Regional Boards shall "initiate a reevaluation of waste discharge requirements for dischargers who, based on the determination of the Regional Board, have discharged all or part of the pollutants which have caused the toxic hot spot. These reevaluations shall be for the purpose of ensuring compliance with water quality control plans and water quality control plan amendments. These reevaluations shall be initiated according to the priority ranking established pursuant to subdivision (a) of Section 13394 and shall be initiated within 120 days from, and the last shall be initiated within one year from, the ranking of toxic hot spots."

The priority ranking for each site is to be included in a Toxic Hot Spot Cleanup Plan which describes a number of factors including identification of likely sources of the pollutants that are causing the toxic characteristics and actions to be taken to remediate each site. The regional list of ranked hot spots will be consolidated into a statewide prioritized list of toxic hot spots, and included in the statewide Toxic Hot Spot Cleanup Plan.

Within specified periods of time, waste discharge requirements for each source identified as contributing to a toxic hot spot are to be reviewed and revised (with certain exceptions) to prevent further pollution of existing toxic hot spots or the formation of new hot spots. The reevaluation of permits is to be conducted in the order established by the priority ranking of hot spots.

<u>Assumptions and Limitations of the Ranking Criteria</u>

The Water Code Section 13393.5 requires that the 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.

Assumptions

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 for the purpose of setting priorities on candidate, 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 candidate or known toxic hot spot).

5. Assessment of cost and feasibility of remedial actions for a site will be considered in toxic hot spot cleanup plans but factors that influence cost will be considered in the ranking criteria (e.g., estimates of areal extent of a toxic hot spot).

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.

10. A site for which an approved cleanup plan has been implemented and completed will be removed from the from the priority list.

Limitations

The ranking criteria are intended to provide the relative priority of a site within the group of sites considered to be candidate or 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 previously 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 another 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 a toxic hot spot. The determination of whether a site qualifies to be considered a toxic hot spot is a separate and previous step.

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.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action: Five ranking systems are presented for consideration. Two of these systems were developed for purposes somewhat different than those of the BPTCP. These are the Clean Water Strategy used by the State Water Board for resource allocations, and the Hazard Ranking System used by US EPA for Superfund site prioritization. These systems are offered for consideration because they are established and have been used with success for their respective purposes.

1. <u>Use the Clean Water Strategy approach for ranking toxic hot spots.</u>

   The State Water Board's Water Quality Coordinating Committee, in 1990, has developed the Clean Water Strategy (Strategy) as a management tool to provide a common framework for applying the collective professional judgement of State and Regional Water Board staff to identify and prioritize water quality problems (Diaz, 1991). The Strategy consists of six phases which, to date, have been partially implemented. These phases are: (1) collecting water quality information, (2) comparing and ranking the importance and the condition of water bodies, (3) setting priority on work required to address threats and impairments of water quality identified in Phase 1, (4) allocation of staff and contract resources to the list generated in Phase 3, (5) implementation of the funded work, and (6) review and assessment of results and products. CWS rankings are developed through a collective professional judgement process. This process uses criteria and numerical ratings to allow statewide staff to separate and group waters in five levels of importance (value of the resource) and within each level of importance, to group the severity of problems in five levels. The CWS does not rely on formulas or weighted criteria in developing rankings. The CWS process relies on a series of "bite size" judgements and groupings, which when combined result in general consensus on final rankings.

Phases 1 and 2 of the Strategy might be applied to satisfy the Water Code requirements for Toxic Hot Spot ranking in the BPTCP. While the basic purpose of the Strategy is to prioritize responses to water quality problems (similar to Toxic Hot Spot ranking) there are some fundamental differences in purpose and approach between the Strategy and the requirements of the BPTCP. The most fundamental difference is that the Strategy creates priorities for work based on ranking of entire water bodies whereas the Hot Spot Ranking is intended to address hot spots which, except in extraordinary cases, are likely to be localized areas. In addition, the Strategy must consider a number of water quality impairments other than those caused by toxic pollutants. For instance, depressed levels of dissolved oxygen should be considered in the Strategy but would be excluded for BPTCP purposes. A third difference is that the Strategy generates independent ranked lists for several classes of water bodies (such as rivers, lakes, and wetlands), while the BPTCP is required to rank hot spots together, irrespective of the type of water body (such as wetlands; fresh, brackish, and marine portions of estuaries;

and bays). Finally, the Strategy rankings are designed to support Phases 3 and 4; i.e., proposed responsive actions and allocation of resources. In the BPTCP, determination of likely responsive actions to hot spot designations are included as part of Toxic Hot Spot Cleanup Plans and are not included in the ranking process.

Since the Strategy was developed before the BPTCP was established, it will likely be modified to incorporate new information from the BPTCP. A likely outcome of this modification will be that the toxic hot spot rankings will be included as one of the many factors used to develop water body rankings in the Strategy.

2. Use the ranking system developed for the federal Superfund Program (i.e., Hazard Ranking System).

The Hazard Ranking System (HRS) was developed as part of the implementation of the national Superfund program (US EPA, 1990). The HRS is designed to score the relative threat associated with actual or potential releases of hazardous substances from specific sites and to rank the site on the National Priority List for superfund cleanup. The HRS provides a numerical value derived from the assessment of four different environmental pathways each evaluated for three specific factors. The pathways are: (1) ground water migration, (2) surface water migration, (3) soil exposure, and (4) air migration. The three factors are (1) the likelihood of release, (2) waste characteristics, and (3) targets. Through a series of steps, each pathway is assigned a numerical score which integrates the assessment of the three factors for that pathway. The pathway scores are then combined to produce the final site value. The site is ranked against other sites based on this final site value; larger numeric values receive a higher priority.

The actual derivation of a final site value is a rather complex process that requires a significant amount of site-specific information. Some steps in the process are common to all four pathways while others are specific to the particular pathway under consideration.

While the HRS provides a somewhat consistent treatment of sites for ranking purposes, the requirement of extensive evaluation makes it rather cumbersome and time consuming process. Furthermore, this system still requires a number of assumptions and professional judgement in order to complete the evaluation and ranking. The HRS was developed under guidance from Congress that the system "to the maximum extent feasible, . . . accurately assesses the relative degree of risk to human health and the environment posed by sites and facilities subject to review" (Fed. Reg. Vol 55, No. 241, pg 51532). Although this directive does not constitute a mandate for a full risk assessment before ranking, it has been interpreted to require a more detailed analysis (as evidenced by the HRS) than required for the purposes of the BPTCP. The level of details required to complete an HRS evaluation does not seem justified for BPTCP purposes.

Furthermore, the HRS is designed to emphasize threats to human health. For example, two of the three factors in the surface water-overland/flood migration path address human exposure (drinking water threat and human food chain threat), and one factor addresses environmental threats (sensitive environments). The scores for these factors further emphasize human health by allowing a maximum score for drinking water and food chain factors of 100 but only a maximum of 60 for environmental threats.

When scores are computed for the final site value, the emphasis clearly falls on human health considerations. This is in contrast to the BPTCP where human health and environmental (aquatic life and wildlife) considerations are given equal weight.

3. <u>Use a very simple approach based on chemical values in tissues and water (Simplified Toxic Hot Spot Ranking Criteria).</u>

In looking for the simplest approach to ranking, it becomes clear that using a single type of information greatly reduces the complexity of the problem. An approach using only chemical data is presented below. This approach satisfies Water Code requirements. It is quite easy and simple to use but loses detail in the rankings when compared to the weighted toxic hot spot ranking criteria discussed subsequently in this report. The simplified criteria follow:

A. Tissue residues:

Assign values based on criteria listed below and using the average concentration of pollutants reported for any organisms collected from the site for a single sampling event. Assign a value for each substance that exceeds its MTRL. Select the substance providing the highest score.

If a concentration of a toxic substance in tissue:

Equals or exceeds MTRL[1] of 1000 ug/kg assign a value of 1

Between MTRL of 10 ug/kg and 1000 ug/kg assign a value of 2

Less than or equal to MTRL of 10 ug/kg assign a value of 3

multiply by 2 if more than one substance exceeds its MTRL in the same sample.

B. Water column quality:

Assign values based on criteria listed below and using the concentration of pollutants reported for ambient waters collected from the site. Use the substance providing the highest score for exceeding water quality objectives in the appropriate statewide plan. Ranking values are assigned based on the values below:

For water quality objective equal to or over 1 mg/l, assign a value of 1.

For water quality objective between 100 ug/l and 1 mg/l, assign a value of 2.

For water quality objective less than 100 ug/l, assign a value of 3.

Multiply by 2 if more than one substance exceeds its applicable water quality objective.

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[1]MTRLs (Maximum Tissue Residue Levels) are calculated by multiplying the Environmental Protection Agency human health water quality criterion by the chemical's bioconcentration factor (BCF). The BCF is defined as the ratio of the contaminant concentration in tissue to contaminant concentration in water.

C. Sediment values:

Assign values based on sediment weight-of-evidence guidelines recommended for the State of Florida and the criteria listed below and using the dry weight normalized concentration in bulk sediments collected from the site. Use the substance providing the highest score.

Above the Probable Effects Level (PEL) assign a value of 3.

Between the Threshold Effects Level (TEL) and PEL assign a value of 2.

Multiply by 2 if more than one substance from a different class of chemicals exceeds to TEL.

D. Final Ranking Value:

Values should be generated for criteria 1 through 3 wherever possible. In some cases it will not be possible to generate a criterion. For example, a pollutant of concern may not have an associated sediment value. In these cases assign a value of zero for each criterion that cannot be fully developed.

Sum the values for criteria 1 through 3. The resulting sum is the final ranking value. The site with the highest score will be assigned rank #1.

4. Use a ranking approach based on beneficial uses to be protected; chemical values in tissues, sediment and water; and other factors required by law (Weighted Toxic Hot Spot Ranking Criteria). These ranking criteria rank potential and candidate or known toxic hot spots separately.

The ranking system presented below has been designed to (1) provide a site-specific refinement of the Clean Water Strategy and (2) address specific requirements of the BPTCP (Water Code Sections 13390 et seq.).

A value for each criterion described below should be developed provided appropriate information exists. Any criterion for which no information exists should be assigned a value of zero. The sum of the values for the six criteria will serve as the final ranking score. In developing the score for each criterion an initial value is identified and then adjusted by one or two correction factors as appropriate. The Alternative 4 weighted criteria follow:

A. Human Health Impacts

<u>Potential Exposure</u>: Select from the following the applicable circumstance with the highest value:

Human Health Advisory issued for consumption of non-migratory aquatic life from the site (assign a value of 5); Tissue residues in aquatic organisms exceed FDA/DHS action level (3); Tissue residues in aquatic organisms exceed MTRL (2).

<u>Potential Hazard</u>: 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 noncarcinogen 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 another pollutant potentially causing human toxicity (other than cancer)(3); other pollutants of concern (1).

B. Other Beneficial Use Impacts

1. <u>Rare, threatened, or endangered species present</u>: 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 exposed to or dependent on the site (assign a value of 5), Threatened or rare species exposed to or dependent on the site (4), Endangered, 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 Criteria B1 value.

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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.

2. <u>Demonstrated aquatic life impacts</u>: Select one or more value(s):

Community impairments associated with toxic pollutants (assign a value of 5), statistically significant toxicity demonstrated with acute toxicity tests contained in this policy or acceptable to the SWRCB or the RWQCBs (4), Statistically significant toxicity demonstrated in chronic toxicity tests acceptable to the BPTCP (3), 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.

3. <u>Chemical measures</u>[3]:

Any chemistry data used for ranking under this section should be no more than 10 years old, and should have been analyzed with appropriate analytical methods and quality assurance.

i. 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).

ii. Water quality objective or water quality criterion: Exceeded regularly (assign a value of 3), infrequently exceeded (2).

iii. Sediment values (sediment weight of evidence guidelines recommended for State of Florida): Above the Probable

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[3]The tissue residue guidelines and sediment values to be used in the ranking system are listed in Table XX. Water quality objectives to be used are found in Regional Water Quality Control Board Basin Plans or the California Ocean Plan (depending on which plan applies to the water body being addressed). Where a Basin Plan contains a more stringent value than the statewide plan, the regional water quality objective will be used.

Effects Level (PEL)[4] (3), between the TEL[5] and PEL (2). For a substance with no calculated PEL: Above the effects range median[6] (ER-M) (2), between the effects range lowest 10 percent (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 (i) through (iii) above. Add the values for (i) through (iii) (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

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[4]PEL is that concentration above which adverse biological effects are likely to occur. It is developed by taking the geometric mean of the 50th percentile value of the effects database and the 85th percentile value of the no-effects database.

[5]The Threshold Effects Level (TEL) is defined as the sediment concentration that is the upper limit of the minimal effects range. The value is derived by taking the geometric mean of 15th percentile of the ascending effects database and the 50th percentile of the ascending no-effects database.

[6]The ER-M is analogous to the PEL. It is that concentration above which adverse effects are likely. It is developed by taking the 50th percentile of the ranked adverse effects data in the Long and Morgan database. The ER-L is developed by taking the 10th percentile of the ranked adverse effects data.

(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). If site can not be classified (assign a value of 1).

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: An estimate of potential exposure and an estimate of potential hazard. For the exposure estimate the highest score is given if a human health advisory has been issued. These advisories are an indication that aquatic life used for consumption is severely contaminated (i.e., the beneficial use is severely impaired). 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 by itself demonstrate a waterbody impairment. MTRLs receive the lowest scores because they are established for a specific consumption rate (6.5 g/day for the EPA

Section 304(a) criteria 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 an other 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 three Statewide Plans, EPA methods for calculating water quality criteria, and the approaches of OEHHA and DHS.

B. <u>Other Beneficial Use Impacts</u>

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

1. <u>Rare, threatened or endangered species</u>

This criterion evaluates the exposure or dependence of rare, threatened or endangered species at a known toxic hot spot. The highest value is assigned if an endangered species is exposed to or dependent upon a site and lower scores if threatened or rare species are exposed to or dependent upon a site. Exposure of endangered species to a site is considered more severe than regular or occasional presence of rare or threatened species.

If multiple species in the 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 exposed or dependent upon a site.

2. <u>Demonstrated Aquatic Life Impacts</u>

This criterion is a measure of aquatic life impact from the most severe conditions to less severe conditions. Measurements of actual measured marine or bay community impairment indicates that there is a direct measurement of 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. Reproductive impairments and occasional toxicity are given the lowest values because of the difficulty in interpreting these effects on aquatic life populations.

If multiple species are effected 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 effected. This factor will allow for distinctions to be made between moderate and more severe responses of organisms.

3. <u>Chemical Measures</u>

This criterion has three parts: (i) Tissue residues, (ii) water quality objectives and water quality criteria, and (iii) sediment values. As described in the last section 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". A chemical severity factor is added to the value generated above based on the substance with the most stringent water quality objective. This factor gives more weight to chemicals that have aquatic life effects at very low concentrations.

i. <u>Tissue Residues and Water Quality Objectives</u>

Tissue residue levels are very difficult to evaluate in terms of impact on aquatic life but some measures do exist to aid in the interpretation of chemicals bioaccumulated 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 effect 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.

The "water quality objective or water quality criterion" criterion gives a higher value when a water quality objective from the appropriate water quality control plan or the EPA water quality criteria are exceeded regularly. If an objective is infrequently exceeded a lower score is given.

The California Enclosed Bays and Estuaries Plan and the Inland Surface Waters Plan were nullified by the California Superior Court in 1994. The objectives in these plans will, therefore, not be used for developing rankings of toxic hot spots.

In order to provide assistance in interpretation of any available water quality monitoring information the U.S. Environmental Protection Agency (EPA) water quality criteria will be used. EPA has developed water quality criteria (i.e., Clean Water Act Section 304(a) criteria) for the protection of aquatic life and human health. For aquatic life, these criteria were derived by a complex method presented in Stephan, et al. (1985) and EPA (1986). Most of the aquatic life criteria are expressed as four-day averages to be exceeded no more than once every three years on average.

For many priority pollutants, EPA has developed criteria for the protection of human health. These EPA criteria assume that human exposure to contaminants can result from both drinking water and edible aquatic species. Therefore, the criteria represent concentrations in water that protect against the consumption of aquatic organisms and drinking water containing chemicals at levels greater than those predicted to result in significant human health problems. EPA methods for calculating human health criteria date from 1980 when separate equations were presented for exposure resulting from the consumption of aquatic organisms only and from the combined consumption of aquatic organisms and drinking water (Federal Register 45(231): 79347-79356, November 28, 1980).

The EPA water quality criteria that are presented in Table XX are from the National Toxics Rule (Federal Register 57(246): 60848-60923). Most of the criteria listed in the National Toxics Rule for the protection of human health have been updated (new potency factor or reference dose taken from the Integrated Risk Information System (IRIS)).

ii. Sediment Values

[THIS MOST BE UPDATED WITH NEW LONG, ET AL. AND MACDONALD INFORMATION.]

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. At this point in time, 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. These are the National Oceanic Atmospheric Administration (NOAA) technical memorandum NOS OMA 52 by Long and Morgan (1990), and the sediment weight-of-evidence guidelines developed for the Florida Coastal Management Program (1992). These reference have been recently updated (Long et al., 1994, in press; MacDonald, 1994, in press).

Long and Morgan (1990) and Long et al. (1994) 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 (1992) revised and expanded the Long and Morgan (1990) data set and then identified two levels of concern for each substance: the "TEL" or threshold effects 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 TEL 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 Table 3. 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 (Table 3). 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 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 TEL are available.

C. <u>Areal Extent of Toxic Hot Spot</u>

The rationale for this criterion is to discount smaller sites because these sites will be difficult or perhaps may not be practical to 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 over- or under-estimate the size of the toxic hot spot, we assume that one of the first steps in planning for a cleanup of a known toxic hot spot will be a characterization of the size of the hot spot before any remedial activity occurs.

D. <u>Pollutant Source and Remediation Potential</u>

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 will be 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.

Table 3

Comparison of Sediment[7] Screening Levels Developed by NOAA and the State of Florida

SUBSTANCE	State of Florida[8] TEL	PEL	ERM[9]	NOAA ERL[10]	ERM[11]
Organics ug/kg					
Total PCBs	21.55	188.79	380	22.7	180
Acenaphthene	6.71	88.9	650	16	500
Acenaphthylene	5.87	127.89		44	640
Anthracene	46.85	245	960	85.3	1100
Fluorene	21.17	144.35	640	19	540
2-methyl naphthalene	20.21	201.28	670	70	670
Naphthalene	34.57	390.64	2100	160	2100
Phenanthrene	86.68	543.53	1380	240	1500
Total LMW-PAHs	311.7	1442.0		552	3160
Benz(a)anthracene	74.83	692.53	1600	261	1600
Benzo(a)pyrene	88.81	763.22	2500	430	1600
Chrysene	107.71	845.98	2800	384	2800
Dibenzo(a,h)anthracene	6.22	134.61	260	63.4	260
Fluoranthene	112.82	1493.54	3600	600	5100
Pyrene	152.66	1397.60	2200	665	2600
Total HMW-PAHs	655.34	6676.14		1700	9600
Total PAHs	1684.06	16770.54	35000	4022	44792
p,p'-DDE	2.07	374.17	15	2.2	27
Total DDT	3.89	51.70	350	1.58	46.1
p,p'-DDT	1.19	4.77			
Lindane	0.32	0.99			
Chlordane	2.26	4.79	0.5	6	
Dieldrin	0.715	4.30	0.02	8	
Endrin	0.02	45			
2-methylnaphthalene	65	670			
Metals mg/kg					
Arsenic	7.24	41.6	85	8.2	70.0
Antimony			2		2.5
Cadmium	0.676	4.21	9	1.2	9.6
Chromium	52.3	160.4	145	81.0	370.0
Copper	18.7	108.2	390	34.0	270.0
Lead	30.24	112.18	110	46.7	218.
Mercury	0.130	0.696	1.3	0.15	0.71
Nickel	15.9	42.8		20.9	51.6
Silver	0.733	1.77	2.5	1.0	3.7
Zinc	124	271.0	280	150.0	410.

[7]Values are for bulk sediment expressed on a dry weight basis

[8]McDonald, in press

[9]Long and Morgan, 1990

[10]Long et al., in press

TABLE 4

CHEMICAL SPECIFIC WATER QUALITY CRITERIA USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	WQC CMC d ug/l (Fresh)	WQC CCC d ug/l (Fresh)	WQC CMC d ug/l (Estuarine)	WQC CCC d ug/l (Estuarine)	WQC (Fresh) ug/l (10-6 risk for carcinogens)c	WQC (Estuarine) ug/l (10-6 risk for carcinogens)c
Antimony				14	a 4300	a
Arsenic	360 m	190 m	69 m	36 m	0.018a,b	0.14 a,b
Beryllium						
Cadmium	3.9 e,m	1.1 e,m	43 m	9.3 m		
Chromium (III)	1700e,m	210 e,m				
Chromium (VI)	16 m	11 m		1100 m	50 m	
Copper	18 e,m	12 e,m	2.9 m	2.9 m		
Lead	82 e,m	3.2 e,m	220 m	8.5 m		
Mercury	2.4 m	0.012 i	2.1 m	0.025i	0.14	0.15
Nickel	1400e,m	160 e,m	75 m	8.3 m	610 a	4600 a
Selenium	20	5	300 m	71 m		
Silver	4.1 e,m	2.3 m				
Thallium				1.7 a	6.3 a	
Zinc	120 e,m	110 e,m	95 m	86 m		
Cyanide	22	5.2	1	1	700 a	220000 a,j
Asbestos					7,000,000k	
2,3,7,8-TCDD (Dioxin)					0.000000013	0.000000014
Acrolein					320	780
Acrylonitrile					0.059 a	0.66 a
Benzene					1.2 a	71 a
Bromoform					4.3 a	360 a
Carbon tetrachloride					0.25 a	4.4 a
Chlorobenzene					680 a	21000 a,j
Chlorodibromomethane					0.41 a	34 a
Chloroethane						
2-Chloroethylvinyl ether						
Chloroform					5.7 a	470 a
Dichlorobromomethane					0.27 a	22 a
1,1-Dichloroethane						
1,2-Dichloroethane					0.38 a	99 a
1,1-Dichloroethylene					0.057 a	3.2 a
1,2-Dichloropropane						
1,3-Dichloroproplyene					10 a	1700 a
Ethylbenzene					3100 a	29000 a
Methyl bromide					48 a	4000 a
Methyl chloride						
Methylene chloride					4.7 a	1600 a
1,1,2,2-Tetrachloroethane					0.17 a	11 a
Tetrachloroethylene					0.8	8.85
Toluene					6800 a	200000a
1,2-Trans-dichloroethylene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane					0.60 a	42 a
Trichloroethylene					2.7	81
Vinyl chloride					2	525
2-Chlorophenol						
2,4-Dichlorophenol					93 a	790 a,j
2,4-Dimethylphenol						
2-Methyl-4,6-dinitrophenol					13.4	765
2,4-Dinitrophenol					70 a	14000 a
2-Nitrophenol						
4-Nitrophenol						
3-Methyl-4-chlorophenol						
Pentachlorophenol	20 f	13 f	13	7.9	0.28 a	8.2 a,j
Phenol					21000 a	4600000 a,j
2,4,6-Trichlorophenol					2.1 a	6.5 a
Acenaphthene						
Acenaphthylene						
Anthracene					9600 a	110000 a
Benzidine					0.00012 a	0.00054 a
Benzo(a)anthracene					0.0028	0.031
Benzo(a)pyrene					0.0028	0.031
Benzo(b)flouranthene					0.0028	0.031
Benzo(ghi)perylene						
Benzo(k)flouranthene					0.0028	0.031

CHEMICAL SPECIFIC WATER QUALITY CRITERIA USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	WQC CMC d ug/l (Fresh)	WQC CCC d ug/l (Fresh)	WQC CMC d ug/l (Estuarine)	WQC CCC d ug/l (Estuarine)	WQC (Fresh) ug/l (10-6 risk for carcinogens)c	WQC (Estuarine) ug/l (10-6 risk for carcinogens)c
Bis(2-chloroethyl) ether					0.031 a	1.4 a
Bis(2-chloroisopropyl) ether					1400 a	170000 a
Bis(2-ethylhexyl) phthalate					1.8 a	5.9 a
4-Bromophenyl phenyl ether						
Butylbenzyl phthalate						
2-Chloronaphthalene						
4-Chlorophenyl phenyl ether						
Chrysene					0.0028	0.031
Dibenzo(a,h)anthracene					0.0028	0.031
1,2-Dichlorobenzene					2700 a	17000 a
1,3-Dichlorobenzene					400	2600
1,4-Dichlorobenzene					400	2600
3,3'-Dichlorobenzidine					0.04 a	0.077 a
Diethyl phthalate					23000 a	120000 a
Dimethyl phthalate					313000	2900000
Di-n-butyl Phthalate					2700 a	12000 a
2,4-Dinitrotoluene					0.11	9.1
2,6-Dinitrotoluene						
Di-n-octyl phthalate						
1,2-Diphenylhydrazine					0.040 a	0.54 a
Flouranthene					300 a	370 a
Flourene					1300 a	14000 a
Hexachlorobenzene					0.00075 a	0.00077 a
Hexachlorobutadiene					0.44 a	50 a
Hexachlorocyclopentadiene					240 a	17000 a,j
Hexachloroethane					1.9 a	8.9 a
Indeno(1,2,3-cd)pyrene					0.0028	0.031
Isophorone					8.4 a	600 a
Naphthalene						
Nitrobenzene					17 a	1900 a,j
N-Nitrosodimethylamine					0.00069 a	8.1 a
N-Nitrosodi-n-propylamine						
N-Nitrosodiphenylamine					5.0 a	16 a
Phenanthrene						
Pyrene					960 a	11000 a
1,2,4-Trichlorobenzene						
Aldrin	3 g 1.3 g				0.00013 a	0.00014 a
alpha-BHC					0.0039a	0.013 a
beta-BHC					0.014 a	0.046 a
gamma-BHC	2 g 0.08 g	0.16 g	0.019		0.063	
delta-BHC						
Chlordane	2.4 g	0.0043 g	0.09 g	0.004 g	0.00057 a	0.00059 a
4,4'-DDT	1.1 g	0.001 g	0.13 g	0.001 g	0.00059 a	0.00059 a
4,4'-DDE					0.00059 a	0.00059 a
4,4'-DDD					0.00083 a	0.00084 a
Dieldrin	2.5 g	0.0019 g	0.71 g	0.0019 g	0.00014 a	0.00014 a
alpha-Endosulfan	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a
beta-Endosulfan	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a
Endosulfan sulfate					0.93 a	2.0 a
Endrin	0.18 g	0.0023 g	0.037 g	0.0023 g	0.76 a	0.81 a
Endrin aldehyde					0.76	0.81
Heptachlor	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00021 a	0.00021 a
Heptachlor epoxide	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00010 a	0.00011 a
PCB-1242		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1254		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1221		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1232		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1248		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1260		0.014 g	0.03 g		0.000044 a	0.000045 a
PCB-1016		0.014 g	0.03 g		0.000044 a	0.000045 a
Toxaphene	0.73	0.0002	0.21	0.0002	0.00073 a	0.00075 a

Table 4 (Continued)

Footnotes:

a. Criteria revised to reflect current EPA q1* or RfD, as contained in the Integrated Risk Information System (IRIS). The fish tissue bioconcentration factor (BCF) from the 1980 criteria documents was retained in all cases.

b. The criteria refer to the inorganic form only.

c. Criteria in the matrix based on carcinogenicity (10-6 risk).

d. Criteria Maximum Concentration (CMC) = the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) without deleterious effects. Criteria Continuous Concentration (CCC) = the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. ug/l = micrograms per liter.

e. Freshwater aquatic life criteria for these metals are expressed as a function of total hardness (mg/l), and as a function of the pollutant's water effects ratio (WER) as defined in 40 CFR 131.36(c). The equations are provided in matrix at 40 CFR 131.36(b)(2). Values displayed above in the matrix correspond to a total hardness of 100 mg/l and a WER of 1.0.

f. Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH, and are calculated as follows. Values displayed above in the matrix correspond to a pH of 7.8. CMC=exp(1.005(pH)-4.830) CCC=exp(1.005(pH)-5.290)

g. Aquatic life criteria for these compounds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute values shown are final acute values (FAV) which by the 1980 Guidelines are instantaneous values as contrasted with a CMC which is a 1-hour average.

h. These totals simply sum the criteria in each column. For aquatic life, there are 30 priority toxic pollutants with some type of freshwater or saltwater, acute or chronic criteria. For human health, there are 91 priority toxic pollutants with either "water + fish" (fresh) or "fish only" (Estuarine) criteria. Note that these totals count chromium as one pollutant even though EPA has developed criteria based on two valence states.

i. If the CCC for mercury exceeds 0.012 ug/l more than once in a three year period in the ambient water, the edible portion of fish must be analyzed to determine whether the concentration of methyl mercury exceeds the Food and Drug Administration (FDA) action level (1.0 mg/kg).

j. No criteria for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even the results of such a calculation were not shown in the document.

k. The criterion for asbestos is the MCL (56 Federal Register 3526, January 30, 1991). The units for asbestos are fibers/l.

l. This letter not used as a footnote.

m. Criteria for these metals are expressed as a function of the WER as defined in 40 CFR 131.36(c).

TABLE 5

CHEMICAL SPECIFIC MAXIMUM TISSUE RESIDUE LEVELS (MTRL) FOR USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
Antimony	14.00	4000
Arsenic	0.79	6.16
Beryllium	0	0
Cadmium	0	0
Chromium (III)	0	0
Chromium (VI)	0	0
Copper	0	0
Lead	0	0
Mercury	1000	1000
Nickel	29000	216000
Selenium	0	0
Silver	0	0
Thallium	200	700
Zinc	0	0
Cyanide	700	220000
Asbestos	0	0
2,3,7,8-TCDD (Dioxin)	0	0
Acrolein	69000	168000
Acrylonitrile	2.00	20.00
Benzene	6.25	369.91
Bromoform	35.69	2988
Carbon tetrachloride	4.69	83
Chlorobenzene	7000	216000
Chlorodibromomethane	1.54	128
Chloroethane	0	0
2-Chloroethylvinyl ether	0	0
Chloroform	21.38	1763
Dichlorobromomethane	1.01	83
1,1-Dichloroethane	0	0
1,2-Dichloroethane	0.46	119
1,1-Dichloroethylene	0.21	17.95
1,2-Dichloropropane	0	0
1,3-Dichloroproplyene	0	0
Ethylbenzene	116000	1088000
Methyl bromide	0	0
Methyl chloride	0	0
Methylene chloride	0	0
1,1,2,2-Tetrachloroethane	0.85	55
Tetrachloroethylene	24.48	270.81
Toluene	73000	2140000
1,2-Trans-dichloroethylene	0	0
1,1,1-Trichloroethane	0	0
1,1,2-Trichloroethane	2.7	189
Trichloroethylene	28.62	858.6
Vinyl chloride	2.34	614.25
2-Chlorophenol	0	0
2,4-Dichlorophenol	4000	32000
2,4-Dimethylphenol	0	0
2-Methyl-4,6-dinitrophenol	0	0
2,4-Dinitrophenol	100	21100
2-Nitrophenol	0	0
4-Nitrophenol	0	0
3-Methyl-4-chlorophenol	0	0
Pentachlorophenol	3.08	90.2
Phenol		

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
2,4,6-Trichlorophenol	3150000	6.9E+08
Acenaphthene	0	0
Acenaphthylene	0	0
Anthracene	0	0
Benzidine	0	0
Benzo(a)anthracene	0	0
Benzo(a)pyrene	0	0
Benzo(b)flouranthene	0	0
Benzo(ghi)perylene	0	0
Benzo(k)flouranthene	0	0
Bis(2-chloroethyl) ether	0.02	0.21
Bis(2-chloroisopropyl) ether	0.08	3.46
Bis(2-ethylhexyl) phthalate	182000	22100000
4-Bromophenyl phenyl ether	0	0
Butylbenzyl phthalate	0	0
2-Chloronaphthalene	0	0
4-Chlorophenyl phenyl ether	0	0
Chrysene	0	0
Dibenzo(a,h)anthracene	0	0
1,2-Dichlorobenzene	150000	945000
1,3-Dichlorobenzene	22000	145000
1,4-Dichlorobenzene	22000	145000
3,3'-Dichlorobenzidine	12.48	24.024
Diethyl phthalate	1680000	8760000
Dimethyl phthalate	11270000	1.0E+08
Di-n-butyl Phthalate	240000	1068000
2,4-Dinitrotoluene	0.17	34.58
2,6-Dinitrotoluene	0	0
Di-n-octyl phthalate	0	0
1,2-Diphenylhydrazine	1.00	13.45
Flouranthene	345000	426000
Flourene	0	0
Hexachlorobenzene	6.52	6.69
Hexachlorobutadiene	1.22	139
Hexachlorocyclopentadiene	1042	73780
Hexachloroethane	165	773
Indeno(1,2,3-cd)pyrene	0	0
Isophorone	36.82	2628
Naphthalene	0	0
Nitrobenzene	49.13	5491
N-Nitrosodimethylamine	0.00001794	0.2106
N-Nitrosodi-n-propylamine	0	0
N-Nitrosodiphenylamine	680	2176
Phenanthrene	0	0
Pyrene	0	0
1,2,4-Trichlorobenzene	0	0
Aldrin	0	0
alpha-BHC	0	0
beta-BHC	0	0
gamma-BHC	0	0
delta-BHC	0	0
Chlordane	8.04	8.32
4,4'-DDT	31.62	31.62
4,4'-DDE	31.62	31.62
4,4'-DDD	44.49	45.02
Dieldrin	0.65	0.65
alpha-Endosulfan	251	540
beta-Endosulfan	251	540
Endosulfan sulfate	251	540

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
Endrin	3000	3200
Endrin aldehyde	3000	3200
Heptachlor	2.35	2.35
Heptachlor epoxide	1.12	1.232
PCB-1242	0	0
PCB-1254	0	0
PCB-1221	0	0
PCB-1232	0	0
PCB-1248	0	0
PCB-1260	0	0
PCB-1016	0	0
Toxaphene	9.56	9.83

A 0 indicats that a MTRL could not be calculated for the chemical.

EPA recommends taht the FDA action level be used for fish contaminationif the water quality objective is exceeded (plese refer to footnote "i" in Table 4).

TABLE 6

NAS, FDA, and EPA Limits Relevant to the BPTCP
Marine Organisms
(ng/g or ppb wet weight)

Chemical	NAS Recommended Guideline[13] (whole fish)	FDA Action Level or Tolerance[14] (edible portion)	US EPA Screening Values[12] (edible portion)
Total PCB	500	2000**	10
Total DDT	50	5000	300
aldrin)	*	300**,***	-
dieldrin)	*	300**,***	7
endrin	*	300**,***	3000
heptachlor)	*	300**,***	-
heptachlor epoxide)	*	300**,***	10
lindane	50	-	80
chlordane	50	300	80
endosulfan	50	-	20,000
methoxychlor	50	-	-
mirex	50	-	2000
toxaphene	50	5000	100
hexachlorobenzene	50	-	70
any other chlorinated hydrocarbon pesticide	50	-	
dicofol	-	-	10,000
oxyfluorfen	-	-	800
dioxins/dibenzofurans	-	-	$7x10^{4}$
terbufos	-	-	1000
ethion	-	-	5000
disulfoton	-	-	500
diazinon	-	-	900
chlorpyrifos	-	-	30,000
carbophenothion	-	-	1000
cadmium	-	-	10,000
selenium	-	-	50,000
mercury	-	1000** (as methyl mercury)	600

* Limit is 5 ng/g wet weight. Singly or in combination with other substances noted by an asterisk.

** Fish and shellfish.

*** Singly or in combination for shellfish.

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[12]Use EPA values and references.

[13]National Academy of Sciences. 1973. Water Quality Criteria, 1972 (Blue Book). The recommendation applies to any sample consisting of a homogeneity of 25 or more fish of any species that is consumed by fish-eating birds and mammals, within the same size range as the fish consumed by any bird or mammal. No NAS recommended guidelines exist for marine shellfish.

[14]U.S. Food and Drug Administration. 1984. Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances. A tolerance, rather than an action level, has been established for PCB.

Trial Application of the Weighted Ranking Criteria

[THIS SECTION NEEDS TO BE UPDATED BY MLR AND REGIONAL BOARDS.]

Evaluation of the weighted toxic hot spot ranking criteria was accomplished by applying the criteria to two known hot spots: the Sacramento River stretching from Freeport to Hood and Cabrillo Pier in Los Angeles Harbor. The information available for the sites is mostly contained in two documents (Montoya 1991 and Birosik 1991) and is summarized below. A table listing the values assigned to the two sites for each criterion is also presented.

As summarized by Montoya (1991), the U.S. Geological Survey has reported water hardness and both dissolved and total concentrations of a variety of metals at the Sacramento River site for a number of years in both wet and dry seasons. Similar data has been produced by the Central Valley Regional Water Quality Control Board as recently as 1991, and the Regional Water Board has performed three-species water toxicity testing in recent years. The State Water Board's Toxic Substances Monitoring Program has reported levels of organic chemicals and metals in game and other fish collected annually at Hood since 1977. The FDA Action Levels are not exceeded but there is a human health warning for mercury (Hg) in Striped Bass. Other relevant information is the presence of an endangered species, winter run chinook salmon (Steinhart, 1990); demonstrated chronic toxicity in multiple species; exceedance of NAS DDT levels; and regularly exceeded water quality objectives for metals.

Data for the Cabrillo Pier area of Los Angeles Harbor consists largely of a recent human health risk assessment (Pollock et al., 1991). Human health impacts are demonstrated by a sportfishing health advisory against the consumption of resident species caught in the vicinity of Cabrillo Pier. The hazardous substance of concern is DDT, a carcinogen. An endangered species, California Least Tern, is present in the area, and exceedance of NAS DDT levels have been reported.

Areal extent of both sites is relatively difficult to judge because the media used to qualify the sites (water in the Sacramento River and fish at

Cabrillo Pier) show greater movement than sediment. Nevertheless, it is safe to assume that both are larger than 50 acres. Both sites are also similar in that the pollutant sources are multiple and partially accounted for. Metals in the Sacramento River can originate from urban runoff, point source discharges, agricultural practices, acid mine drainage, and other sources. DDT and PCB in fish caught from Cabrillo Pier can originate from widely scattered reservoirs in sediment, urban runoff, and perhaps aerial deposition. Both sites are similar in that improvement is unlikely to occur soon without intervention.

The two sites differ, however, in their potential for implementation of an integrated prevention strategy. Controlling metals in the river may be successful because the variety of sources can be controlled through waste discharge requirements; controlling the sources of DDT and PCB is probably not possible with waste discharge requirements. Finally, due to widespread interest in the health of the Delta and concern for threats to human health at Cabrillo Pier, both of these sites are likely to gain the interest of multiple agencies.

Ranking criteria scores for these two known toxic hot spots are presented in Table 4. In summary, the Sacramento River hot spot scored higher than the Cabrillo Pier site. This was due in large part to the greater chemical and aquatic life impacts and a greater the likelihood of success of an integrated control strategy, these higher values were somewhat compensated for by a greater human health impact at Cabrillo Pier.

Table 7: Ranking Criteria Scores for Two Known Hot Spots the Sacramento River (Freeport to Hood) and Cabrillo Pier

Criteria	Known Hot Spot: Sacramento River, Freeport to Hood	Known Hot Spot: L.A. Harbor, Cabrillo Pier
A. Human health impact		
1. Potential exposure	Human Health Advisory (Hg) 5	Human health advisory 5
2. Hazard	Non-Carcinogen with RFD 5	Carcinogen with cancer potency 5
3. Total score (a x b)	25	25
B. Beneficial use impacts		
1. Endangered species	Endangered species present 5	Endangered sp. present 5
2. Aquatic life	Chronic toxicity 3 x 2 = 6	Not demonstrated 0
3. Chemical measures		
i. Tissue residues	DDT NAS level exceeded 3	DDT NAS level exceeded 3
ii. Water objective	Metals regularly exceeded 4	No data 0
iii. Sediment values	No data 0	No data 0
Total score	7 x 2 = 14	3 x 2 = 6
C. Areal extent	>50 acres 8	>50 acres 8
D. Pollutant source	Metals in river water from multiple sources 3 x 2 = 6	DDT & PCB in fish from multiple sources 3 x 2 = 6
E. Remediation potential	Improvement unlikely without intervention by an integrated strategy 4 x 3 = 12	Improvement unlikely without intervention but strategy is unclear 4 x 1 = 4
Cumulative Score	76	54

Ranking of Potential Hot Spots

The BPTCP will conduct confirmatory work on potential hot spots to determine if they are known toxic hot spots. Since a large number of potential hot spots are likely to be identified, some manner of scheduling the confirmatory work and prevention activities is needed.

In contrast to known hot spot ranking, Potential Hot Spots have substantially less information available for ranking purposes. Furthermore, since monitoring costs are much lower than probable remediation costs, the ranking of sites for monitoring and prevention purposes does not justify the level of detail used for known toxic hot spot ranking. Consequently, ranking of these sites is less quantitative, consisting simply of the grouping of sites into high, medium, and low probability of qualifying as a known hot spot. The predominant types of information available for ranking are State Mussel Watch (SMW) tissue levels, sediment contaminant levels, and, less frequently, toxicity testing. Other kinds of data which are only occasionally available include organism impairment, community degradation, and water contaminant levels.

The highest rank is reserved for sites that are most likely to qualify as known hot spots due to the existence of data indicative of high risk and falling into one of the five conditions for qualification as a known toxic hot spot. Such data will include positive toxicity testing results, tissue contaminant levels approaching NAS, FDA, or OEHHA protective levels, and occasionally other appropriate data. Sediment contaminant data are not included because no chemical-specific sediment quality objectives have been adopted in water quality control plans. Generally, old information will have less importance than recent data, unless the recent data is not particularly useful in judging the likelihood for known hot spot qualification. For example, recent positive toxicity tests will probably be considered equivalent to screening and therefore require confirmatory toxicity testing. Conversely, recent SMW results below NAS, FDA, or OEHHA protective levels will probably be judged unworthy of further tissue testing if territorial fish are unavailable at that site.

The "medium" rank consists of sites with high sediment contaminant levels, as judged first using the PEL sediment screening values, and the values from Long and Morgan (1990) for additional substances where an ER-M is available. Sampling and analysis of fish tissue will focus on SMW sites with EDLs over 85 unless the results of high rank sites show that fish are unavailable or incapable of concentrating pesticides, PCB, or mercury above protective levels.

Remaining sites are of low rank and consist predominantly of sediment contaminant levels below ER-M, PEL values and/or SMW EDL 85.

5. <u>Use a ranking approach based on beneficial uses to be protected (with higher emphasis on human health protection); chemical values in tissues, sediment and water; and other factors required by law (Weighted Toxic Hot Spot Ranking Criteria). These ranking criteria rank potential and candidate or known toxic hot spots separately.</u>

The ranking system presented below has been designed to (1) provide a site-specific refinement of the Clean Water Strategy and (2) address specific requirements of the BPTCP (Water Code Sections 13390 et seq.) and to weight the ranking more heavily towards sites with human health impacts.

A value for each criterion described below should be developed provided appropriate information exists. Any criterion for which no information exists should be assigned a value of zero. The sum of the values for the six criteria will serve as the final ranking score. The higher the score the higher the rank. In developing the score for each criterion an initial value is identified and then adjusted by correction factors as appropriate.

The ranking scores range from roughly 5 to 100. Scores of 60 or above are ranked high and scores below 60 are ranked low.

The Alternative 5 weighted criteria follow:

A. Human Health Impacts

<u>Potential Exposure</u>: Select from the following the applicable circumstance with the highest value:

Human Health Advisory issued for consumption of non-migratory aquatic life from the site (assign a value of 10); Tissue residues in aquatic organisms exceed FDA/DHS action level (5); 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[15] with a cancer potency factor or noncarcinogen with a reference dose (assign a value of 3); Pollutant(s) of concern is(are) not known or suspected carcinogens without a cancer potency factor or another pollutant potentially causing human toxicity (other than toxicity)(2); other pollutants of concern (1).

B. Other Beneficial Use Impacts

1. 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 exposed at or dependent upon the site (assign a value of 5), Threatened or rare species exposed at or dependent upon the site (4), Endangered, threatened or rare species 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 Criteria B1 value.

2. 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 with acute toxicity tests contained in this policy or acceptable to the SWRCB or RWQCBs (4), Statistically significant toxicity demonstrated in chronic toxicity tests

[15]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.

acceptable to the BPTCP (3), 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.

3. <u>Chemical measures</u>[16]:

Any chemistry data used for ranking under this section should be no more than 10 years old, and should have been analyzed with appropriate analytical methods and quality assurance.

i. 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).

ii. Water quality objective or water quality criterion: Exceeded regularly (greater than 50 percent of the time) (assign a value of 3), infrequently exceeded (less than or equal to 50 percent of the time) (2).

iii. Sediment values (sediment weight of evidence guidelines recommended for State of Florida): Above the

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[16]The tissue residue guidelines and sediment values to be used in the ranking system are listed in Table XX. Water quality objectives to be used are found in Regional Water Quality Control Board Basin Plans or the California Ocean Plan (depending on which plan applies to the water body being addressed). Where a Basin Plan contains a more stringent value than the statewide plan, the regional water quality objective will be used.

Probable Effects Level (PEL)[17] (4), between the TEL[18] and PEL (2). For a substance with no calculated PEL: Above the effects range median[19] (ER-M) (2), between the effects range lowest 10 percent (ER-L) and ER-M (1).

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:

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[17]PEL is that concentration above which adverse biological effects are likely to occur. It is developed by taking the geometric mean of the 50th percentile value of the effects database and the 85th percentile value of the no-effects database.

[18]The Threshold Effects Level (TEL) is defined as the sediment concentration that is the upper limit of the minimal effects range. The value is derived by taking the geometric mean of 15th percentile of the ascending effects database and the 50th percentile of the ascending no-effects database.

[19]The ER-M is analogous to the PEL. It is that concentration above which adverse effects are likely. It is developed by taking the 50th percentile of the ranked adverse effects data in the Long and Morgan database. The ER-L is developed by taking the 10th percentile of the ranked adverse effects data.

Site is unlikely to improve without intervention (10), site may or may not improve without intervention (3), 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 3), potential for implementation of an integrated prevention strategy involving multiple dischargers (2), site suitable for implementation of identified remediation methods (1). If site can not be classified (assign a value of 1).

Rationale for Criteria

The rationale for the criteria listed above are the same as for the Alternative 4 ranking criteria. The Alternative 5 ranking criteria differ from the Alternative 4 criteria because the human heath criterion in 1 (above is given a weight of 30 percent versus 15 percent for criterion 1 in Alternative 4. Weights were reduced for chemical measures, remediation potential and participation of multiple agencies.

Trial Application of the Weighted Ranking Criteria

[THIS SECTION NEEDS TO BE UPDATED BY MLR AND REGIONAL BOARDS.]

Evaluation of the weighted toxic hot spot ranking criteria was accomplished by applying the criteria to two known hot spots: the Sacramento River stretching from Freeport to Hood and Cabrillo Pier in Los Angeles Harbor. The information available for the sites is mostly contained in two documents (Montoya 1991 and Birosik 1991) and is summarized below. A table listing the values assigned to the two sites for each criterion is also presented.

As summarized by Montoya (1991), the U.S. Geological Survey has reported water hardness and both dissolved and total concentrations of a variety of metals at the Sacramento River site for a number of years in both wet and dry seasons. Similar data has been produced by the Central Valley Regional Water Quality Control Board as recently as 1991, and the Regional Water Board has performed three-species water toxicity testing in recent years. The State Water Board's Toxic Substances Monitoring Program has reported levels of organic chemicals and metals in game and other fish collected annually at Hood since 1977. The FDA Action Levels are not exceeded but there is a human health warning for mercury (Hg) in Striped Bass. Other relevant information is the presence of an endangered species, winter run chinook salmon (Steinhart, 1990); demonstrated chronic toxicity in multiple species; exceedance of NAS DDT levels; and regularly exceeded water quality objectives for metals.

Data for the Cabrillo Pier area of Los Angeles Harbor consists largely of a recent human health risk assessment (Pollock et al., 1991). Human health impacts are demonstrated by a sportfishing health advisory against the consumption of resident species caught in the vicinity of Cabrillo Pier. The hazardous substance of concern is DDT, a carcinogen. An endangered species, California Least Tern, is present in the area, and exceedance of NAS DDT levels have been reported.

Areal extent of both sites is relatively difficult to judge because the media used to qualify the sites (water in the Sacramento River and fish at Cabrillo Pier) show greater movement than sediment. Nevertheless, it is safe to assume that both are larger than 50 acres. Both sites are also similar in that the pollutant sources are multiple and partially accounted for. Metals in the Sacramento River can originate from urban runoff, point source discharges, agricultural practices, acid mine drainage, and other sources. DDT and PCB in fish caught from Cabrillo Pier can originate from widely scattered reservoirs in sediment, urban runoff, and perhaps aerial deposition. Both sites are similar in that improvement is unlikely to occur soon without intervention.

The two sites differ, however, in their potential for implementation of an integrated prevention strategy. Controlling metals in the river may be successful because the variety of sources can be controlled through waste discharge requirements; controlling the sources of DDT and PCB is probably not possible with waste discharge requirements. Finally, due to widespread interest in the health of the Delta and concern for threats to human health at Cabrillo Pier, both of these sites are likely to gain the interest of multiple agencies.

Ranking criteria scores for these two known toxic hot spots are presented in Table 8. In summary, the Sacramento River hot spot scored higher than the Cabrillo Pier site. This was due in large part to the greater chemical and aquatic life impacts and a greater the likelihood of success of an integrated control strategy, these higher values were somewhat compensated for by a greater human health impact at Cabrillo Pier.

Table 8: Ranking Criteria Scores for Two Known Hot Spots the Sacramento River (Freeport to Hood) and Cabrillo Pier

Criteria	Known Hot Spot: Sacramento River, Freeport to Hood		Known Hot Spot: L.A. Harbor, Cabrillo Pier	
A. Human health impact				
1. Potential exposure	Human Health Advisory (Hg)	10	Human health advisory	10
2. Hazard	Non-Carcinogen with RFD	3	Carcinogen with cancer potency	3
3. Total score (a x b)		30		30
B. Beneficial use impacts				
1. Endangered species	Endangered species present	3	Endangered sp. present	3
2. Aquatic life	Chronic toxicity	3 x 2 = 6	Not demonstrated	0
3. Chemical measures				
i. Tissue residues	DDT NAS level exceeded	3	DDT NAS level exceeded	3
ii. Water objective	Metals regularly exceeded	4	No data	0
iii. Sediment values	No data	0	No data	0
Total score		7		3
C. Areal extent	>50 acres	8	>50 acres	8
D. Pollutant source	Metals in river water from multiple sources	3 x 2 = 6	DDT & PCB in fish from multiple sources	3 x 2 = 6
E. Remediation potential	Improvement unlikely without intervention by an integrated strategy	10 x 2 = 20	Improvement unlikely without intervention but strategy is unclear	10 x 1 = 10
Cumulative Score		85		60

Ranking of Potential Hot Spots

The BPTCP will conduct confirmatory work on potential hot spots to determine if they are known toxic hot spots. Since a large number of potential hot spots are likely to be identified, some manner of scheduling the confirmatory work is needed.

In contrast to known hot spot ranking, Potential Hot Spots have substantially less information available for ranking purposes. Furthermore, since monitoring costs are much lower than probable remediation costs, the ranking of sites for monitoring purposes does not justify the level of detail used for known toxic hot spot ranking. Consequently, ranking of these sites is less quantitative, consisting simply of the grouping of sites into high, medium, and low probability of qualifying as a known hot spot. The predominant types of information available for ranking are State Mussel Watch (SMW) tissue levels, sediment contaminant levels, and, less frequently, toxicity testing. Other kinds of data which are only occasionally available include organism impairment, community degradation, and water contaminant levels.

The highest rank is reserved for sites that are most likely to qualify as known hot spots due to the existence of data indicative of high risk and falling into one of the five conditions for qualification as a known toxic hot spot. Such data will include positive toxicity testing results, tissue contaminant levels approaching NAS, FDA, or OEHHA protective levels, and occasionally other appropriate data. Sediment contaminant data are not included because no chemical-specific sediment quality objectives have been adopted in water quality control plans. Generally, old information will have less importance than recent data, unless the recent data is not particularly useful in judging the likelihood for known hot spot qualification. For example, recent positive toxicity tests will probably be considered equivalent to screening and therefore require confirmatory toxicity testing. Conversely, recent SMW results below NAS, FDA, or OEHHA protective levels will probably be judged unworthy of further tissue testing if territorial fish are unavailable at that site.

The "medium" rank consists of sites with high sediment contaminant levels, as judged first using the PEL sediment screening values, and the values from Long and Morgan (1990) for additional substances where an ER-M is available. Sampling and analysis of fish tissue will focus on SMW sites with EDLs over 85 unless the results of high rank sites show that fish are unavailable or incapable of concentrating pesticides, PCB, or mercury above protective levels.

Remaining sites are of low rank and consist predominantly of sediment contaminant levels below ER-M, PEL values and/or SMW EDL 85.

Staff Recommendation: Adopt Alternative 4.

Proposed Language: RANKING CRITERIA

Use the Ranking Criteria in Alternative 4 plus the values used for site ranking in Tables 3, 4, 5 and 6.

Issue 5: Monitoring Procedures for Toxic Hot Spot Identification

Issue: Description: Each coastal RWQCB is required by the Water Code to develop a monitoring and surveillance program for enclosed bays and estuaries. Given the working definition of a Toxic Hot Spot, several choices regarding specific monitoring procedures are necessary. The most prominent of these are 1) which mix of indicators to use, 2) how to most efficiently address recurrent effects, and 3) the most cost effective use of field replicates.

Monitoring Program Objectives

Section 13392.5 requires, in part, that each RWQCB shall, in consultation with the SWRCB, 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.

This issue is broken into three parts to facilitate discussion of each of monitoring and assessment: Selection of biological methods, sampling design and data analysis.

Issue 5A: Selection of Biological Monitoring Methods

Issue Description: 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 analyses of the impacts at a site.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Use toxicity test also to determine which sites are toxic hot spots.

   Solid phase sediment bioassays are a direct indication of toxicity of the sediments to test organisms and serve as an in direct indicator of bioaccumulation of pollutants. The advantages and disadvantages of toxicity testing in general is presented in Table 2.

   The most common test organisms are various species of amphipods (shrimp-like crustaceans), worms and tests on interstitial waters (water from the pore between sediment grains) using water column organisms or life stages. Water toxicity tests can also be used to measure toxicity of sediments that overlay sediments.

   There a re a number of established tests that can be sued to assess and monitor marine and estuarine sediments and waters. The SWRCB should consider adoption of a standard list of toxicity test protocols for marine, estuarine and fresh water conditions that may be encountered applicable to the BPTCP.

   Not all tests available should be approved by the State Water Board because a number of test are still developmental. The tests presented in Table 3 meet the following criteria for suitability:

   A. the existence of a detailed written description of the test method;

   B. Interlaboratory comparisions of the method;

C. Adequate testing with water, wastewater, or sediments; and

D. measurement of an effect that is clearly adverse and interpretable in terms of beneficial use impact.

The tests listed in Table 4 are developmental and do not meet the suitability criteria.

2. Use bioaccumulation monitoring (mussels or fish) to locate toxic hot spots.

The most common approach for measuring bioaccumulation in aquatic organisms at sites with polluted sediments is to either deploy or collect naturally occurring bivalves (usually mussels and then measuring the levels of pollutants in the tissues. Both of these approaches have been used by the California Mussel Watch Program (Rassmussen et al., 19). In the past Mussel Watch information have been used to determine the relative concentration of pollutants in tissues. The tissue measurements of pollutants is a good measure of exposure of the mussels to pollutants in the water column and, indirectly, the sediments. Measurements of pollutants in the tissues of mussels do not measure an effect on the tissue concentrations on the mussels themselves. Taken with measures of effect (e.g., toxicity tests, or benthic community analysis, etc.), bioaccumulation monitoring is a powerful tool for measuring exposure to pollutants.

Bioaccumulation in fish species can also be used to assess the potential impacts of humans eating contaminated fish. Risk assessments can be developed to estimate the potential risk for human consumption of the fish A health risk assessment is defined as an analysis which evaluates and quantifies the potential human exposure to a pollutant that bioaccumulates or may bioaccumulate in edible fish, shellfish or wildlife. Once a health risk assessment is complete the assessment can be reviewed by OEHHA to determine if a human health warning on the site or waterbody is warranted.

3. Use biomarker monitoring alone to locate toxic hot spots.

In addition to measures of effect, measures of exposure of organisms to pollutants can be a powerful tool applied to identification of toxic hot spot. 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 is that many are adaptable to inexpensive, rapid assessment methods. A major disadvantage is that there are no widely accepted protocols for these types of tests and the relationship between biomarker response and significance of the response is not always known.

Several exposure measures focussing on the cellular or subcellular level are available. There are enzyme systems which are induced by the presence of pollutants which can be measured. For example, selected enzymes in the P450 system have been shown to be 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 have been used to identify polluted sites. A special application of the P450 system which is under development by the program is the use of a genetically engineered cell line to elucidate exposure to dioxins, furans and related substances.

Another enzyme system of interest is the group of enzymes known as stress proteins (Sanders, 1990). These enzymes appear to be elevated in response to exposure to metals, as well as other stress factors. Stress proteins generally function to stabilize macromolecules during transport within cells and in the repair of damaged enzymes.

Also potentially useful is a group of enzymes that has been associated with the development of cancer. A number of enzymes have been noted to be either depressed or elevated in both tumor cells and in cells identified as precancerous. The measurement of a biochemical alteration in the presence of a disease state which can be associated with, or be considered an effect of contamination, offers a prime opportunity to evaluate these enzymes for little additional cost. Further work is needed to evaluate the utility of this group in environmental monitoring.

4. Use benthic community analysis alone to establish if a site or station os a toxic hot spot.

Measurements of the benthic community of invertebrates is a direct measurement of one of the biological resources the BPTCP is aiming to protect. An analysis of the benthic community involves assessing the various types of organisms and their numbers that live in and on the sediments. Community structure at polluted sites can be compared to unpolluted sites or alternatively organisms indicative of polluted or clean conditions can be used to compare sites. Organisms that live in the sediments can be greatly effected by pollutants present in the sediments; however, pollutant effects may be very difficult to distinguish from naturally occurring conditions (e.g., sediment type, temperature and storm effects) (Table).

If evaluated correctly and non-degraded sites are available, benthic community analysis can provide a definitive evaluation of whether a site is a toxic hot spot.

5. Us a weight of evidence that combines a number of indicators to assess if a site or station is a toxic hot spot.

The best bioassessment methodology would be the combination of an array of tests that exploits several exposure routes and effects. 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 can form the basis for a weight-of-evidence approach. The analysis of community composition provides 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). 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.

Staff Recommendation:

Adopt Alternative 5.

Guidelines to promote standardized analytical methodologies are required by statute; details are contained in the BPTCP Quality Assurance Project Plan (QAPP) (Stephenson et al., 1994).

Proposed Policy Language:

The tests below shall be used to measure water and sediment toxicity. Other tests may be added to the list as deemed appropriate by the State or Regional Water Boards provide the tests have a detailed written written description of the test method; Interlaboratory comparisions of the method; Adequate testing with water, wastewater, or sediments; and measurement of an effect that is clearly adverse and interpretable in terms of beneficial use impact.

The tests list in Tale 10 should be included in the policy.

Table 9

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 pollutants 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 these 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 variability).	These tests are not surrogates for determining natural changes in population diversity.
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 10
Water and Sediment Toxicity Tests That Meet
the Criteria For Acceptability

Type of Toxicity Test	Organism Used: Common Name	Organism Used: Scientific Name	Reference
Solid Phase Sediment	Amphipod	Rhepoxinius	ASTM, 1993
	Amphipod	Eohaustorius	ASTM, 1993
	Amphipod	Ampelisca	ASTM, 1993
	Amphipod	Hyalella	ASTM, 1993
	Polychaete	Neanthes	Johns et. al., 1990
Sediment Pore Water	Bivalve larvae	Crassostrea	ASTM, 1993
		Mytilus	ASTM, 1993
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongy-locentrotus	Dinnel et al., 1987; 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	Horning and Weber, 1985
Ambient Water	Bivalve larvae	Crassostrea	ASTM, 1993
		Mytilus	ASTM, 1993
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongylocen-trotus	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	Horning and Weber, 1985

Table 11

Water and Sediment Toxicity Tests that Did Not meet the Criteria for Acceptability

Type of Toxicity Test	Common Name	Scientific Name	Reference
Growth	Echinoderm	<u>Lytechinus</u>	Thompson et al., 1989
Growth	Sand Dollar	<u>Dendraster</u>	Casillas et al., 1991
Biological Response	Microtox	Bacterium	Brouwer et al., 1990
Growth	Amphipod	<u>Grandidierella</u>	Nipper et al., 1989

Table 12

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 exposure and health risk through consumption of bioaccumlatory organisms.	Difficult to associate contamination in mobile species to species resident in areas 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 13

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 contaminated sites.
May integrate patchy temporal exposure.	No existing USEPA 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 bioassessment methods.	Requires experienced other expert investigators.
Selective for particular pollutant or class of pollutants.	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 14

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 (such as sediment texture, temperature, and storm effects).
Can distinguish population changes.	Requires expert investigators.
Direct measure of actual exposure.	Sampling and handling may bias measurements. Interpretation of community structure may be very complex.

Issue 5B: Selection of Sampling Strategy

Issue Description: Requirements of Section 13390 et seq. of the Water Code include directing the SWRCB and the seven coastal California Regional Water Quality Control Boards (RWQCBs) to develop ongoing monitoring and surveillance programs for the enclosed bays and estuaries of California (Section 13392.5). The primary purpose of the monitoring and surveillance programs is to identify toxic hot spots.

The four objectives of BPTCP regional monitoring are:

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

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.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Use a haphazard approach for sample site selection.

   Under this approach sites would be selected based on the whim or personal preference of the individual State or Regional Board staff. The basis for site selection is ease of implementation rather than previous knowledge of scientific understanding. Since study objectives are unknown or not specified, this approach is the "no design" approach. This approach is not defensible and should not be used.

2. Use a worst-case sampling design for site selection.

   This approach is based on previous knowledge about the presence and distribution of potential sources of sediment pollution in the water body or previously known pollutants or biological effects in the water body. This sample design is useful as an initial survey to determine the potential for pollution-related problems, followed by a more complete sampling later (if needed). This approach is most useful when there is adequate information available from previous studies on biological effects present, measurements of chemicals present, sources and other information.

A limitation of this approach is that the data collected from this type of survey can only be evaluated in terms of the sampling stations that are sampled. The areal extent of the pollution or biological effects can not be determined.

3. Use a random or stratified random sampling design for site selection.

This design is very useful when little is known about the likely distribution of pollutants or biological effects in a water body. To use this design a grid is established and stations are randomly selected with each location having an equal probability of being sampled. The number of samples can be selected statistically based on the requirements of the survey (i.e., the objectives of the study) and acceptability of error rates. A stratified random design is distinguished from a purely random design by the selection of zones (based on available information) that exhibit similar levels of pollution, similar source type, or other characteristics. Samples are randomly collected in the various zones that are selected.

Using these approaches provides a statistical basis for determining the areal extent of the identified pollution or biological effects.

Staff Recommendation: Adopt a combination of Alternatives 2 and 3.

Proposed Policy Language:

SCREENING SITES AND CONFIRMING TOXIC HOT SPOTS

In order to identify known toxic hot spots a two-tier process shall be used. The first tier is a screening step where a suite of toxicity tests is used at a site. Sediment grain size, total organic carbon (TOC) and H_2S concentration are measured to differentiate pollutant effects found in screening tests from natural factors. Chemical analyses (metals and organics) will be performed on a subset of the screening samples.

If effects are found at sites by these screening steps, the sites will be retested to confirm the effects. In the confirmation step measurements will be replicated (if needed) and compared to reference sites. Chemical measurements (metals, organics, TOC, H_2S) and other factors (e.g., sediment grain size) will be measured.

Measurements of benthic community structure and, if needed, bioaccumulation will also be made.

A Battery of Screening Tests

Selecting a battery of toxicity screening tests can improve cost-effectiveness by expanding the range of potential impacts to be evaluated. Although recurrent toxicity must be demonstrated to qualify a site as a "candidate" toxic hot spot, the degree of certainty for each of the measurements does not necessarily have to be equivalent. The cost of 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 the site.

Even though the list of acceptable tests is long (see Table 10 above), the State and Regional Water Boards should evaluate the use of the following tests first.

Table 15

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/or anaphase aberration
Neanthes (Polychaete worm)	Bedded sediment	Survival and growth

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 or pore 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, and reproductive success 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.

Site Selection

Regional Monitoring Designs

Three somewhat different designs are used in BPTCP monitoring. Six of the coastal RWQCBs have used a design (summarized in Table 5 and Table 6) that combines toxicity testing, chemical analysis, and benthic community analysis in a two-phased screening-confirmation framework (Table).

The Central Valley RWQCB, 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 (metals and pesticides) constitutes the main program components. Sediment toxicity testing could be added to the monitoring design at a later stage.

Table 16

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 (see Table 5)	Repeat of positive results
Field replicates	None	Three (if needed)
Lab replicates	Five	Five
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	Occasionally (sites with no pre-existing bioaccumulation data)

Table 17

Sequence of Tasks for Designating Toxic Hot Spots

1. Select toxicity screening sites.
2. Sample screening sites.
3. Conduct battery of four 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 quality assurance requirements have been met.
9. Report on Items 7 and 8.
10. Select sites and toxicity tests for confirmation and reference sites.
11. Sample confirmation and reference sites.
12. Conduct subset of the battery of toxicity tests which were screening hits; analyze for hydrogen sulfide, TOC, and 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 program: (1) potential toxic hot spots base on existing information, (2) high risk sites based on existing information, (3) stratified random sites, and (4) reference sites. Potential toxic hot spots are the highest priority sites because some indication already exists that these sites have a pollution-related problem. These data are typically sites with information available on chemical contamination of mussel tissue, data documenting water and sediment toxicity, measurements of metals or organic chemicals in sediments, and, occasionally, biological impairment. These sampling efforts are typically point estimates.

There are many other sites that are considered "high risk" even though we have no monitoring information to support this contention. High risk sites are locations where a nearby activity (such as marinas, storm drains, and industrial facilities) are thought to be associated with a certain risk of toxicity. The measurements at high risk sites are either point estimates or selected probabilistically.

When little is known about the quality of a waterbody segment, the monitoring efforts should use 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 for the State and Regional Water Boards to make better estimates of area (percentage) of water bodies that is impacted. The State and Regional Water Boards shall consider the use the techniques used by the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program.

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 are reviewed. Since these sources yield an insufficient number of sites, fine-grained areas presumed to be relatively free of contamination are also examined. These sites may likewise prove to be rare, so sites with chemicals present, but experiencing low energy tidal flushing, will also be sampled. Sites with previous indication of no pollution, and those lacking sediment toxicity measurements will also be sampled. Finally, random selection of sites (as described above) may prove useful in locating reference sites.

Toxicity Screening

All tests will 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 the collection of a single field sample from each site (Table 7, Steps 1 and 2). Five laboratory replicates are 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 7, Step 3) to determine their relative contribution to any observed toxic affects. 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 after conducting confirmation testing (Table 7, Steps 4-9). 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.

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

With the identification and sampling of acceptable reference sites, all screening sites (Table 7, Steps 10 and 11) with at least one positive test result will be revisited 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 present or absent. Confirmation testing is more intensive because of (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 for the same test. 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 non-impacted sites can be distinguished (Table 7, 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 7, 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 appear to be due to human-causes 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. Similarly, when toxicity is not demonstrated but benthic impacts are observed, 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 (such as areal extent, range of effects, and source determination) will be described in the cleanup plan and is not intended (unless samples are collected using a random or stratified random design) under this phase of the program.

Issue 5C: Toxic Hot Spots Data Analysis

PRESENT POLICY: Although impacted areas have been identified in the past using coastal monitoring data, such data were predominantly chemical in nature. The BPTCP's combination of bioeffects and chemical data necessitates the development of new data analysis methods. There is presently no routine method of analysis of these types of data that has been used previously by the State and Regional Water Boards.

ISSUE DESCRIPTION: Condition 2 of the current working definition of a Toxic Hot Spot states that a site at which "the water or sediment exhibits toxicity associated with toxic pollutants" is considered to be a Toxic Hot Spot.

[Have to add benthic throughout]

Because sediment toxicity can result from factors other than toxic pollutants (e.g., ammonia, grain size, and, perhaps, a variety of other natural factors), demonstrating "association" at an individual site requires stronger evidence than simply the joint occurrence of both toxicity and toxic pollutants. Unlike water toxicity testing, Toxicity Identification Evaluations (TIEs) to more firmly establish the cause of the toxicity in sediment are not expected to be routinely applied prior to Hot Spot designation, due both to their developmental nature as well as the expense to the BPTCP.

During the analysis of the BPTCP's San Diego region dataset, a number of issues arose regarding the proper procedures to use in demonstrating association. Among these were the appropriate definition and use of reference sites, the method for distinguishing impacted from non-impacted sites, the determination that anthropogenetic toxic pollutants rather than natural factors were associated with the bioeffects observed, the proper use of sediment effects values appearing in the literature to bolster the demonstration of association, the role of statistical correlations, and the evaluation of recurrent bioeffects. As time went on, two alternatives emerged for the overall treatment of the data - a conventional approach and a new approach developed by BPTCP and DFG staff. The following describes these two alternatives and includes illustrations of the number of Toxic Hot Spots identified by each.

COMMENTS RECEIVED: This section will be completed after the State Board hearing on the proposed guidance document.

ALTERNATIVES
FOR STATE
BOARD ACTION: 1. Weight of Evidence Data Analysis Approach

Research Design

Initially the research design identified "reference sites" which were selected to match out the confounding effect of natural causes of toxicity. These sites were nontoxic over repeated testing and were chosen, as well as could be, to mimic the grain size and TOC of the sites being studied for Hot Spot status. The expectation was that study sites would be classifiable as Hot Spots when they exhibited significantly more toxicity than "reference sites" with similar grain size and TOC. No effort was made to ensure that "reference sites" contained low levels of pollutants since that would bias the determination of the association with toxic pollutants (i.e. if nontoxic sites which were relatively high in pollutants were unacceptable as "reference sites", then there would be an artificially greater, or biased, difference in pollutant concentrations between study and "reference sites", thereby resulting in a biased association). As sampling progressed, at least one "reference site" was included in each leg to satisfy the additional function of ensuring that collection and handling methods were not responsible when all the potential Hot Spot stations in a leg showed toxicity.

Once the complete toxicity and chemistry data set was received and preliminary data analysis performed, a modified concept of the research design and "reference sites" emerged. Figure 1 (which displays the relationship between R. abronius survival and pollutant concentration, in this case mercury) shows that all the sites evaluated in a sampling effort can be viewed as falling into one of four quadrants. The first, which is on the lower right of the graph, consists of sites which are being evaluated for consideration as Toxic Hot Spots - they are high both in toxicity and in the concentration of a toxic pollutant. In the simplest terms, these are the sites that are both higher in toxicity and higher in pollutant levels than all other sites. A second group of sites, which are diagonal from the first (upper left), satisfy the conventional view of a "reference site" since they are nontoxic and low in pollutant. They have particular utility in demonstrating the other end of a dose-response curve when one exists, thereby presenting a strong case to link pollutants with bioeffects. The two other quadrants, however, shed additional light on the association between toxicity and toxic pollutants. The upper right quadrant contains sites that are low in toxicity but high in pollutant; these sites address the bioavailability of the pollutant since the one furthest to the right illustrates how high the concentration of the pollutant can be without causing toxicity (the Apparent Effects Threshold or AET). Finally, the lower left quadrant contains sites that are high in toxicity but low in pollutant; these sites demonstrate that factors other than toxic pollutants may be capable of causing significant toxicity. Note that evaluation of this quadrant requires viewing the full set of graphs (one for each pollutant measured) to determine whether any measured pollutants at all occur in high concentrations at the toxic stations; if not, then the toxicity may be associated with a variety of unmeasured toxins, perhaps natural, perhaps manmade.

Conceptualizing what a "reference site" is begins with an understanding of what it is used for. The following four uses have been identified: 1) as mentioned above, as a check on sampling and laboratory methods in each sampling leg (if all the sites in a leg were toxic, questions would be raised about sample bottle contamination, sampler expertise, etc.), 2) as a population estimate of nontoxic sites against which toxic sites are compared statistically to determine where to draw the line between toxicity and the lack of toxicity, 3) as mentioned above, as data for the nontoxic, low-pollutant end of a dose-response curve, and 4) as mentioned above, as an illustration of AETs and the existence of toxicity associated with factors other than measured pollutants, ammonia, grain size, and hydrogen sulfide. Once the uses of "reference sites" are established, then the definition and terminology follow. To satisfy the first and second uses, all that is needed is nontoxic sites, regardless of their pollutant levels. An appropriate term for sites such as these is, of course, "nontoxic". To satisfy the third use, sites must be both nontoxic and low in pollutants. Since this is the conventional definition of "reference sites", that terminology will be retained. Note, however, that these sites also satisfy the first and second uses since they are nontoxic. To satisfy the fourth use, two types of sites are required - nontoxic and polluted as well as toxic and low in pollutants. For current lack of better terminology, these sites can be referred to as "AET sites" and "unmeasured toxins" sites, respectively.

While on the subject of research design and "comparison sites" (the all-inclusive or generic term), some attention must be given to the selection of these sites. Fundamentally, all efforts which consciously or unconsciously bias site selection should be avoided. One common bias is to select only those comparison sites that are nontoxic and low in pollutants by going to "pristine" areas. This may act to severely restrict the data used to produce AETs; rather, sites should be chosen either without respect to pollutant levels (via widespread or random sampling) or with respect to gradients (to more systematically locate highest concentrations that are nontoxic). Another bias would be the discarding of toxic test results from sites which had shown repeated lack of toxicity. Often viewed as "reference sites going toxic", these data should instead be viewed as a possible demonstration of the influx or sudden availability of unmeasured toxins. The consequences of these two biases can be significant; not only can they result in substantially lower AETs and the absence of data to illustrate the presence of other toxins, but they also can act to produce an artificially high correlation between toxicity and pollutant levels. Reference to Figure 1 shows this graphically; if biases are in effect which act to reduce the number of data points in the upper right and lower left quadrants, then an artificially high correlation between toxicity and mercury concentration would result.

Distinction Between Toxic and Nontoxic Sites

[Wait for J&B or use Bob Smith's approach with necessary modification]

Identification of Pollutants Associated with Toxicity Using Internal Apparent Effects Thresholds (the Graphical Method of Analysis)

Once the toxic sites were identified, a series of 122 scattergrams were produced illustrating, for each pollutant, the concentration (in ug/g or ppm for metals and ng/g or ppb for organics) and toxicity at all of the field replicate stations (please see Appendix B). When all of these graphs are viewed (referred to as "graphical" analysis) they fall into two groups: 1) those which have at least one toxic station whose pollutant concentration is greater than that of the most highly concentrated nontoxic station and 2) those which do not. The highest concentration of the pollutant at a nontoxic station is its Apparent Effects Threshold or AET. The assumption underlying its use is that toxicity at a station cannot be associated with an individual pollutant when its concentration is less than the highest concentration of the same pollutant at a nontoxic station (i.e. less than its AET). Graphs 2 through 5 are examples from the full set of graphs that serve to illustrate this point. It would be difficult to argue that the toxicity at stations with

[50% ?]

or less survival was associated with acenaphthene, tributyltin, p,p'-DDE, or zinc since much higher concentrations were observed at nontoxic stations (please refer to the limitations section below).

At least two issues need to be considered in the interpretation of these graphs. First, it may be argued that nontoxic stations with the very highest concentrations should be thought of as outliers and, in fact, that 95% confidence intervals should be calculated for pollutant concentrations at the nontoxic stations. In response, it may be that outlier status should be conferred only when one or two stations are repeatedly involved and when the pollutant measured is particularly susceptible to a measurement artifact (e.g., paint chips, lead shot, copper wire, and other types of non-dispersed metals captured in the sediment sample, such as filings, pellets, and ore). That is, if more stations and both organics and metals are involved, then the AET values should not be considered outliers. This turns out to be a rather critical area of the analysis since AETs are, by definition, the most extreme data points and must be clearly distinguished from outliers. Appendix C shows that, in fact, several different nontoxic stations had the highest concentrations rather than just one or two repeatedly and this pattern existed for PAHs, PCBs, and pesticides as well as TBT and metals. Regardless, this area should receive careful review by a statistician. Such a review should include the realization that the same issue applies to the other axis of the scattergrams; that is, whether extreme toxicity values as well as extreme concentration values should be considered outliers.

Second, TOC normalization of sediment chemistry data is often performed to correct for the effect of varying levels of organic carbon. To test the utility of this approach, stations with pollutants above their respective AETs were identified from graphs containing both TOC-normalized (Figures 6 through 31) and non-normalized data (Figures 32 through 58). Although metals are not conventionally treated in this manner, they were for this analysis to determine whether differences emerged. Table 1 shows that, for this dataset, the general conclusion is not altered greatly by TOC normalization, although one or two exceptions did occur (lindane at station 90051 and, perhaps, heptachlor at station 90009). Both methods show that a number of PCBs and pesticides (principally chlordanes and heptachlor) were above their respective AETs at stations 93228, 90002, and 93210. The two methods also agreed on the lack of implication of pollutants at stations 93219, 93232, 90025, and 93200.

Although, ideally, graphical analysis should focus on individual pollutants, the sediment effects values appearing in the next step of the analysis are occasionally reported for groups of chemicals. Therefore, Figures 62 through 67 were also examined to identify stations which exceeded AETs for the two stereoisomers of chlordane combined, for o,p'-DDT and p,p'-DDT combined, for total PCBs measured (including Arochlor 5460), and for total PAHs measured, total low-molecular-weight PAHs, and total high-molecular-weight PAHs. The results of these additional analyses (presented in Table 1) are that cis- and trans-chlordane combined are greater than the corresponding AET for stations 93228 and 90002 and all PCBs combined are greater for station 93210.

> ["One station is higher for high-molecular-weight PAHs than the nontoxic stations but this definition may be altered"...revisit this based on J&B's analysis]

Comparison of these AET values from San Diego Bay with those produced throughout Southern California by the BPTCP showed that only heptachlor had a higher AET elsewhere (2.1 ppb in Los Angeles Harbor). This level and the corresponding TOC-normalized value is high enough to remove heptachlor from concern at station 93210. The appropriateness of this procedure is addressed in the next section. Fortunately, though, in this instance there is little material effect on the determination of Hot Spots since the case, if made, will be driven by other pollutants present at this station.

Compatibility with Sediment Effects Values

To judge whether a pollutant is of high enough concentration to cause a bioeffect, pollutant concentrations at toxic sites are often compared to the values of a variety of sediment effects measures. These range from equilibrium partition coefficients (EqP), apparent effects thresholds (AET), and spiked bioassays to measures which derive from the combination of these data, such as median and 10% effects ranges (ER-M and ER-L) and threshold and probable effects levels (TEL and PEL). These measures all have their strengths and weaknesses but, due to relatively less bias, some may be preferred over others for designating Hot Spots. Although it might be useful to locate reviews by, perhaps, EPA, NOAA, or Florida which weigh the direction and magnitude of various biases, such an effort would probably be rather time consuming and might not lead to a clear resolution anyway. Therefore, the following paragraphs describe several of the more prominent biases. These are followed by an attempt to explain the various relationships that can occur between the pollutant concentration at a station and the various sediment effects measures. In conclusion, a summarization of the compatibility between the sediment effects values and the pollutants and stations implicated in the previous section (see Table 1) is presented.

Bias in Sediment Effects Measures: As one example of a potentially significant bias, consider AETs, ERMs, ERLs, TELs, and PELs. To judge whether a pollutant is of high enough concentration to be associated with a bioeffect, pollutant concentrations at toxic sites are often compared to values such as these, all of which are derived completely or predominantly from field-collected data in which pollutant mixtures occur. These values have their utility but because they are biased by the influence of a mixture of pollutants they are inappropriate for this specific use. The bias is always in the same direction (towards underestimating the concentration at which a single pollutant causes a bioeffect...that is, its threshold) and its magnitude is largely unknown. The following example provides clarification.

Assume that a group of sites have been identified that are contaminated with varying levels of both trans-chlordane and Arochlor 5460 and which range from nontoxic to toxic as measured by an amphipod test. The highest trans-chlordane concentration among the nontoxic sites would constitute an AET for that pollutant. However, there are very likely higher levels of trans-chlordane that would have been nontoxic were it not for the added presence of Arochlor 5460. Therefore, the AET underestimates the concentration at which trans-chlordane begins to cause toxicity. As a consequence, it can be concluded that AETs are a biased estimate of threshold concentrations and that the direction of the bias is always the same - towards underestimation. What there is little appreciation for is the magnitude of the bias. Is it off by a factor of 2, or 10, or 100, or what? Because the same bias is operating whenever field data are used to develop protective levels, ER-Ms, ERLs, TELs, and PELs are likewise biased even though some of the data used in their calculation is derived from spiked bioassays and partition coefficients.

It must also be pointed out that both spiked bioassay and equilibrium partition data may also be unidirectionally biased. Early spiked bioassay studies, for example, may have been terminated before equilibrium was established in the test containers. Since the expectation might be that relatively more pollutant was bioavailable compared to complete equilibrium, early studies might be biased more towards overestimating the toxicity resulting from a particular pollutant concentration than later studies. However, natural systems may have greater bioavailability due to frequent resuspension than a bioassay test system, regardless of the time given to equilibrate. This might act to drive the bias in the opposite direction. Sediment effects values derived from equilibrium partition coefficients may also be biased due to the reliance on water bioassays and octanol-water partition coefficients used in their calculation but whether the overall bias is unidirectional and, if so, in which direction is unclear. The magnitude of the bias is likewise in question.

Relationships Among Different Sediment Effects Measures: The BPTCP's preference is to use the dataset's own AET (the "internal" AET) to determine the effects threshold for pollutants. In contrast to ERMs, ERLs, PELs, and TELs, this has the advantage of being specific to the same species, lifestage, endpoint, geographic area, time period, and laboratory as the toxic stations. The internal AET is also superior in that it has the theoretical capability of being the most valid measure. Taken to its extreme, an AET's true value is the concentration of a *single* pollutant (in the field and uncomplicated by the influence of other toxins) that falls just short of producing toxicity. Although the absence of single-pollutant sites (due to the limited size of the dataset) may bias the AET towards underestimating the threshold, this bias is probably considerably less than that of ERMs, ERLs, PELs, and TELs. (No doubt some analyses of the Florida database would be useful in evaluating this). Perhaps it would be useful to think of this in terms of the scattergrams provided.

The most important point to locate on any given graph is the true (i.e. unbiased) AET. Since AETs usually result from sites with multiple pollutants (and are, therefore, biased towards underestimating the threshold), the true AET is always at or to the right of the internal AET. If the ERMs, ERLs, PELs, and TELs lie to the left of the internal AET, it's a rather straightforward conclusion that the internal AET is a more accurate estimate of the true AET. If, however, these four values lie to the right of the internal AET, it isn't clear what to conclude; are they closer to the true AET and, therefore, superior or are they further to the right than the internal AET is to the left?

The same applies for spiked bioassay and EqP but, interestingly, not necessarily for external AETs.

These estimates are usually accompanied by disclaimers that they are not to be applied outside the area where they've been developed but closer inspection raises important questions. First, because AETs are derived from a single site, does the disclaimer mean the AET can't be applied to other sites in the same area either? Second, why, exactly, can't AETs be applied to other areas? If the reason is that bioavailability is different due to some physical characteristic of the sediment that varies between the two areas, what is the physical characteristic(s)? Temperature may differ between the two areas but standard protocols demand it be held constant during laboratory testing. Grain size and TOC may differ but probably no more than between sites within the same area. The type of minerals and organic components present may differ, but AETs *within* an area are incapable of sorting out these differences. Therefore, it seems that external AETs may have problems, but these problems are compensated by the increase in likelihood that the true AET is being approached when they are used. As with other measures, they have little utility when to the left of the internal AET. When to the right, however, they may represent a more accurate estimate of the true AET and should be treated accordingly.

Proper treatment, however, is a complicated matter. Regardless of the source of the AET, internal or external, assuming that the relationship between the measured fraction and the bioavailable fraction is constant across all sites in San Diego Bay is, of course, hard to justify. Although the data can be stratified into grain-size-and-TOC categories, other variables such as mineral type and organic composition may be the driving factors. This will always be a valid criticism of the program's conclusions but it's probably an unavoidable reality.

Due to the number of combinations between a station's pollutant concentration and various sediment effects values, interpretation will be necessary on a case-by-case basis. Nevertheless, three generalizations can be made: 1) data specific to test organisms used in the BPTCP are preferable to that of other organisms, 2) empirical data are preferable to theoretical data, and 3) data specific to a single test organism and a single pollutant are preferable to those derived from a wide variety of organisms and pollutants. As examples, R. abronius spiked bioassay and AET data have precedence over EqP data, effects ranges, and effects levels.

Compatibility Between Internal AETs and Sediment Effects Values: Application of sediment effects values to the results of the previous section (see Table 1) can produce a more refined list of stations for consideration as Toxic Hot Spots. To accomplish this, the appropriate tables from Long and Morgan (1990) are included in Appendix D. Ideally, the updated version of these tables, which is being produced for the Florida document, should be used but it is not yet available for release. Consequently, the following analysis should be viewed as somewhat preliminary.

Reported data for lindane are insufficient to make a case for or against compatibility between internal AETs and sediment effects values; neither AET, spiked bioassay, ERM, nor ERL data were reported; EqP values were greater than the internal AET; and the updated TEL (0.32 ppb) and PEL (0.99 ppb) bracketed the internal AET (approximately 0.4 ppb). Final evaluation of site 90051 should, therefore, await release of the Florida database in hopes that AET and/or spiked bioassay data are included.

In contrast, a rather strong case can be made for the combination of cis- and trans-chlordane; the internal AET (just over 50 ppb; Figure 62) is greater than all the effects data concentrations from Long and Morgan (1990) with the exception of spiked bioassay LC_{50}s on two other organisms. Furthermore, the updated ERL, TEL, and PEL are an order of magnitude less than the internal AET. Final evaluation of the implicated stations (93228 and 90002) would benefit from the Florida report, especially if R. abronius spiked bioassay and more AET results are included, but the case is already quite strong for compatibility between internal AET and sediment effects values for chlordane at these two stations.

Similar to lindane, the database for heptachlor is insufficient to make a case for or against compatibility; the internal AET (either 1 or 2 ppb, depending on whether LA data is applied) is greater than EqP data but appropriate AET, spiked bioassay, effects range, and effects level data are unavailable. Again, final evaluation of, in this case, station 90009 should await the Florida database.

The database for o,p'-DDT is even less amenable to making a case for or against. Because a separate table for o,p'-DDT is not present in Long and Morgan or in the updated numbers, the two DDT isomers (o,p' and p,p') were combined in Figure 63 and compared to the table of total DDT values. When this was done, however, station 93210 no longer fell to the right of the internal AET. The new internal AET (110 ppb) is greater than EqP data and updated effects ranges and effects levels but appropriate AET and spiked bioassay data are unavailable. Once again the Florida data should be reviewed before final judgement is made but, as will soon be demonstrated, the case is rather firm for other pollutants at station 93210.

The chlordane derivatives and metabolic products, heptachlor epoxide, p,p'-DDMS, and delta-hexachlorocyclohexane have no tables in Long and Morgan so judgement of their effect on stations 93228 and 90002 should also await the Florida data.

Because the sediment effects values for PAHs are presented as total, total low molecular weight, and total high molecular weight, graphs were included for all three groupings. Although there is still no case for the nine most toxic stations since the internal AET is so much higher, one other station may show compatibility if its toxicity (70%) is eventually judged to be toxic.

[still waiting for J&B's analysis]

This station's high-molecular-weight PAHs are higher than the internal AET (just over 45,000 ppb; Figure 67) which is itself bracketed by external AET data (>15,000, 18,000, and 69,000 ppb). Appropriate EqP and spiked bioassay data are unavailable but the updated ERM, ERL, TEL, and PEL values are substantially lower than the internal AET. If the Florida data include spiked bioassay results lower than the internal AET and the station is judged to be toxic, a rather strong case for compatibility can be made.

Finally, another strong case can be made for the combination of PCBs; the internal AET (just short of 3000 ppb; Figure 64) is comparable to or greater than the R. abronius AET and spiked bioassay values. Furthermore, the EqP as well as the updated ERM, ERL, TEL, and PEL are an order of magnitude less than the internal AET. As with chlordane, final evaluation of the implicated station (93210) would benefit from the Florida data, but the case is rather strong for compatibility between internal AET and sediment effects values for total PCB at this station.

In summary, strong compatibility with sediment effects values from Long and Morgan (1990) has been demonstrated for stations 93228, 90002, and 93210. The case is less strong for stations 90051 and 90009 but release of the updated Florida database may alter this conclusion. Stations 93232, 90025, 93200, and, especially, 93219 were not examined for compatibility since no internal AETs were exceeded at these stations.

Grain Size, Ammonia, and Hydrogen Sulfide Analysis

Once pollutant concentrations were analyzed graphically, the same approach was applied to the interpretation of grain size, ammonia, and hydrogen sulfide data. Figure 59 shows that only station 90051's ammonia level was higher than the internal AET. Figure 60 shows that none of the toxic stations had percent fines that were higher than the highest values at nontoxic stations. Figure 61 presents hydrogen sulfide data. Although this dataset is not complete for the full set of stations, results from other study areas and the one relatively high concentration at a nontoxic station suggest that observed toxicity is not due to hydrogen sulfide. Combination of the ammonia data with the average NOEC for most amphipods from the Los Angeles report (approximately 400 ug/l) suggests that the internal AET for ammonia is much too low an estimate of threshold effects. Therefore, there is little likelihood that ammonia is responsible for the toxicity at station 90051. To further test this conclusion, the Florida data should be reviewed for ammonia sediment effects values.

Dose-Response Analysis

Dose-response analysis, which is equivalent for the purposes of this effort to correlation analysis, is a very powerful argument for associating the pollutant with toxicity. If the correlation is strong enough and independent of the measured natural toxins, then a strong argument can probably be made that it is unlikely that other natural toxins or infectious agents behaved in a similar dose-response fashion. Therefore, when combined with other evidence implicating the pollutant at a particular station, perhaps the strongest case for a Hot Spot can be made. Simple correlations, however, can be misleading since many toxicants often covary. Therefore, correlation matrices should be produced to demonstrate whether, for example, the pollutant is significantly more correlated with toxicity than, say, ammonia or grain size. It should be emphasized, however, that the correlation should be both statistically significant and of sufficient magnitude for a strong case to be made.

Of the pollutants implicated by comparison with internal AETs, heptachlor (Figure 34) appeared to be most correlated with toxicity. Correlation coefficients were calculated for the dataset with and without the inclusion of non-detects. The respective values were -0.46 ($p = 0.000004$) and -0.95 ($p = 0.00002$), offering initial indications that a significant correlation does exist (proper treatment of non-detects may result in an intermediate value). Further analysis showed that ammonia (no non-detects) is correlated at -0.46 ($p = 0.000002$); even at this correlation, however, heptachlor is still of dominant concern since ammonia levels are so low compared to the average NOEC for amphipods (see previous section). When the same set of analyses was performed on the Los Angeles dataset, ammonia again played little role but heptachlor results were not so noteworthy. Little correlation was observed without non-detects ($r^2 = -0.26$) and the results were insignificant ($p < 0.5$). In summary, the case for Hot Spot status at station 90009 may have been made stronger by virtue of the dose-response relationship for heptachlor independent of ammonia in San Diego Bay; however, the lack of such an association in Los Angeles raises concern. Given the number of pollutants routinely assayed, it may be that the San Diego correlation was a chance event but a statistician should be consulted on this.

Station vs Site Analysis and Recurrence of Toxicity

The second-to-last step in the analysis is to determine how the *stations* whose toxicity is associated with pollutants relate to the most toxic *sites*. To summarize the preceding steps, stations 93228, 90002, and 93210 exhibit strong associations which cannot be explained by ammonia, grain size, or hydrogen sulfide. Stations 90051 and 90009 await updated sediment effects values to judge their associations, although station 90009's case for Hot Spot status is strengthened by a heptachlor dose-response relationship that is independent of ammonia. Focusing on the former group until Florida's data become available, these three stations are the Seventh Street Channel (93228), the Downtown Anchorage (90002), and the Navy Shipyards-04 (93210). More than one station at a site, of course, makes for a stronger Hot Spot case. Although this did not occur with this group of stations, if station 90009 is also judged to have pollutants associated with toxicity, then a second station occurs at the Seventh Street Channel. Whether a single station at a site is sufficient to make the case is an issue that should be reviewed by a statistician.

The final step is the demonstration of recurrent toxicity but there are two ways to assess this: 1) show that the *site* is toxic and that the screening station is as well or 2) show that the screening station is toxic twice, both during screening and during confirmation. The former option was chosen due to the difficulty of returning to exact stations as well as because the field replicates are intended to provide measures of variability rather than to demonstrate repeatability. Given this, the following table summarizes the relationship between stations and sites, both for toxicity as well as the demonstration of an association with pollutants (**bold** stations are both toxic and associated with pollutants):

Screening	Confirmation
NS	**93228**
toxic	**90009** (?)
NS	93227
nontoxic	**90002**
NS	93222
NS	93221
NS	**93210**
NS	93211
toxic	90021

NS = Not sampled

The first and third sites in the table showed recurrent toxicity between the screening and confirmation phases while the second did not.

In conclusion, sites 90009 (composed of stations 90009, 93228, and 93227) and 90021 (composed of stations 90021, 93210, and 93211) demonstrated both toxicity associated with pollutants (for at least one station) and recurrent toxicity. These two sites therefore qualify as Toxic Hot Spots (note, however, the limitation described below regarding the role of toxicity at "unmeasured toxins" sites). Site 90002 (composed of stations 90002, 93222, and 93221) did not demonstrate recurrent toxicity and therefore does not qualify.

Limitations of the Graphical Method

One important drawback of this method is the lack of a direct measure of the bioavailability of toxic pollutants. The single, pollutant-specific AET is at best a crude measure of this important variable since it very likely changes as parameters such as TOC and other sediment conditions that effect bioavailability vary. In fact, it might be argued that the internal AET should match toxic sites for these variables. Although TOC normalization addressed this issue, it might be useful to conduct additional analyses. For example, it might be informative to categorize TOC values and match internal AETs and toxic sites within TOC categories.

A not-so-obvious limitation is that the method may be scale dependent or, perhaps, even dataset dependent. Scale dependency relates to the geographic area and mix of facilities which are addressed in the sampling event. The data analyzed here came from a variety of facilities (marinas, shipyards, berths, stormdrains, etc.) scattered throughout San Diego and Mission Bays. For the method to have greatest utility, however, it should produce similar results on a smaller scale (a pollutant gradient at a single facility for example). Due to differences in sample site placement, the mix of pollutants, sediment conditions, and other determinants of toxicity, however, this method of analysis may produce very different results as the scale of the sampling event varies.

Similarly, this method may not be of much utility on other data sets of a similar scale. Perhaps by chance, the San Diego data were characterized by lower pollutant levels in the range of intermediate toxicity as compared to the nontoxic and toxic extremes. This allows clear distinction between the internal AET and concentrations at the most toxic stations. When this distinction does not occur (as, apparently, in the Los Angeles dataset), it is much more difficult to determine whether some of the most highly polluted stations are nontoxic (and therefore internal AETs) or toxic (and therefore Hot Spots). Figure 67 illustrated this for high-molecular-weight PAHs; the highest concentration occurred at 70% survival which, at this point, is neither clearly toxic nor clearly nontoxic. Another view, however, is that careful selection of sample sites is critical to the broad utility of the method; when stations which are likely to be the most toxic are intentionally or otherwise avoided, then the method may lose its utility.

On another level, the statistical analysis is rather informal at this point, being predominantly limited to graphical interpretation. Although this may be sufficient, statistical expertise should be contacted to determine whether improvements can be provided. For example, topological analysis may be appropriate to assess the distance and direction of each site from the AET. It would also be useful to address the other statistical issues raised at various points in the analysis.

Furthermore, this method is biased towards missing some sites that may qualify as Hot Spots. In comparison to the use of ERMs, ERLs, TELs, and PELs, reliance on internal AETs results in a conscious choice to accept a higher false negative rate (i.e. not labeling a site a Hot Spot when in fact it is) in exchange for a lower false positive rate (i.e. labeling a site a Hot Spot when in fact it isn't). Reducing false positives at the expense of increasing false negatives is of greater concern at this time because the choice has been made to proceed first with the strongest cases for Hot Spots. So, although some sites will probably be missed, the alternative may be that some other sites would be designated Hot Spots when, in fact, they probably weren't.

Finally, several issues regarding analysis of the data have yet to be resolved. First is concern for the cost effectiveness of field replicates. Because the case for association between bioeffects and pollutants has been made on field replicates (i.e. stations) rather than sites, it might be more cost effective to determine which sites show association from screening (which is non-replicated). However, measurement of field variability is still necessary so the most cost effective blend must be determined. Concerns about the cost effectiveness of replicates should also be directed towards the optimization of laboratory replicates. Second, no attempt has been made to analyze the variance that arises temporally. This source of variation should be contrasted with other sources to determine whether the recurrence of toxicity has been assessed in an appropriate manner. Third, the entire data set should be analyzed with the appropriate multivariate technique to determine what portion of the total variance in toxicity is explained by pollutants; the results of this analysis should then be merged with the graphical analysis to determine consistencies or the lack thereof.

2. Correlation Approach for Data Analysis

Although this approach is yet to be explicitly proposed, several features are frequently used in various State and Federal Programs.

The "conventional" approach apparently consists of 1) a statistical analysis that distinguishes between toxic and nontoxic sites, 2) the joint occurrence of both toxic pollutants and toxicity at a site, with ERMs, ERLs, PELs, or TELs used to determine whether toxic pollutants are implicated, 3) comparison of these sites with a biased group of nontoxic, low pollutant-level (or ambient level) reference sites to further bolster the argument that the pollutants are associated with the toxicity, 4) simple correlation between pollutants and toxicity among the group of sites, and 5) dismissal of sites whose toxicity is likely caused by ammonia.

Staff Recommendation: Adopt Alternative 1.

A single field study is ordinarily incapable of establishing a firm cause-and-effect relationship due to the variety of uncontrolled confounding factors. However, when combined with additional field work and accompanying laboratory investigation, judgements and conclusions can eventually be made. Alternative 1 does not, therefore, firmly establish that toxic pollutants are responsible for amphipod toxicity. Rather, the objective of the analysis was to make the strongest case for association at individual sites given the research design chosen. To learn the most from this effort, a data analysis approach was employed that presented stronger evidence for an association than what can be labeled the "conventional" approach. The following describes the advantages of this "graphical" approach and presents several examples of the differences in numbers of Hot Spots that arise between the two.

Advantages of the Graphical Method Over the Conventional Approach

As discussed previously in the section labeled "Compatibility with Sediment Effects Values", the graphical method (or internal AET method) is superior to the conventional method in determining the effects threshold of pollutants. The internal AET (especially when combined with spiked bioassay and external AET data) has more in common with the toxic sites and pollutants being evaluated than ERMs, ERLs, PELs, and TELs due to the derivation of these values from a variety of organisms, end points, pollutants, laboratories, geographic areas, etc. Although the internal AET approach may be more conservative and thereby miss some problem sites (discussed above in limitations section), the evidence for those that are implicated is stronger than that produced by the conventional approach.

A related advantage is that the interpretation of the internal AET may be being more carefully worded; pollutants are firmly rejected as being problematic rather than firmly implicated. This is akin to the difference between accepting and rejecting hypotheses. Since hypotheses can only, formally, be rejected, they are stated as a null. The interpretation of internal AETs parallels this; they are firmly rejecting pollutants as not being associated with toxicity. The ERMs, ERLs, TELs, and PELs sometimes seem to be being used to argue that greater concentrations *are* associated with toxicity. It may be a fine point but careful wording of conclusions is probably justified.

Another advantage is the specific focus given to toxicity arising at sites where the toxins routinely measured by the program are absent. These "unmeasured toxins" sites demonstrate that significant toxicity, independent of metals and synthetic organics, may occur in coastal waters. For example, station 93219 illustrates this point well; although R. abronius survival was 31 percent during confirmation, none of the pollutants measured were present at levels above PELs and ERMs and only four were above TELs (p,p'-DDE, copper, nickel, and zinc). Beyond the importance of this for designating Hot Spots (i.e. the lingering doubt that the toxicity at stations 90009 and 90021 may be caused, in whole or in part, by "unmeasured toxins"), this focus also accommodates the conversion of conventional reference sites from nontoxic to toxic. Rather than being viewed as a difficult-to-interpret set of data or, worst of all, as a dataset to be discarded or put on hold, such an event can be viewed as a positive occurrence since it provides evidence of sources of toxicity other than those conventionally measured.

Finally, the graphical method of analysis is more accommodating for the treatment of data in general. It can be used when the site selection method is modified (from BPTCP to NOAA to EMAP), when various approaches to reference site selection are implemented, and even when the entire dataset seems to behave erratically (as may be the case for the winter of 1994 confirmation effort).

Comparing the Two Methods for Chlordane, PCBs, and PAHs

Three groups of pollutants - chlordane, PCBs, and high-molecular-weight PAHs - offer clear illustrations of the differing results that can be obtained from the graphic approach and the conventional approach. Figures 62, 64, and 67 are reproduced as Figures 68-70 to show the concentration of various sediment effects values. The first shows that application of the updated ERL, TEL, and PEL to the data without regard to the internal AET would implicate station 90009 (20 ppb chlordane) as another Hot Spot. Figure 69 shows that at least three additional stations would be implicated since their total PCB concentrations are higher than the updated ERM, ERL, TEL, and PEL. Finally, Figure 70 implicates at least two additional stations due to higher concentrations than the ERM, ERL, TEL, and PEL for high-molecular-weight PAHs. Additionally, there may be other differences between the two approaches. For example, for those graphs where the internal AET was not exceeded, Appendix E presents those pollutants which had concentrations above the ERMs, ERLs, TELs, and PELs. This table simply illustrates that far more pollutants would be implicated at these sites using the conventional approach.

Although it may be tempting to reconsider the results of the graphical analysis at this point, imagine that a potentially responsible party might take special interest in the internal AET. To him or her it may seem more than a little curious that for his site the pollutant is judged to be associated with the toxicity while for another site with a higher concentration of the same pollutant no such judgement is made (and, consequently, no Hot Spot is designated). Although such a situation could result from differences in the bioavailability of the pollutant, the burden of proof might come to rest with the program. This would be an especially difficult case to make given evidence from other stations (notably station 93219) that significant sources of toxicity exist which are apparently associated with something other than ammonia, grain size, hydrogen sulfide, or the toxic pollutants currently assayed.

Given the differing results of the two methods and the advantages of the graphical approach, the staff recommendation is to adopt Alternative 1.

Table 18. Determination of Pollutants with Concentrations Greater Than the Apparent Effects Threshold, by Station and for TOC-Normalized and Non-Normalized Data.

Pollutants with Concentrations Greater Than AET[1]

Station	Non-Normalized	TOC Normalized
1	None	**lindane**
2	trans-chlordane	trans-chlordane
	cis-chlordane	
	cis- + trans-chlordane	cis- + trans-chlordane
	alpha-chlordene	alpha-chlordene
	delta-hexachlorocyclohexane	delta-hexachlorocyclohexane
	heptachlor	
	p,p'-DDMS	p,p'-DDMS
	PCB28	
	PCB31	PCB31
	PCB206	PCB206
	PCB209	
	2,3,4-trimethylnaphthalene	2,3,4-trimethylnaphthalene
3	None	heptachlor
4	trans-chlordane	trans-chlordane
	cis-chlordane	cis-chlordane
	cis- + trans-chlordane	cis- + trans-chlordane
		alpha-chlordene
	gamma-chlordene	gamma-chlordene
	trans-nonachlor	trans-nonachlor
	cis-nonachlor	cis-nonachlor
	oxychlordane	oxychlordane
	heptachlor epoxide	heptachlor epoxide
5	None[2]	None[2]
6	None[2]	None[2]
7		**o,p'-DDT**
	PCB8	PCB8
	PCB15	PCB15
		PCB18
		PCB44
		PCB52
		PCB70
	PCB105	
	PCB128	
	PCB151	PCB151

	PCB206 Arochlor 5460 All PCB combined	**PCB201** **PCB203** PCB206 Arochlor 5460 All PCB combined
8	None[2]	None[2]
9	None[2]	None[2]

[1] Bold type indicates pollutants that were notably different between non-normalized and TOC normalized (operationally defined as moving from above the AET to below or vice versa).
[2] Metals at these stations were low compared to AETs and organics were just above detection limits or, at station 5, seldom detected.

Figure 4 Maps of Sampling Strata for San Diego Bay, Mission Bay, the San Diego River, and Tijuana Slough

Figure 5 Scattergrams of R. abronius Survival vs Pollutant Concentration for Each Pollutant Measured

Table 19 Outlier Analysis of Nontoxic Stations

A. Pesticides

1. DDT

   a. Pattern of 3 outliers: PPDDD, PPDDE, PPDDMU, PPDDT, OPDDD
   b. Pattern of 2 outliers (1 in common with "a"): OPDDT

2. Pattern of 2 outliers (1 in common with "b"): aldrin

3. Pattern of 1 outlier: HCB

4. Pattern of 2 outliers (1 in common with "b"): TBT

B. PAH

1. Pattern of 1 outlier: CHR, PYR, MPH1, FLA, DBA, BAA, BAP

2. Pattern of 1 other outlier: PHN

3. Pattern of a third single outlier: ACE, MNP1

4. Pattern of two outlyers: MNP2, FLU, ANT, BPH

C. PCB

1. Pattern of 3 outlyers: 101, 110, 105, 118, 128, 132, 137, 138, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, 187, 189, 52, 70, 74, 87, 95, 97, 99

2. Another pattern of 3 (2 in common with "1"): 157, 66

3. Pattern of 2 (1 in common with "1"): 18

4. Another pattern of 2 (2 in common with "1"): 194, 195, 201, 203, 28, 49

5. Another pattern of 2: 209

6. Another pattern of 2 (?): 27

7. Pattern of 1 (?): 44

8. Another pattern of 1 (1 in common with "3"): 8

D. Metals

1. Pattern of 1 outlier: lead, chromium, zinc

2. Pattern of 2 outliers (1 in common with "1" plus another one): cadmium

3. Another pattern of 1: silver, manganese, iron, aluminum

4. A third pattern of 1: copper

E. Conclusion

For each major category of pollutants (pesticides, PAH, PCB, and metals), at least 4 different patterns of stations are outliers. The number of stations which were classified as outliers ranged from 4 for metals to 5 for PAH to 7 for DDT and PCB.

Table 20 Pollutants with Concentrations Greater than ERMs, ERLs, TELs, and/or PELs for Toxic Stations Which Did Not Exceed the Internal AET

Issue 6: Development Process for Regional Toxic Hot Spot Cleanup Plans

Present Policy: None.

Issue Description: The Administrative Procedure Act requires that any plan, policy, or guideline developed by the State or Regional Water Boards comply with certain provisions of the APA. The State and Regional Boards must also comply with CEQA. Both processes have numerous steps and requirements to be completed correctly. The existing process is presented in Figures 2 and 3.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives for SWRCB Action:

1. Include the process for adoption of the Toxic Hot Spot Cleanup Plans in the SWRCB Policy.

   Under this alternative Figures 2 and 3 would be included in the SWRCB Policy. The advantage of this approach is that it would be clear to all interest persons what process the RWQCBs and SWRCB would use to develop the Plans. Unfortunately, if APA or CEQA requirements change before the Plans are fully developed the graphics could become dated and cause more confusion than anything else. To remedy confusion the SWRCB would be compelled to revise the Policy.

2. Do not include the process for adoption of the Toxic Hot Spot Cleanup Plans in the SWRCB Policy.

   With this alternative the SWRCB would not include a graphic of the process for adoption of the Cleanup Plan. The process followed would be the process in effect including any modification made in CEQA or the APA.

3. Do not include the entire process for adoption of cleanup plans but give guidance the the RWQCBs on when to invite public review.

   Under this alternative the SWRCB and RWQCbs would be required to use the process available when the Cleanup Plans are adopted but several important steps would be highlighted. The SWRCB could give additional guidance on public participation before and during the development of the Regional Toxic Hot Spot Cleanup Plans and require SWRCB approval of the Regional Plans after their development. The SWRCB could also specify preferences for submittal of the Plans to the Office of Administrative Law.

Staff Recommendation: Adopt Alternative 3.

Proposed Policy Language: PROCESS FOR DEVELOPMENT OF REGIONAL AND STATEWIDE HOT SPOT CLEANUP PLANS

In adopting Regional and Statewide Cleanup Plans, the State and Regional Water Boards shall comply with the provisions of the California Environmental Quality Act and the Administrative Procedure Act.

In addition to these requirements the RWQCBs shall involve all interested parties in the development of the Regional Cleanup Plans. The RWQCbs shall convene an advisory committee of local dischargers, likely responsible parties, environmental groups, trade organizations, and public health interests to advise them on the development of the Cleanup Plans. To the extent possible the RWQCBs shall solicit the voluntary assistance of likely responsible parties in the development of the Cleanup Plans. If information is needed and a likely responsible party is recalcitrant in providing assistance, the RWQCBs shall require participation of the likely responsible party under the authority granted by Water Code Section 13267.

Once a Regional Cleanup Plan is adopted by the RWQCB, the Plan will be submitted to the SWRCB for approval. The Regional Plan will be reviewed for concurrence with the Water Quality Control Policy for Implementation of the Bay Protection and Toxic Cleanup Program as well other Water Quality Control Plans and Policies of the SWRCB.

The SWRCB will compile all approved Regional Cleanup Plans and the required additional findings into a Statewide Toxic Hot Spot Cleanup Plan. The Statewide and Regional Toxic Hot Spot Cleanup Plans will be submitted at one time to the Office of Administrative Law. During the development of the Statewide Plan the SWRCB will seek advise of the BPTCP Advisory Committee (established by Water Code Section 13394.6).

Issue 7: Mandatory Requirements for Regional and Statewide Toxic Hot Spot Cleanup Plans

Present Policy: None.

Issue

The SWRCB and RWQCBs are required by the Water Code (Section 13394) to address a variety of topics including the following information:

- A priority ranking of all THS, including recommendations for remedial actions;
- A description of each THS including a characterization of the pollutants present at the site;
- An estimate of the total cost to implement the cleanup plan;
- An assessment of the most likely sources of pollutants; (responsible parties)
- An estimate of recoverable costs from responsible parties;
- Preliminary Assessment of Actions required to remedy or restore a THS to an unpolluted condition;
- A two-year expenditure schedule identifying state funds to implement the plans;
- A summary of actions that have been initiated by the regional boards to reduce the accumulation of pollutants at existing THSs and to prevent the creation of new THSs
- Findings and recommendations concerning the need for a toxic hot spot cleanup program.

These requirements are somewhat general and many of the topics require some definition and clarification if they are to be applied consistently Statewide.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Do not adopt any additional guidance for development of toxic hot spot cleanup plans.

   The only guidance required by the by the Water Code for implementation of the Bay Protection and Toxic Cleanup Program is for the Ranking Criteria

(Section 13393.5). The SWRCB is not required to adopt any additional guidance for the program. An advantage of this approach is that the RWQCB has ultimate flexibility in interpretation of Water Code Section 13394. A disadvantage is that there is a great possibility of inconsistent implementation of the Program across the State.

2. Adopt guidance on each of the required sections of cleanup plans to require consistency of form and application of the various provisions.

   The SWRCB could specify what is required to adequately and consistently develop the Regional and Statewide Cleanup Plans. This additional guidance should not limit the RWQCBs to the quantity of information presented but rather should establish the basic amount of information necessary to complete the requirements of the Water Code.

   The SWRCB should also define a number of terms used throughout the policy to avoid confusion in interpretation.

Staff Recommendation: Adopt Alternative 2.

Proposed Policy Language:

CONTENTS OF REGIONAL AND STATEWIDE TOXIC HOT SPOT CLEANUP PLANS

The Regional and Statewide Toxic Hot Spot Cleanup Plans shall contain (at a minimum) the following information:

A priority ranking of all THS (including a description of each THS including a characterization of the pollutants present at the site).

The Regional Water Boards shall use the definition of a potential candidate and known toxic hot spot listed in this Policy. The Regional Water Boards will then rank sites using the appropriate Ranking criteria in this Policy. The Regional Water Boards shall create a two lists of toxic hot spots: (1) Candidate/Known Toxic Hot Spots and rank the list using the appropriate criteria, and (2) Potential Toxic Hot Spots and rank the list using the appropriate criteria.

Each ranked list shall be established in the Regional Cleanup Plan that contains the following information for each toxic hot spot:

1. Water body name. The name shall conform to the water body name in the Regional Basin Plan.

2. Segment Name. The Regional Water Boards shall list a descriptive name in the water body segment where the toxic hot spot is located if the segment name is more descriptive than the water body name.

3. Site Identification. The Regional Water Boards shall list a station or site identifier that can be linked to a monitoring station location (e.g., BPTCP monitoring station, State Mussel Watch station, discharger self monitoring station, or any other appropriate identifier).

4. Reason for Listing. The Regional Water Boards shall list the reason for the site or station to be listed. The value given shall be the appropriate trigger value in the definition of a Toxic Hot Spot that is the cause for the listing.

5. Pollutants present at the site. The Regional Water Boards shall also list which chemicals are present at sufficiently high levels to be of concern.

6. Report reference substantiating toxic hot spot listing. All references support the designation of the toxic hot spot shall be listed with the other information required for designation of a toxic hot spot. The references shall include, but not limited to: author, year of publication, title of report, and other identifying information (e.g., name of journal (including volume and pages), regional Board file number, agency report, or other identifier that will allow the report to be independently located).

After the lists of toxic hot spots, each Candidate/Known Toxic Hot Spot shall be listed separately and the following information compiled for the site by the Regional Water Boards:

1. An assessment of the areal extent of the THS and Sediment Toxicity Identification Evaluations.

   The RWQCB shall characterize the areal extent of the Toxic Hot Spot. The RWQCB can either estimate the boundary, size and/or volume of the Toxic Hot Spot or the RWQCB can work with a potential responsible party to characterize the site. In determining the areal extent the RWQCB should consider a temporal component (i.e. the historic vs ongoing nature of the Toxic Hot Spot), the mix of chemicals present (routinely measured vs other anthropogenic pollutants), and the mix of biological effects (bioaccumulation, sublethal, and lethal effects in a range of organisms).

Since this phase of assessment is a determination of the magnitude and extent of the Toxic Hot Spot, all these concerns should be considered in the design of the monitoring effort to characterize the areal extent of the toxic hot spot. Though these additional concerns can add significantly to the cost (either in funding or impact on beneficial use) of remediation, this expense is modest compared to remediating a larger or smaller area than is absolutely necessary. To avoid such a development, all interested parties (including Potential Responsible Parties) should be involved in the design of site characterization monitoring.

For areal extent determination, it is recommended that the RWQCBs use a stratified random sampling design to delineate horizontal extent of pollution; if sediment is layered, sample within distinct layers for vertical extent using sediment coring. For source confirmation, incorporate more intense sampling within the stratified random scheme (have more strata or more samples within a stratum) or utilize systematic random sampling (transects).

RWQCBs should also consider using sediment toxicity identification evaluation (TIE) methods to make a better estimate of the cause-and-effect relationship between chemicals and toxicity. TIEs provides strong scientific evidence that a chemical or chemical is causing toxicity. TIE procedures can also be used to remove the potential effects of ammonia or hydrogen sulfide on test organisms.

2. An assessment of the most likely sources of pollutants (responsible parties).

Regional Boards shall list potential responsible parties that are likely to have discharged or deposited the pollutants identified in the toxic hot spot lists.

This process may be somewhat straightforward when single sources are responsible. The process will become considerably more complex when an attempt is made to document the relative contribution of a variety of sources. Such an effort might involve a complex spatial and temporal array of, perhaps, both water and sediment monitoring stations as well as an investigation of chemical concentrations in the watershed. The Watershed approach described in the Prevention Section should be implemented.

Potential responsible party identification shall be dependent on factors such as, site location, pollutant type, mix of chemicals found to be present at the site, and identification and location of PRP. In cases where enough evidence has been accumulated to connect a THS to a PRP, it is required that the PRP be involved early in the development of the cleanup planning process by the RWQCB. The PRP shall assist in the development of alternative cleanup options.

In some cases, after a site is identified as a Toxic Hot Spot, there may not be any identified PRP to assume the financial responsibility of cleanup. In such cases the identified THS would remain reported as a THS in the Cleanup Plan lists. The Regional Water Quality Control Board and the State Water Resources Control Board would assume the role of leadership to initiate cleanup through the adoption of the Statewide Cleanup Plan.

In some cases a multi-agency response for Cleanup actions would be the most appropriate way to proceed. This alternative would be dependent on fiscal resources being available from other agencies or communities that would allow an integrated participation in the cleanup of the orphan site. Some basins where THS are identified may already have watershed plans in existence. Cleanup priority and the funding necessary to do cleanup would come under an already established watershed plan. Local agencies may have already initiated some cleanup actions, which may warrant some supplemental action by the State Board if the site ranks high on the known toxic hot spot list and if legislation has been passes to provide the state funds for such purposes.

2. A summary of actions that have been initiated by the regional boards to reduce the accumulation of pollutants at existing THSs and to prevent the creation of new THSs.

   The summary of actions shall contain descriptions of any issued waste discharge requirements, National Pollutant Discharge Elimination System permits, general permits (e.g., construction, industrial stormwater, etc.), cleanup and abatement orders, cease and desist orders, actions taken or initiated by other State or Federal agencies (e.g., Department of Defense Base Closure, Damage Assessment activities of the National Oceanic and Atmospheric Administration, etc.).

3. Preliminary Assessment of Actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions.

   The Regional Water Boards shall evaluate the alternatives listed in the Cleanup section of this policy. After evaluating the cleanup alternatives the Regional Water Boards shall list their assessment of the actions that could be implemented. This listing shall not be mandatory if a responsible party has been identified. Responsible parties shall be given every opportunity to develop a site-specific cleanup plan that cost-effectively plans for the remediation of the site.

4. An estimate of the total cost to implement the cleanup plan.

   Regional Water Boards shall estimate costs of cleanup plan implementation using the estimates provided in this Policy. Regional Board may deviate from the costs estimate in the policy if clearly justified in the cleanup plan. If a potential responsible party has been identified the RWQCB shall require that the PRP prepare a proposal for site remedial actions.

5. An estimate of recoverable costs from responsible parties.

   The costs recoverable from responsible parties should be developed by the Regional Water Boards in consultation with identified or potential responsible parties. The costs should be justified in the cleanup plan.

6. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from responsible parties.

   The Regional Water Boards should develop a brief workplan for the implementation of the cleanup plans for sites without responsible parties identified. The workplan shall contain costs and estimated schedule for: finding polluted sediments (monitoring), assessment of areal extent of toxic hot spot, implementation of remedial actions including but not limited to sediment removal and disposal, treatment of removed sediments, or capping of polluted sediments. The expenditure plan should also contain funding for assessing the effectiveness of remediation.

The Statewide Toxic Hot Spot Cleanup Plan shall be a simple compilation of the Regional Toxic Hot Spot

Cleanup Plans. In addition, the Statewide Plan shall contain a complete listing of all Known Toxic Hot Spots (ranked using the scores developed by the Regional Water Boards). All known sites with no responsible parties identified or with only partial responsibility parties identified shall be clearly indicated.

Before submittal to the Legislature (as required by Water Code Section 13394) the State Water Board will also develop Findings and recommendations concerning the need for funding a toxic hot spot cleanup program to cleanup or prevent the identified Known Toxic Hot Spots. These findings shall include, but not limited to: total funding needed to cleanup toxic hot spots with no responsible party identified, finding on any additional need to monitor potential toxic hot spots, recommendation for program modifications and funding needed to administer cleanup activities.

ORPHAN SITE is defined as a known or candidate toxic hot spot site or station of any area in a water body that the RWQCB can not locate, assign, or determine a potential responsible party. In some cases the RWQCB may not be able to assign a portion of the potential responsibility for a site. In such a case the RWQCB shall determine the portion of the site to identified potential responsible party (Parties) and the remainder of the problem shall become an orphan site.

POTENTIAL RESPONSIBLE PARTY is defined (Section 107(a) of CERCLA) as:

1. The owner and operator of a vessel or facility,

2. Any person who at the time of disposal of any hazardous substance owned or operated any facility at which such hazardous substance were disposed of,

3. Any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances, and

4. Any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities, incineration vessels or sites selected by such person, from which there is a release, or a threatened release which causes the incurrence of response costs, of a hazardous substance.

Issue 8: Process to remediate polluted sediment at toxic hot spots

Present Policy: None

Issue Description: The SWRCB should consider establishing an understandable process or approach to help RWQCBs implement remediation of polluted sediments.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives

1. Adopt a three step process that is comprised of developing sediment cleanup levels, selection of remediation alternatives, and selection of the preferred alternative.

   A simplified sediment cleanup process is proposed to account for differences between federal and California law. To comply with Section 13360 of the Porter-Cologne Act, the Regional Boards would attempt to notify responsible parties before beginning the three-step process. If responsible parties could not be identified or if the parties failed to specify cleanup methods in a timely manner, the Regional Boards would then follow the three-step process and suggest the means of compliance in the regional cleanup plan.

   The proposed three-step process would be:

   1. Establish a range of potential cleanup levels;

   2. Perform a preliminary assessment of remedial actions; and

   3. Select preferred remediation actions.

   The information gathered would be applied in the regional cleanup plans and in the ranking of known toxic hot spots on the statewide list. Regional boards could later compel responsible parties to propose additional cleanup plans for those sites for which responsible parties had not been previously identified, as required by Section 13360. Adoption of this simplified three-step process would save time and be consistent with State Board Resolution 92-49.

2. Adopt guidance from U.S. Environmental Protection Agency regarding sediment remediation.

   Federal guidance for sediment cleanup is based on federal law and policy, and seems to assume that federal remediation managers have more authority than state managers to designate the means of compliance. The six-step process addresses federal programs such as superfund (CERCLA) and Department of Defense sites in which federal agencies could be primary responsible parties. A recent federal report, EPA 893-B-93-001, Selecting Remediation Techniques for Contaminated Sediment, presents a six-step process for federal site managers. The six-step process includes:

1. Determine the degree of sediment pollution;
2. Screen the treatment options;
3. Review the sediment characteristics affecting different treatment technologies;
4. Screen out the less-appropriate technologies;
5. Perform an initial screening evaluation; and
6. Select a treatment system.

Again, this six-step federal process assumes site managers have the authority to select remediation methods.

Staff Recommendation: Adopt Alternative 1.

Proposed Policy Language: PROCESS FOR REMEDIATING POLLUTED SEDIMENTS

To comply with Section 13360 of the Porter-Cologne Act, the Regional Boards would attempt to notify responsible parties before beginning the three-step process. If responsible parties can not be identified or if the parties failed to specify cleanup methods in a timely manner, the Regional Boards would then follow the three-step process and suggest the means of compliance in the regional cleanup plan.

The three-step process for remediating polluted sediments is:

1. Establish a range of potential cleanup levels;
2. Perform a preliminary assessment of remedial actions; and
3. Select preferred remediation actions.

The information gathered shall be applied in the regional cleanup plans and in the ranking of known toxic hot spots on the statewide list. Regional boards could later compel responsible parties to propose additional cleanup plans for those sites for which responsible parties had not been previously identified, as required by Section 13360.

Issue 9: Responsibility for suggesting methods for toxic hot spot cleanup (Section 13360)

Present Policy: Section 13360 of the Porter-cologne Water Quality Control Act specifies that regional boards and courts shall not "...specify the design, location, type of construction, or particular manner in which compliance may be had...." This section prohibits regional board staff from specifying the means of compliance, an action reserved for responsible parties. The Bay Protection legislation, however, requires regional boards to submit regional cleanup plans by 1998 whether or not responsible parties have been identified by regional boards.

Issue Description: Section 13360 effectively prohibits regional Boards from accurately predicting cleanup costs for purposes of ranking the sites on a priority list; however, it does not prohibit regional boards from <u>suggesting</u> the means to clean up known toxic hot spots in regional cleanup plans before identifying all responsible parties and following up later with actual identification of responsible parties after the three-step process had been completed. At this stage, regional boards could then issue requests for technical reports from potential responsible parties, and cleanup and abatement orders requiring responsible parties to propose cleanup methods and costs.

The procedure suggested here would require two cleanup plans: an initial plan, and a subsequent plan by responsible parties. Although it seems two cleanup plans would be redundant, a better procedure has not been found to satisfy both the legislation and the Bay Protection and the Porter-Cologne Act Section 13360 prohibition.

Comments Received: This section will be completed after the SWRCB hearing on the Policy

Alternatives For SWRCB Action:

1. RWQCBs should develop two cleanup plans. After determining that responsible parties could not be identified, regional boards would apply best professional judgment in suggesting the means and costs of hot spot cleanups in the regional cleanup plans. At a later date and during the cleanup phase, regional boards would require potential responsible parties to submit cleanup plans for the actual remediation.

2. RWQCB should develop one Cleanup Plan and responsible parties should submit proposals to cleanup toxic hot spots or be required under Cleanup and Abatement Orders to implement Regional Cleanup Plans.

Regional Boards would identify all responsible parties for all sites and require the parties to submit cleanup plans and costs before submitting regional cleanup plans. If no responsible parties could be identified, regional boards would suggest the means of compliance. Funding would then have to be found to clean up the hot spot. Responsible parties would not be identified nor would responsible parties pay for remediation for these sites.

Staff Recommendation: Alternative 1 is recommended to reduce the liability to the State for remediation of sites.

Proposed Policy Language:

Issue 10: Cleanup Levels

Present Policy: SWRCB Resolution No. 92-49 (as amended) requires RWQCBs to cause dischargers to clean up to either background water quality levels or to a reasonable water quality level if background can not be attained, taking into account all the factors authorized by State and Federal law.

Issue Description: BPTCP site assessment has been based on bioeffects measures as well as chemical analysis and to use these data to establish, to the extent possible, the relative contribution of natural and anthropogenic factors to biological impacts. In the assessment process sediment chemical levels alone are insufficient basis for identifying a candidate/known toxic hot spot. The logical extension of this perspective would require that both biological and chemical data are also necessary to determine when cleanup of a site has been achieved. Unfortunately, a significant lag time may be necessary for field sediment conditions to achieve equilibrium or for benthic organisms to recolonize after the first layer of material has been removed. For this, and other reasons, a chemical cleanup level may be convenient.

Therefore, the SWRCB should provide a process for developing and evaluating sediment cleanup levels.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Establish Cleanup Level at Background levels.

   A background chemical concentration could be developed from information collected in water bodies that are distinguished by the lack of pollutant sources or portions of water bodies remote from pollutant sources. These levels would be empirical and not based on biological effects. For sediments, background could be sediments that underlay polluted sediments (i.e., historical deposits before polluting activity was initiated). These cleanup levels may be very environmentally conservative.

2. Establish Cleanup levels at ambient levels in the specific water body.

   An ambient cleanup level could be based on the highest water or sediment quality attained with the specific water body not significantly affected by discharges or polluted sediment deposits. If concentration of pollutants in the water body are typically higher than other locations, the ambient levels could be quite high and therefore would not protect beneficial uses. These levels would be empirical and not based on biological effects. These cleanup levels may be or may not be very environmentally conservative.

3. Establish the cleanup level at the no Observed Effect Concentration (NOEC).

   Cleanup levels based on the NOEC for the most sensitive species would have the advantage of being based on biological effects. Unfortunately, the most sensitive species response may be at chemical concentrations that are so low that the levels are near or below empirically derived background levels.

4. Cleanup level should be established at the Apparent Effects Threshold for the available information collected from the water body. In lieu of meeting the AET if biological effects are absent the site could be considered cleaned up.

   The use of an AET as a cleanup level is justified by virtue of the approach that has been taken in the analysis of monitoring data to identify Toxic Hot Spots. For a site to qualify as a toxic hot spot, it must achieve both a certain minimum toxicity or other bioeffect and be in excess of the calculated AET for the water body AET. Although AETs may fall short of sediment quality objectives, in their absence they may qualify as a good substitute for cleanup purposes. As long as all pollutants present at the site are brought down to the level of their respective AETs, this would satisfy the most fundamental requirement of a cleanup level - removal of the conditions which led to the determination of impact in the first place.

   If no toxic response is found at the site or area then remediation could also be considered complete.

5. Cleanup Level should be established at the ERM, PEL or EPA sediment quality criteria.

   These values are based on the effects associated with toxic, and sometimes other, response. In fact PELs and ERM are highly correlated with the occurrence of toxicity in environmental samples (Long, pers. comm.). These values are derived from a variety of methods that could bias the results of the evaluation and may not represent conditions present in the water body of concern.

These values may not be available for all pollutants of concern.

6. Cleanup level development should be a step- wise approach based on the amount of information available for a site or water body.

Instead of selecting one cleanup level as suggested in the previous five alternatives, the SWRCB should consider requiring the RWQCBs to develop cleanup levels for each alternative and then evaluate the feasibility of cleanup actions in view of the range of cleanup levels. In each case if an alternate cleanup level does not make sense, does not protect beneficial uses, does not implement water or sediment quality objectives contained in the Policy or other SWRCB and RWQCB plans or policies (including SWRCB Resolutions 68-16 and 92-49), the cleanup level shall be rejected from consideration.

Staff Recommendation: Adopt alternative 6.

Proposed Policy Language:

Establishment of Cleanup Levels

Establishment of cleanup level by the RWQCBs shall be a step-wise process based on the amount of information available for a site or water body. RWQCBs shall evaluate the following options:

1. A Cleanup Level set at Background levels.

2. A Cleanup levels set at ambient levels in the specific water body.

3. A Cleanup level set at the no Observed Effect Concentration (NOEC) for the specific pollutant of concern.

4. A Cleanup level should be set at the Apparent Effects Threshold for the available information collected from the water body. In lieu of meeting the AET if biological effects are absent the site could be considered cleaned up.

5. A Cleanup Level should be set at the ERM, PEL or EPA sediment quality criteria (if available).

If information is not available to develop each cleanup level the RWQCB may elect not to develop the cleanup level for the purposes of the Regional Cleanup Plan or may solicit the assistance of the potential responsible party (if identified).

In each case if an alternate cleanup level does not make sense, does not protect beneficial uses or does not implement water or sediment quality objectives contained in the Policy or other SWRCB and RWQCB plans or policies (including SWRCB Resolutions 68-16 and 92-49), the cleanup level shall be rejected from consideration. The RWQCB shall select the most reasonable cleanup level alternative.

Issue 11: Remediation Actions (Cleanup Methods and Costs)

Present Policy: None

Issue: Description: The RWQCBs are required to determine the type of remedial action that is appropriate for identified toxic hot spots. Remedial technologies should be identified and screened on the basis of effectiveness and implementability. Remedial technologies should attempt to satisfy the remedial objective; i.e., protect beneficial uses. The approach should include identifying the action, the technologies available, and the option that is technically practicable.

In the evaluation of cleanup options, one must consider a possible short-term or long-term increase in exposure, or the potential for providing new exposure pathways during the remediation process, as in dredging/disposal options. Choosing not to disturb the sediments may also be a viable option, and may mean leaving the material in place, and/or containing it.

In determining remediation actions, reasonable costs must also be factored into the selection of an appropriate alternative.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Treatment of the site only.

This involves the physical or chemical alteration of material. The treatment must reduce or eliminate the toxicity, mobility, or volume of contaminated material. Treatment may be either a) in-situ, or b) ex-situ. In-situ treatment requires uniform treatment and confirmation of effectiveness; however, in-situ methods generally have not been considered effective in marine sediments.

Ex-situ treatment requires a treatment area, or a dedicated site to assure effectiveness.

Types of treatment include:

- biological,
- dechlorination,
- soil washing,
- solvent extraction,
- solidification,
- incineration, and
- thermal desorption.

The treatment choice is contaminant specific. The choice depends upon the chemical characteristics of the contaminants, as well as physical and chemical characteristics of the sediments; for example, clay content, organic carbon content, salinity, and water content. Some treatment options produce by-products which require further handling. Although these technologies are currently being employed for soils, their effectiveness for use in marine sediments should be thoroughly evaluated. If the safety and effectiveness of treatment options are not well known, bench tests and pilot projects should be performed prior to authorization of the use of such treatment methods. Costs for these cleanup methods are presented in Table 19.

2. Dredging: Removal and Disposal or Reuse

Dredging may be combined with containment or offsite disposal. Selection of the method depends upon the amount of resuspension of sediments caused by the dredge at the removal site and at the disposal site. To reduce the transport of polluted sediment to other areas, silt curtains constructed of geotextile fabrics may be utilized to minimize migration of the resuspended sediments beyond the area of removal. Consideration must also be given to temporary loss of benthic organisms at the removal site and at the disposal site.

Selection of the dredging method should take into account the physical characteristics of the sediments, the sediment containment capability of the methods employed, the volume and thickness of sediments to be removed, the water depth, access to the site, currents, and waves. Consideration should also be given to the placement site of the material once it is removed.

Typical dredging methods include mechanical or hydraulic dredging.

- Mechanical dredging often employs clamshell buckets and dislodges sediments by direct force. Sediments can be resuspended by the impact of the bucket, by the removal of the bucket, and by leakage of the bucket. Mechanical dredging generally produces sediments low in water content.

- Hydraulic dredging uses centrifugal pumps to remove sediments in the form of a slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a very high percentage of water at the end of the pipe.

Removal and consolidation often involves a diked structure which retains the dredged material. Considerations include:

a) construction of the dike or containment structure to assure that contaminants do not migrate,

b) the period of time for consolidation of the sediments,

c) disturbance or burying of benthic organisms,

d) Disposal to an offsite location, either upland (landfill), in-bay, or ocean. Considerations once the material has been dredged, for example Long Term Management Strategy (LTMS) for dredge disposal from San Francisco Bay.

    1) staging or holding structures or settling ponds

    2) de-watering issues, including treatment and discharge of wastewater,

    3) transportation of dredged material, i.e., pipeline, barge, rail, truck,

    4) regulatory constraints.

Costs for these cleanup methods are presented in Table 19.

3. Containment

Containment can prevent human or ecological exposure, or prevent migration of contaminants. Containment can be either in-place capping, or removal and consolidation at a disposal structure. Containment options such as capping clearly reduce the short-term exposure, but require long-term monitoring to track their effectiveness.

California does not have a consistent procedure for choosing the capping alternative at sediment sites.

The process for stabilization of sites using sub-aqueous capping to contain toxic waste at a site would be to follow the basic three-step approach and apply the criteria shown in USEPA 893-B-93-001 report, Selection of Remediation Techniques for Contaminated Sediment. This federal remediation document provides a list of performance considerations to test whether clean sediments consisting of sands and silts can be used to effectively contain the waste, either at the present location or at some other location. The list includes, in part:

a. Capping provides adequate coverage of polluted sediments and capping materials can be easily placed.

b. The integrity of the cap must be assured to prevent burrowing organisms from mixing of polluted sediments (bioturbation)

c. The ability of the contaminated sediment to support the cap, i.e. causing settlement or loading.

d. The bottom topography causing sloping or slumping of the capped material during seismic events.

e. Cap erosion or disruption by currents, waves, bioturbation, propeller wash, or ship hulls.

f. Future use of capped area, i.e. shipping channel.

Another consideration is presented in the EPA document concerning whether the no-action alternative would accomplish the same end as capping the site; however, this consideration should be considered as the last alternative as discussed under Process for choosing the no-remediation alternative.

In addition, if sub-aqueous capping is considered, provide a detailed assessment containing a discussion of all of these topics:

i. Point source discharges have been halted.

ii. The costs and environmental effects of moving and treating polluted sediment are too great.

iii. Suitable capping materials are available.

iv. Hydrologic conditions will not disturb the site.

v. The sediment will not be remobilized by human or natural activities.

vi. The bottom will support the cap.

vii. The area is amenable to dredging.

viii. Polluted sediments will not spread.

ix. The site will be noted on appropriate maps, charts, and deeds to document the exact location of the site.

Costs for these cleanup methods are presented in Table 19.

4. No Remediation

This alternative consists of two elements, the first is known as institutional or access controls, or "natural remediation". For example, posting of warning signs, or monitoring of water, sediments, or organisms. Typically, would be protective of human health by providing warning signs for fishing, etc, but not protective of aquatic life. Is typically used to confirm that a remedial action has been achieved or to monitor the effectiveness of the remedy.

The second, is also known as the "no-action alternative". If by no action, the hot spot is to be left in place, because to move it, or to disturb it in any way would be detrimental, then this is an option. This would have to be proven beyond any doubt, and would not be "an easy way out" of dealing with a hot spot.

The approach suggested here contrasts with the federal approach in which the no-action alternative is considered first. It is proposed that in California the no-remediation/no-action alternative be considered only after all other alternatives have been studied. State Board Resolution 92-49 (as amended) requires that regional boards compel dischargers to clean up wastes to protect beneficial uses (III.G.). Resolution 92-49 also requires regional boards to consider "Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement..." (IV.D.).

An appropriate procedure to comply with Resolution 92-49 would be to follow the proposed three-step process and consider certain additional criteria. The following list of criteria was adapted from the sub-aqueous capping section of the federal remediation selection guidance: (1) Point source discharges have been halted. (2) The costs and environmental effects of moving and treating polluted sediment are too great.

(3) Hydrologic conditions will not disturb the site. (4) The sediment will not be remobilized by human or natural activities, such as by shipping activity or bioturbation.

Three additional criteria are recommended for protection of public health and aquatic life: (5) Notices to abandon the site have been issued to appropriate federal, state, and local agencies and to the public. (6) The exact location of the site and a list of chemicals causing the toxic hot spot and their quantities are noted on deeds, maps, and navigational charts. (7) A monitoring program is established to measure changes in discharge rates from the site.

To assure protection of beneficial uses, and compliance with Resolution 92-49, it is recommended that the State Board follow the three-step process and apply the seven criteria suggested above, in which the no-remediation/no-action alternative is considered only after all other alternatives have been considered.

If a no-remediation alternative is considered, provide an assessment of the geographic extent of the pollution, the depth of the pollution in the sediment, compelling evidence that no treatment technologies should be applied and that only the no-remediation alternative is feasible at the site, and a cleanup cost comparison of all other treatment technologies versus the no-remediation alternative.

If a no-remediation alternative is considered, the following information should be provided:

1. Sources of pollution which caused the toxic hot spot to exist

2. Detailed monitoring program, specifying the duration of the monitoring, and all organizations which will carry it out

3. Monitoring program which will show whether rates of pollutant release and the area of influence of the pollutants are not accelerating

4. Detailed assessment containing proof that all of the following statements are true:

   a. Pollutant discharge has been halted

   b. Burial or dilution processes are rapid

   c. Sediment will not be remobilized by human or natural activities

d. Environmental effects of cleanup are more damaging than leaving the sediment in place

e. Uncontaminated sediments from the drainage basin will integrate with polluted sediments through a combination of dispersion, mixing, burial, and/or biological degradation

f. Polluted sediments at the site will not spread

g. The site will be noted on appropriate maps, charts, and deeds to document the exact location of the site.

For no-remediation alternatives, a detailed and exact map of the area will be provided to the US Army Corps of Engineers, US Coast Guard, National Oceanographic and Atmospheric Administration, Coastal Commission, State Lands Commission, and harbor authorities to be included on official navigational charts and other maps to document the exact location of the site and the depth of the site and the pollutants encountered.

For no-remediation alternatives, the US Army Corps of Engineers, US Coast Guard, local harbor authorities, county health officer, California Coastal Commission, State Lands Commission, and State and federal fish and wildlife agencies will be provided with notice of intent to abandon the site and detailed information on the site including: all pollutants known or suspected, concentrations of pollutants, estimate of the total amount of pollutants, potential hazards to human health due to pollutants, potential toxicity and bioaccumulation potential in sport or commercial fish and shellfish. Notification to these other agencies will occur 180 days prior to a decision.

The process for choosing the no-remediation alternative at a site is as follows:

Follow the basic approach and apply the criteria shown in the USEPA Remediation Technique report. Also consider no remediation only if compelling evidence exists that no remediation is needed and that all other treatment options have been considered, cause the site to be noted on deeds and charts and notify all organizations of the intent to abandon the site.

Costs for these cleanup method are presented in Table 19.

5. Analyze all of the alternatives presented as alternatives 1 through 4, and determine which one or which combination of alternatives is best for the site in question.

The RWQCBs should be given significant latitude in determining which alternative action to select for a site. While we believe that the list of alternatives is complete there will likely be a circumstance that wa not taken into consideration. Therefore the RWQCBs should be allowed to identify other methods and associated costs to fit the site-specific condition.

The RWQCBs should also be required to plan for post-remediation monitoring to assess the effectiveness of the remediation.

Staff Recommendation: Adopt Alternative 5.

Proposed Policy Language:

SEDIMENT CLEANUP METHODS

Each known and candidate toxic hot spot shall be evaluated to determine which technique or techniques would best remediate the hot spot. In determining the preferred remedial action(s), each RWQCB shall identify remediation techniques that are technically feasible and reasonable cost effective. Selection of the preferred alternative involves choosing the remediation option that is appropriate for the site (i.e., protective of its beneficial uses). The factor to be considered in evaluating remediation actions include:

1. Is the goal accomplished?

2. What is the cost/benefit?

3. What is the likelihood of success and the time involved?

Each of these factors must be considered with equal weight before a decision on the best remediation technique is made. While cost is an important factor, it is not the driving factor in the decision making process. Considerations include immediate and long-term costs and the cost of monitoring. An assessment of the effectiveness of treatment technologies in protecting other areas from pollution caused by the cleanup should also be provided.

Once equilibrium has been reestablished at a site after cleanup, a repeat of the bioeffects monitoring that led to the original designation as a Hot Spot is necessary. In contrast to the short term assessment of cleanup using chemical monitoring only, the combination of chemical and bioeffects monitoring represents the most complete assessment of the success of remediation efforts. It is critical, however, that this monitoring be performed within the context of a research design that is likely to clearly assess the true effectiveness of remediation. One of the most powerful designs is the before-after, control-impact (BACI) design where a set of control stations is matched to stations at the site with monitoring conducted both before and after remediation is performed. Such a design can be very expensive, not always foolproof, and difficult logistically but, if applied successfully, it can be a powerful tool in resolving conflicts over the relative costs and benefits of various site-specific remediation strategies. Once a particular strategy has been demonstrated to be effective on one of a class of sites, less expensive monitoring may be sufficient at the other sites in the class.

It must be emphasized that the remediation evaluation study should document both costs and benefits (although remediation is intended to lessen impacts on the bioeffects that led to the identification of the Hot Spot in the first place, it may have unintended negative impacts on a separate set of bioeffects). Moreover, the post-remediation evaluation study should be performed within the context of a long term, near coastal waters monitoring effort.

If a BACI design is chosen, it's important to realize that careful selection of sites for the "after" component may result in a significant cost savings. The "before" part of the design consists essentially of the confirmation phase of Hot Spot identification.

Each RWQCB shall provide a cost analysis of several treatment technologies or alternatives for comparison of the cost effectiveness of selecting various alternatives. The minimum list of alternatives to be considered follow.

1. Treatment of the site only.

   Site treatment involves the physical or chemical alteration of material. The treatment must reduce or eliminate the toxicity, mobility, or volume of contaminated material. Treatment may be either a) in-situ, or b) ex-situ. In-situ treatment requires uniform treatment and confirmation of effectiveness; however, in-situ methods generally have not been considered effective in marine sediments.

   Ex-situ treatment requires a treatment area, or a dedicated site to assure effectiveness.

Types of treatment include:

- biological,
- dechlorination,
- soil washing,
- solvent extraction,
- solidification,
- incineration, and
- thermal desorption.

The treatment choice is contaminant specific. The choice depends upon the chemical characteristics of the contaminants, as well as physical and chemical characteristics of the sediments; for example, clay content, organic carbon content, salinity, and water content. Some treatment options produce by-products which require further handling. Although these technologies are currently being employed for soils, their effectiveness for use in marine sediments should be thoroughly evaluated. If the safety and effectiveness of treatment options are not well known, bench tests and pilot projects should be performed prior to authorization of the use of such treatment methods.

2. Dredging: Removal and Disposal or Reuse

Dredging may be combined with containment or offsite disposal. Selection of the method depends upon the amount of resuspension of sediments cased by the dredge at the removal site and at the disposal site. To reduce the transport of polluted sediment to other areas, silt curtains constructed of geotextile fabrics may be utilized to minimize migration of the resuspended sediments beyond the area of removal. Consideration must also be given to temporary loss of benthic organisms at the removal site and at the disposal site.

Selection of the dredging method should take into account the physical characteristics of the sediments, the sediment containment capability of the methods employed, the volume and thickness of sediments to be removed, the water depth, access to the site, currents, and waves. Consideration should also be given to placement site of the material once it is removed.

Typical dredging methods include mechanical or hydraulic dredging.

- Mechanical dredging often employs clamshell buckets and dislodges sediments by direct force. Sediments can be resuspended by the impact of the bucket, by the removal of the bucket, and by leakage of the bucket. Mechanical dredging generally produces sediments low in water content.

- Hydraulic dredging uses centrifugal pumps to remove sediments in the form of a slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a very high percentage of water at the end of the pipe.

Removal and consolidation often involves a diked structure which retains the dredged material. Considerations include:

a) construction of the dike or containment structure to assure that contaminants do not migrate,

b) the period of time for consolidation of the sediments,

c) disturbance or burying of benthic organisms,

d) Disposal to an offsite location, either upland (landfill), in-bay, or ocean. Considerations once the material has been dredged, for example Long Term Management Strategy (LTMS) for dredge disposal from San Francisco Bay.

    1) staging or holding structures or settling ponds

    2) de-watering issues, including treatment and discharge of wastewater,

    3) transportation of dredged material, i.e., pipeline, barge, rail, truck,

    4) regulatory constraints.

SEDIMENT CLEANUP COSTS

Total costs for various remedial technologies is dependent upon many factors, some of the most important being contaminant concentration, cleanup level, physical characteristics of the sediment, and the volume of material to be remediated. In addition, overall costs of remediation will also include monitoring to evaluate the effectiveness of cleanup. Due to the large number of variables associated with remedial actions, the costs for any cleanup will be project specific. The following table are estimates of the various costs associated with several cleanup methods. The quotes listed should not be considered as absolute prices for specific remediation methods.

RWQCBs shall use either the estimates in Table 19 or obtain current estimates of cleanup costs. Currently agencies, such as US EPA, or other organizations publish documents on various aspects of contaminated sediment management. In some cases, the costs associated with remedial technologies are included, and may be either an estimate of a range of costs for a specific technology or are cited from actual case studies. Using these references to obtain cost estimates for a specific project is useful to get a sense of the magnitude of the expenditures involved. However, these references may not itemize the costs for equipment or materials necessary to carry out the project or may not segregate materials form labor costs. The costs for materials or labor will vary depending upon the size or scope of the project; vendors may charge an incrementally lower cost for a larger project. In some cases, costs for treatment technologies are based on pilot or bench scale projects and have not been proven for full scale. Most companies performing the work will charge mobilization and contingency costs.

The RWQCBs may obtain two or three direct quotes from reliable companies. Obtaining direct quotes assures that all aspects of the project are included in the final estimate. These will also help refine the remedial design and the selection of the technology. For instance, selecting the appropriate type of dredging method, designing the appropriate type of containment structure, determining the method for transport of dredged sediments, or selecting the type of pretreatment or effluent treatment methods. Obtaining two or three estimates will allow a more realistic comparison of the cost versus benefit of the selected alternative.

Table 21

Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
I. Removal		
A. mechanical		
1. dipper[4]	1 cu	$1 - 25
2. bucket ladder[4]		
3. dragline[4]		
4. clamshell[2]	1 cy	$10 labor
B. hydraulic		
silt screen[3]	10,000 sf	$30,000 mat/labor
1. plain suction[2,3]	1 cy	$7 - 10 labor
2. cutterhead[4]	1 cy	$7 - 10
3. dustpan		
C. pneumatic[4]	1 cy	>$10
II. Transport (may depend upon if hazardous waste, and will affected by dredge and treatment selection)		
A. pipeline	TBD	TBD
B. barge[4]	TBD	TBD
C. rail[3] (includes 1500 miles of transporation and upland disposal of non-hazardous contaminants)	1 Ton	$53
D. truck[2]	1 cy	$200

Table 21
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost	
III. Pre-Treatment			
A. dewatering pumping[3]	1 cy	$0.05	labor
1. air drying			
a. construct upland			
drying area	(size dependent)[2]	$5,000	labor
wick drains, subdrain blanket[3]	1 sf or lf	$1	materials
b. condition dredged sediment[3]	1 cy	$4 - 7	mat/labor
2. mechanical			
a. filtration[5b]	1 cm	$6	
b. centrifuge[7]	1 cm	<$6	
c. gravity thickening[7]	1 cm	<$6	
B. particle classification: for #2, 3, 4, and 5 below[5b] (sorting and separating)	1 cy	$6 - 100	
1. impoundment basins	1 cy	$6 - 100	
2. hydraulic classifiers	1 cy	$6 - 100	
3. hydrocyclones	1 cy	$6 - 100	
4. grizzlies	1 cy	$6 - 100	
5. screens	1 cy	$6 - 100	

Table 21
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
C. slurry injections (may overlap with other treatment technologies)		
1. chemicals	TBD	TBD
2. nutrients	TBD	TBD
3. microorganisms	TBD	TBD
IV. Treatment (in some cases, costs associated with any particular treatment will be dependent upon contaminant concentration and cleanup levels required. Some of these technologies have been performed on sediments at the bench or pilot scale only, and are not proven for full scale.)		
A. biological		
1. biodegradation/bioremediation[5b]	1 ton	$25 - 100
B. physical		
1. solidification/stabilization[5]	1 cy	< $100
C. chemical		
1. chelation, chemical hydrolysis, detoxification[5a]	1 cy	$200 - 300
2. solvent extraction[5b]	1 ton	$50 - 150
3. electrokinetic soil washing[5b]	1 cy	$100 - 300

Table 21
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
D. thermal		
1. rotary kiln incineration[1]	< 6,700 cy	$675 - 2,025
	6,750 - 20,250 cy	$405 - 1,215
	20,250 - 40,500 cy	$270 - 810
	> 40,500 cy	$135 - 540
2. cyclone furnace vitrification[5b]	1 ton	$450 - 530
3. fluid bed incineration[5b]	1 ton	$50 - 175
V. Disposal		
A. onsite upland[6] (includes unspecified dredging method and disposal)	1 cy	$3 - 4
B. offsite land		
wetlands creation[6]	1 cy	$10 - 20
class I disposal facility[5] (does not include hazardous waste generator fees)	1 ton	$200 - 300
class II disposal facility[5]	1 ton	$55 - 65
class III disposal facility[5]	1 cy	$30 - 40
C. aquatic		
1. confined	TBD	TBD

Table 21
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
2. unconfined		
a. in-bay[6] (includes unspecified dredging method **and** disposal)	1 cy	$2 - 3
b. in-bay[6] (includes clamshell dredging **and** disposal)	1 cy	$1 - 8
c. ocean[6] (includes unspecified dredging method **and** disposal)	1 cy	$5 - 9
VI. Effluent/Leachate Treatment		
A. set up carbon absorption system[2,3] (for organics: does not include O&M)	1 system	$25,000 -30,000 mat/labor
VII. Monitoring/Operation and Maintenance/Miscellaneous		
1. surface water sampling and chemical analysis (chemical specific)		TBD
2. sediment sampling and chemical analysis (chemical specific)		TBD
3. biological monitoring (receptor specific)		TBD
4. mobilization/demobilization		TBD

Table 21
(Continued)
Estimated Cost Ranges for Sediment Remediation

References:

[1] US EPA Office of Research and Development, *Contaminated Sediments Seminar* CERI-91-19, May 1991

[2] *Feasibility Study for the United Heckathorn Site, Richmond, California*, prepared by Levine Fricke - Emeryville, California, January 11, 1991

[3] *Feasibility Study for the United Heckathorn Superfund Site, Richmond, California*, prepared by Batelle/Marine Sciences Laboratory, Sequim, Washington, July 1994

[4] US EPA Office of Water, *Selecting Remediation Techniques for Contaminated Sediment* EPA-823-B93-001, June 1993

[5] Draft Report - Long-Term Management Strategy, *Analysis of Remediation Technologies for Contaminated Dredged Material*, prepared by Gahagan & Bryant Associates, Inc., Novato California in association with ENTRIX, Inc. Walnut Creek, California, October 25, 1993 (includes review and analysis of other documents:

[a] Texas A & M *Proceedings of 25th Annual Dredging Seminar* ;

[b]*Sediment Treatment Technologies Database (SEDTEC)*, 2nd edition; Site Remediation Division, Wastewater Technology Centre, operated by Rockcliffe Research Management, Inc.) - submitted by technology developers and vendors from around the world;

[6] Long-Term Management Strategy Dredging Costs Survey for San Francisco Bay, Tom Gandesbery, RWQCB Region 2, personal communication June 1994

7 US EPA Office of Research and Development, Handbook/Remediation of Contaminated Sediments, EPA/625/6-91/028, April 1991.

Issue 12: Expedited Cleanup Process

Present Policy: RWQCBs currently have the authority to remediate sites that pose a threat to beneficial uses. Cleanup and Abatement Orders, Cease and Desist Orders, the provisions of SWRCB Resolution No. 92-49 (as Amended), and voluntary action of responsible parties are all existing mechanisms to expedite cleanup before or during preparation of Regional Toxic Hot Spot Cleanup Plans.

Issue Description: The development of Toxic Hot Spot Cleanup Plans is a lengthy process that will not be complete until at least 1998. As the Plans are developed there may be the opportunity for responsible parties who agree to begin remediation of a toxic hot spot. RWQCBs should not be prevented from implementing remedial action before a Cleanup Plan is fully adopted.

Comments Received: This section will be completed after the SWRCB hearing on the Policy.

Alternatives For SWRCB Action:

1. Adopt a process to facilitate early implementation of remediation at a toxic hot spot.

   Any responsible party that is interested in initiating early implementation of a site-specific cleanup plan should not be discouraged from doing so. Since the authority to cleanup sites already exists, the SWRCB could adopt a general process for an expedited cleanup process. This process would not replace the need for a Regional Cleanup Plan but,rather, would augment the RWQCBs cleanup planning process. Responsible parties and RWQCBs would not be excused from completion of cleanup plans for a site if the expedited process is initiated.

   The components of an expedited process could include:

   A. Site is found to be a Candidate or Potential Toxic Hot Spot.

   B. Development of a proposal for remediation by the responsible party (parties) that includes timelines for remediation.

   C. Review of the proposal by the RWQCB and approval to implement.

C. Review of the proposal by the RWQCB and approval to implement.

D. Implementation of site-specific cleanup plan by the responsible party (parties).

E. RWQCB and responsible party evaluation of the effectiveness of the remediation

F. Site closure or further action.

2. Rely on existing authority to begin early implementation of Toxic Hot Spot Cleanup Plans.

No additional authority is needed to initiate cleanup at any identified toxic hot spot. Remedial activities could be begun but unless the the SWRCB Policy on implementation of the BPTCP clearly states that early action can proceed, there may be confusion among cooperative potential responsible parties to begin any work. By not stating that early action is possible, some remediation activities may not begin until after 1998.

Staff Recommendation: Adopt Alternative 1.

Proposed Policy Language: EXPEDITED CLEANUP PROCESS

As the Regional Toxic Hot Spot Cleanup Plans are being developed by the RWQCBs, it may be in the best interests of potential responsible parties to begin full or partial remediation of the identified Toxic Hot Spot. In such case the RWQCBs are encouraged to accommodate the potential responsible party by assisting the PRP in implementing a site-specific cleanup plan. This expedited process does not excuse the RWQCB from including the toxic hot spot or the responsible party in the Regional Cleanup Plan.

The components of an expedited process could include:

1. Site is found to be a Candidate or Potential Toxic Hot Spot.

2. Development of a proposal for remediation by the responsible party (parties) that includes timelines for remediation.

3. Review of the proposal by the RWQCB and approval to implement.

4. Implementation of site-specific cleanup plan by the responsible party (parties).

5. RWQCB and responsible party evaluation of the effectiveness of the remediation

6. Site closure or further action.

Issue 13: Toxic Hot Spot Prevention Strategies

Present Policy: Porter-Cologne Water Quality Control Act, Chapter 5.6, Section 13394(h) requires that the Regional and State Water Boards in the process of completing THS cleanup plans include a section that summarizes the actions been initiated to reduce the accumulation of pollutants at existing hot spots sites and to prevent the creation of new hot spots.

Issue Description: Various factors influence the ability to implement prevention measures in identified toxic hot spots in bays and estuaries. The most important factors among others are: land use practices, type of pollutant affecting the site, areal extent of the site, and whether responsible party or parties are willing or able to implement the necessary control measures to prevent a THS or its recurrence.

There are three possible types of prevention tools that can be used in preventing and/or remediate toxic hot spots. These consist of (1) Voluntary Tools which include actions that can be taken at the community level, (2) Interactive Cooperative Programs involving funds to entice private and public agencies to do prevention projects and activities, and (3) Regulatory Actions, taken in compliance with various existing regulatory programs currently in force throughout the state,

These implementation tools can be put to use in two ways, (1) The Point source pollution control management strategy which achieves pollution control through the imposition of waste discharge permits, prohibitions and/or enforcement actions, and (2) Watershed Management Planning strategy which uses a multi-disciplinary, multi-regulatory integrated approach to achieve effective protection while allowing the flexibility to address specific problems within the context of a watershed. The question is to determine which process provides the possibility of achieving the best solutions to address point and nonpoint source of pollution in the receiving waters and sediment of bays and estuaries.

1. <u>Voluntary Programs</u>

Voluntary actions ideally represent the preferred approach for addressing toxic hot spots mitigation and prevention upon bays and estuary environments. Community based planning efforts, such as the Coordinated Resources Management Planning (CRMP) groups and Watershed Advisory Groups (WAGs), offer a forum through which information about a particular bay or estuary may be distributed and obtained. Other avenues to voluntary action that can be taken could include such activities as Adopt-a-Watershed program which would involve the public and/or school pupils in watershed contamination prevention and protection issues through the practical application of scientific principals. Press releases can also appear to the public as news items, fueling a local sense of relevance and action.

2. <u>Interactive Cooperative Programs</u>

Interactive Cooperative Programs can be effective in developing comprehensive pollution prevention strategies among private and public agencies by providing ways that will encourage involvement, promote interagency cooperation and aid in the development of coordinated approaches to take pollution prevention steps. There are three types of Interactive Cooperative Programs. These can be categorized as follows; Interagency Agreements, Funding Programs and Federal Programs. Where appropriate, examples of how a program is currently being utilized to prevent or address pollution, is provided.

A. Interagency Agreements

Interagency Agreements, in the form of Management Agency Agreements (MAAs), and Memorandum of Understanding (MOUs) can provide effective cooperation and regulatory coordination among regulatory or planning agencies with different statutory jurisdiction. Such Interagency Agreements are useful in defining each agency's authority, responsibility and level of coordination in implementing mitigating and preventive water quality control measures.

The Forestry protection agreements between the State, Regional Boards and the US Forest Service, the California Department of Forestry and Board of Forestry is an example of a MAA. This form of interagency agreement commits each agency to the use of State Water Board certified Best Management Practices (BMPs) to control nonpoint source discharges on managed land. In order to prevent water quality impacts The Regional Water Boards enforces compliance with the BMPs and may impose additional control actions above and beyond those specified if the adopted practices are not applied correctly or if it is determined that water quality is not being protected.

As an example of an MOU, the Santa Monica Bay Restoration Plan identified the need to formulate an MOU between the County of Public Works Department and the City of Los Angeles. This MOU would allow County workers access to City-controlled storm drains to investigate spills and, in turn, allow access to City workers in County-controlled storm drains for the same purpose. This would promote better coordination of spill responders and thus allow more effective protection of Santa Monica Bay water quality.

B. Funding programs

There are several federal and state funding programs currently in place that can be useful in encouraging the development of pollution prevention actions. These include the following:

(1) Nonpoint Source Grants Clean Water Act(CWA) Section §319

The Clean Water Act (CWA), Section 319(h), provides grant funds for projects directed at the management of nonpoint source pollution. High priority projects are considered those which implement specified nonpoint source management practices under Section 319 requirements, and projects which address nonpoint source waters listed pursuant to CWA section 303(d), water quality limited segments (see TMDL discussion, below). High priority for 319(h) funding is also given to those projects that protect high quality waters. In addition, nonpoint source funds can also be used for the implementation of watershed management plans or strategies that lead to coordinated water quality management, or for the demonstration of specific practices considered part of a watershed management effort.

The State Board, Division of Water Quality, Nonpoint Source Unit and Regional Board Nonpoint Source staff, administer this grant program.

(2) Water Quality Planning (CWA §205(j))

Section 205(j) of the Clean Water Act (CWA) allows each state to provide funding for water quality management and planning projects. In addition, Congress has provided funding under Section 604(b), State Revolving Fund Set-Aside. Any regional or local public agency may apply directly to the State Board for 205(j) project funding. The State Board, Division of Water Quality, Water Quality Planning Unit and Regional Board Planning staff, administer this grant program.

(3) Wetlands Grants

Section 104(b) of the Clean Water Act provides funds for wetland restoration. The focus of these grants is wetland protection, but wetland restoration can be included when it is part of an overall wetland protection program. These grant funds are available only to State agencies, federally recognized Indian Tribes, and interstate and inter-tribal agencies. Non- profit, local agencies and universities are not eligible to receive these grants, however they can receive funding through a State or tribal agency as long as the State or tribal agency actively participates and has a significant role in the project. A 25% match of the grant amount is required. Priorities for funding include watershed projects to address watershed protection which have a substantial wetlands component in a holistic, integrated manner, and development of an assessment and monitoring program to determine the ecological integrity of wetlands. Other types of projects such as development of wetlands water quality standards and incorporation of wetlands into the Section 401 program are considered for funding.

The State Board, Division of Water Quality, administer this grant program.

(4) State Revolving Funds (SRF) Loan Program

The State Revolving Funds (SRF) Loan Program provides funding for the construction of publicly-owned treatment works (POTWs), for nonpoint source correction programs and projects, and for the development and implementation of estuary conservation and management programs. The loan interest rate is set at one-half the rate of the most recent sale of a State general obligation bond.

Proposed projects must be submitted to the Regional Board for placement on a Regional Board SRF Priority List. Projects are classified and ranked according to several criteria, including documented health problems, conformance with applicable Water Quality Control Plans or other management plans, and/or compliance with waste discharge requirements. The Regional Board Executive Officer can directly submit the list to the State Board. The State Board then adopts the Statewide Priority List, after which the funds are available on a first-come, first-served basis.

The State Board, Division of Clean Water Programs, administer this loan program.

(5) Agricultural Drainage Management Loan Program

The State Agricultural Drainage Management Loan Program is funded with a 75 million dollar bond fund. The program funds are available for feasibility studies and the design and construction of agricultural drainage water management projects. The interest rate is set at one-half the rate of the most recent sale of a general obligation bond. The loan term is not to exceed 20 years. The loan limits are $20 million for any one project and $100,000 for a feasibility study. Only local agencies can apply for this loan. The project must remove, reduce, or mitigate pollution resulting from agricultural drainage. The State Board, Division of Water Quality, administer this loan program.

C. Federal Programs

(1) Nonpoint Source Best Management Practices

As defined in 40 CFR 103.2 (M), BMPs are; "Methods, measures or practices selected by an agency to meet its nonpoint source control needs. BMPs include, but are not limited to structural and nonstructural controls, and operation and maintenance procedures. BMPs can be applied before, during and after pollution producing activities to reduce or eliminate the introduction of pollutants into receiving waters."

BMPs fall into two general categories: Source Controls which prevent a discharge or threatened discharge. Recycling, fertilizer management, erosion control and physical barriers to prevent livestock impacts are considered source control measures. Treatment Controls measures remove pollutants from the nonpoint source before it reaches the waterbody of concern. Examples include, created wetlands, sedimentation basins and oil/water separators.

BMP example:

San Diego Creek (Newport Bay Watershed): Erosion in the Newport Bay watershed and the resultant siltation in the Bay is a continual threat to the Bay's designated uses. Sediment loads result from erosion of open space lands and from man's activities in the watershed including extensive grading for development; increased runoff and channel erosion due to urbanization and erosion of agricultural lands. Most deposition occurs during major storm events, although low-level transport occurs year-round.

In 1982, the Southern California Association of Governments (SCAG) completed the "San Diego Creek Comprehensive Stormwater Sedimentation Control Plan" as part of an area-wide planning process conducted pursuant to Section 208 of the Clean Water Act. This Plan recommended a reduction or erosion at the source through the implementation of agricultural and construction BMPs and resource conservation plans. Well-coordinated efforts to implement the recommendations of the 208 Plan have been and are being made by the state, local agencies and the Irvine Company, the largest private landowner in the watershed. Several cities in the watershed now have grading ordinances which require erosion/siltation control plans using BMPs for construction projects. With technical assistance from the Regional Board, the County oversees a program to ensure development and implementation of resource conservation plans (RCPs) by agriculture. Implementation of BMPs in the watershed has effectively reduced silt deposition in Newport Bay.

The following points should be taken into consideration when proposing BMPs to protect water quality.

(a) Implementation of BMPs does not guarantee compliance with water quality objectives and full attainment of a beneficial use. BMPs should be considered as one mechanism for reducing pollution loading. BMP implementation must be followed up with ongoing monitoring to determine effectiveness.

(b) Not all BMPs are applicable to all types of water bodies, runoff conditions, etc. Careful consideration of site-specific conditions should be done prior to implementation of BMPs.

(c) Initially, BMPs may be costly for local agencies or private property owners to implement. The long term economic and environmental benefits of implementation should be stressed.

(d) Indirect BMP enforcement authority by a Regional Board may need to be achieved through interagency agreements with the agency that has direct regulatory authority.

(e) Currently, the State Board, Nonpoint Source Program Unit is in the process of developing standard BMPs as part of the Coastal Zone Reauthorization Act. Ideally, these BMPs would be applicable statewide for a variety of land uses.

(2) Total Maximum Daily Loads (TMDLs)

Section 303(d) of the Clean Water Act requires States to identify water bodies that do not meet water quality standards after technology based control has been implemented. These water bodies may be impacted by conventional or toxic pollutants from either point or nonpoint sources and are designated Water Quality Limited Segments. Once these water bodies are identified, states are required to develop Total Maximum Daily Loads (TMDLs) and a Waste Load Allocation or Load Allocation as a strategy for reducing the contaminant load. The Waste Load Allocation and Load Allocation refer to the quantity of pollutant that can be added to waterbody and still maintain the beneficial use. The TMDL allocates a portion of the load to point sources (Waste Load Allocation), nonpoint sources (Load Allocation) with a margin of safety.

The Malibu Creek Nitrogen TMDL (Santa Monica Bay)is an example of how the TMDL process can be used to reduce contaminant loads.

The Malibu Creek watershed drains to Malibu Lagoon and Santa Monica Bay. Both the Creek and lagoon have been impacted by algal blooms from excessive nutrients from the watershed. The Los Angeles Regional Water Board, in cooperation with a number of local agencies has been collecting water quality data for nitrogen in the Malibu Creek watershed.

As a first step in the TMDL process they establish a quantifiable acceptable level of nutrient input that will not cause algal blooms in the watershed. Through the cooperative monitoring program, both known and potential sources of nutrient inputs were identified. Subsequently, a source loading quantity will be quantified and finally this information will be used to develop a TMDL model which will determine adequate Waste Load Allocations and Load Allocations.

(3) National Estuary Program

As specified in the Clean Water Act, Section 320, significant coastal estuaries and water bodies may be nominated by the Governor and accepted into the

National Estuary Program by the Environmental Protection Agency. It must be demonstrated that the waterbody is of national significance from both an ecological and a public health standpoint.

The purpose of the program is to establish a mechanism for coastal protection. Acceptance into the National Estuary program provides a formal structure for developing water quality protection mechanisms, and may be an effective tool for initiating pollution prevention programs. Water bodies in the National Estuary Program are targeted for the development of comprehensive conservation and management plans that recommend priority corrective actions and compliance schedules addressing point and nonpoint source pollution. These plans must also propose methods to restore the chemical, physical and biological integrity of the estuary, as well as assure that beneficial uses are protected.

Santa Monica Bay serves as a prime example of how the National Estuary Program can be utilized to implement appropriate water quality protection and prevention strategies. As a result of this designation, the Santa Monica Bay Restoration Project was formed and has produced the Santa Monica Bay Restoration Plan to address a number of water quality concerns in Santa Monica Bay.

3. <u>Regulatory</u>

The following State and federal regulatory activities are carried out by the State and Regional Boards. These programs contain water quality protection enforcement provisions that must be complied with before operations are allowed to proceed. These programs, either require permits containing specific provisions or require the strict adherence to specific operating procedures in order to provide appropriate water quality protection to a target receiving water. They have been identified and described on the basis of (1) information provided by each program that can be useful in the prevention of toxic hot spots and their recurrence, and (2) how these regulatory activities can be useful in providing component tools (mechanisms and process) to help prevent toxic hot spots.

A. Waste Discharge Requirements and the National Pollutant Discharge Elimination System (NPDES) Program

The Regional Water Boards issue waste discharge requirements orders which incorporate Federal Clean Water Act (CWA) provisions (NPDES Permits) and Porter-Cologne Act regulatory provisions to regulate point source discharges to navigable waters of the U.S. (streams, rivers, lakes,or coastal waters)and ground waters of the state. The permits are implemented in California through a cooperative program with the USEPA and the state and Regional Boards. As a result, the issuance of waste discharge permits satisfies both state and federal law. The regulatory provisions of the permits include the authority to issue the permits for a fixed term not to exceed five years. The regulation provides authority for inspection and monitoring. It also provides for a pretreatment program which authorizes the state to impose pretreatment standards (promulgated by the USEPA) on industrial users of POTWs. This federal regulation also includes the necessary enforcement authority to implement the law.

During the issuance process The Regional Water board staff analyzes the discharge and prepares waste discharge requirements for Board adoption. The requirements must implement the water quality control plans and policies to protect beneficial uses of the receiving waters. Monitoring data provided by the permit program can provide information about possible toxic hot spots. Stricter effluent limits can help remediate and prevent recurrence of toxic hot spots. The Imposition of appropriate effluent standards may help to prevent toxic hot spots.

B. Coastal Zone Act/Coastal Zone Act Reauthorization Amendments (CZARA)

In passing into law the CZARA, Congress identified nonpoint source pollution as a significant factor in coastal water degradation. This acknowledgment links coastal water quality with land use activities along the shore. Section 6217 now requires that states with approved coastal zone management programs develop a coastal nonpoint source pollution control program as well. In compliance with section 6217 the state (SWRCB, RWQCBs, Coastal Commission,and BCDC) will develop a plan to implement the federally required management measures for nonpoint source pollution to restore and protect coastal waters. Guidance has already been issued by the USEPA identifying 56 management measures for control of coastal water quality impacts from various land uses.

The management measures are being evaluated and ultimately the program developed will:(1)identify those land uses that individually or cumulatively may cause or contribute significantly to a degradation of a coastal water,(2) identify critical geographical areas adjacent to coastal waters and (3) implement measures to achieve and maintain water quality standards. The management measures developed to control nonpoint source pollution in coastal waters should prove useful in remediating and preventing toxic hot spots in receiving coastal waters.

C. Clean Water Act Section 404 and 401

Section 404 of the Clean Water Act prohibits the discharge of dredge or fill materials into navigable waters of the U.S. unless a permit is obtained from the U.S. Army Corps of Engineers. The USEPA has oversight and veto authority over the Corps determination to issue the permit if it finds that the proposed project will have adverse effects on the receiving waters. Section 401 of the CWA requires that any federally permitted activity issued under CWA Section 404 complies with the States adopted water quality objectives and effluent limitations. Under this section the State, through the SWRCB must issue the water quality certification. The water quality certification declares that the proposed activity will be conducted using prescribed technology and that it will not result in any violation of any effluent limitations or water quality objectives. Until such a certification is issued, denied or waived by the SWRCB the proposed project can not proceed.

During the process of project review for certification a Regional Water Board may find that a 404 proposed project may have potential of causing detrimental effects on the receiving waters of a bay. In that case, a Regional Water Board may recommend denial of certification to the SWRCB or may find that the imposition of waste discharge requirements on the proposed 404 permitted activity as a condition of certification would be appropriate. The Regional Water Board may also find that water quality impacts can be avoided if the project is modified and/or if proposed methods and practices employed in the project are changed.

D. Storm Water Program

The 1987 amendments to the Clean water Act added Section 402(p)to the already existing NPDES program. The new section established a framework to regulate municipal and industrial storm water discharges to surface waters or through municipal separate storm sewers. The SWRCB currently issues general permits to regulate all storm water discharges.

Owners or operators of industrial storm water discharge system must obtain authorization for the use or continued use of storm water discharge systems by submitting a "Notice of Intent", which signifies that the discharger intends to comply with the provisions of the general permit. The general permit authorizes the discharge of industrial storm water from industrial facilities, prohibits illicit connections and discharges containing hazardous substances in storm water in excess of reportable quantities prescribed by federal regulation. A Permit for discharges of industrial storm water requires the development an implementation of a Storm Water Pollution Prevention Plan (SWPPP) emphasizing storm water BMPs, requires that all applicable CWA provisions associated with effluent limitations to control pollutant discharge be met, and the establishment of a monitoring program that will demonstrate compliance with the general permit, aid in the implementation of the SWPPP BMPs and, measures the effectiveness of the implemented BMPs.

The actual permit process could help prevent toxic hot spots from these permitted activities.

Established monitoring program could be helpful in determining possible sources contributing to the formation of toxic hot spots and aid to determine appropriate management practices to help prevent toxic hot spots.

Alternative Strategies

1. Point Source Pollution Control Strategy

Historically, this is the way point source pollution control has been carried out, by applying a permitting process, imposing effluent limits on wastewater discharges, establishing prohibitions, and taking enforcement actions whenever it has been necessary. Other water quality protection strategies have been available through the State and Regional Water Board system and in other federal and state agencies but they tend to be applied in an independent fashion. Unfortunately, each potential prevention tool, has been conceived independently adopted through different legislation, forming distinct portions of different programs. Many potentially useful prevention Strategies reside in different agencies with different authorities. Each has been designed to address specific problems and/or sources of pollution, all are usually funded differently and therefore applied independently. Toxic hot spot prevention requires not only control of point sources of pollution but even more importantly control over nonpoint sources as well. This requires a broader more coordinated approach. Proper prevention control requires the use of flexible and integrated strategies in order to effectively remediate and prevent the reoccurrence of polluted sites in bays and estuaries. The present way of implementing water quality controls confines activities to agencies, programs or geographical jurisdictions and does not promote the application of a coordinated water quality protection approach.

2. Watershed Management Planning

The watershed management planning approach is a comprehensive strategy that can make possible the implementation of cost effective integrated control actions that can effectively achieve the protection necessary to maintain and restore beneficial uses of watershed as a whole. For a given watershed, not only all hydrologic resources are considered (streams, lakes, groundwater basins, bays and estuaries) but also all land use practices being applied in the watershed as well. Interdisciplinary work groups that are able to cross over geographical and political boundaries to identify water quality problems prioritized them, and develop effective solutions. Solutions developed are applied from the whole watershed perspective, that is, problem solutions are applied where they will do the most good from the watershed perspective.

This process also allows for dischargers, landowners, business owners, environmental groups, non-profit groups, and other members of an affected community to discuss the watershed issues and get involved in seeking practical, cost effective solutions to the watershed identified THSs. Such meetings help in the exchange of information, ideas, and expertise among different representations resulting in effective and more easily implementable management practices. Solutions developed could be unique to the watershed or they could be composed of a specific combination or modification of existing practices.

The following example describes how the watershed approach works in practice.

1. <u>The Morro Bay Watershed</u>:

Currently the Central Coast Regional Water Board is conducting a pilot program in the Morro Bay watershed where sedimentation is a major problem. The Executive Officer in this Regional Water Board, required each unit supervisor to assign a staff person to the watershed protection work group. The interdisciplinary workgroup assembled included staff from each of the Regional Water Board's Program Units. Other staff with special skills could be brought into the work group as needed.

Morro Bay watershed, sedimentation problems comes from a wide variety of past and present land use practices (cattle grazing, abandoned chromium mines, irrigated agriculture, military base, landfills, underground tanks, septic tanks, and development of fresh water resources). The first task of the work group was to list, define and rank the problems in this watershed. Sedimentation ranked highest. Second the sites where most erosion was occurring where located. The two most significant erosion problems were determined to be caused by over grazing of range land (sheet erosion) and by heavy equipment training(sheet and gully erosion). Improved grazing methods are being developed and implemented in the watershed, and less damaging training procedures are being implemented to diminish the erosion effects from the training site.

effective Watershed management has been achieved through the application of integrated and coordinated actions brought about by the varied perspectives and experiences of the management work group focused on the problems of this particular watershed.

Comments Received: This section will be completed after the SWRCB hearing.

Alternatives For SWRCB Action:

1. <u>No change to control strategy implementation</u>

This option, in effect, does not require endorsement of any different approach. Toxic hot spot prevention is achieved through the application of existing control strategies whether the areal extent is large or not.

2. <u>Watershed Management Planning Strategy</u>

Effective prevention of sediment and water quality degradation in Bays and Estuaries requires a broad approach where all point and non-point sources of pollution from various land use activities are taken into consideration. The watershed management planning approach allows for the development of management practices that can address specific problems within a watershed area overcoming the barriers imposed by geography and different political jurisdictions. This promotes interaction and cooperation among all concerned parties which can result in a more comprehensive and effective solutions to solve water quality problems within a hydrologically defined watershed basin.

Staff Recommendation:

Adopt Alternative 2.

Toxic Hot Spot Cleanup Plans should be written such that actions taken either to remediate or prevent THSs use an integrated and coordinated management protection approach . The watershed strategy should encompasses all waters surface, ground, inland and coastal and address point and nonpoint sources of pollution.

The Cleanup Plans should also be written to take into account and accommodate the water quality control priorities identified by already established local watershed plans. Wherever watershed plans are established, THS Cleanup Plans should serve as a supplementary documents recommending different approaches to prevent toxic hot spots in the bays and estuaries of a particular watershed. In cases where a watershed plan is not in place the THS cleanup Plans should serve to provide guidance in implementing appropriate controls to prevent THSs.

Proposed Policy Language:

PREVENTION OF TOXIC HOT SPOTS

In the process of developing strategies to prevent toxic hot spots, the RWQCBs should focus on designs that accomplish the following:

1. Consider use of any established prevention tool such as (a) voluntary programs, (b) Interactive cooperative programs, and (c) Regulatory programs, individually or in any combination that will result in an effective THS prevention strategy

2. Promote a watershed management protection approach focused on hydrologically defined areas (watersheds) rather than areas defined by arbitrary political boundaries (counties, districts, municipalities), that take into account all waters, surface, ground, inland, and coastal and address point and nonpoint sources of pollution that may have influence or has been identified to have influenced the identified Toxic Hot Spots.

3. Welcomes the participation and input of, interdisciplinary groups of interested parties (including all potential responsible parties) able to cross over geographical and political boundaries to develop effective solutions for preventing Toxic Hot Spots.

4. develops prevention strategies with enough flexibility to be used as watershed protection plans where there is non established or have the ability to meld with a watershed protection plan that is already in force to address THS. Solutions developed should also be developed for, and applied at sites where it will do the most prevention and where it will be the most cost-effective at mitigating and preventing toxic hot spots at a watershed level.

Issue 14: Program of Implementation

Present Policy: None.

Issue Description: The development of Toxic Hot spot Cleanup Plans will be a long and sometimes very difficult process to complete. In order to meet the deadlines contained in the Water Code the SWRCB should consider adoption of a schedule for completion of the Regional and Statewide Cleanup Plans.

Alternatives for SWRCB Action:

1. Adopt a Schedule for Completion of the Cleanup Plans.

   The SWRCB should develop a schedule with interim deliverables on the completion of Regional and Toxic Hot Spot Cleanup Plans. The Regional Plans are due in to be adopted by January 1, 1998. The Statewide Plan is due to be delivered to the Legislature by June 30, 1999. The RWQCBs could report on progress on developing the Plans as follows:

   A. Report on identifying pollutant sources

   B. Report of identifying potential responsible parties.

   C. Report on development of Cleanup Plans with assistance of interested parties.

   D. Draft Cleanup Plan (Available for RWQCB hearing)

   E. Submission of the Adopted Regional Cleanup Plan

   F. Approval by the SWRCB

   G. Draft Statewide Cleanup Plan (Prepared with the advise of the BPTCP Advisory Committee)

   H. Completion of Final Statewide Cleanup Plan.

   I. Submittal of the Statewide Cleanup Plan to the Legislature.

2. Do not adopt a schedule for completion of the Cleanup Plans.

Scheduling of the development of the Cleanup Plans could be handled administratively by the SWRCB and RWQCB staff. The priority of the Plan development could be balanced with other priority programs. The interested public would not have a sense of when and what steps the Boards are taking to develop the plans.

Staff Recommendation: Adopt Alternative 1.

Proposed Policy Language: PROGRAM OF IMPLEMENTATION

This section of the policy establishes deadline for the completion of the Toxic Hot Spot Cleanup Plan and for implementation of other sections of the Water Quality Control Policy.

The schedule and products to be completed are listed in Table 20.

Table 22

Schedule for the Development of Toxic Hot Spot Cleanup Plans

	Activity	Schedule	1995	1996	1997	1998	1999
A.	Report on identifying pollutant sources	(due 6 months after Policy adoption)	--------------------	X			
B.	Report of identifying potential responsible parties.	(due 9 months after Policy adoption)	-------------------	X			
C.	Report on development of Cleanup Plans (with assistance of interested parties).	(due 12 months after Policy adoption)		-------------X			
D.	Draft Cleanup Plan (Available for RWQCB hearing)			X			
E.	Submission of the Adopted Regional Cleanup Plan				X		
F.	Approval by the SWRCB				X		
G.	Draft Statewide Cleanup Plan (Prepared with the advise of the BPTCP Advisory Committee)					X	
H.	Completion of Final Statewide Cleanup Plan.					X	
I.	Submittal of the Statewide Cleanup Plan to the Legislature.					X	

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REFERENCES

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WATER QUALITY CONTROL POLICY
FOR IMPLEMENTATION OF THE BAY PROTECTION
AND TOXIC CLEANUP PROGRAM

State of California

STATE WATER RESOURCES CONTROL BOARD

1995

WATER QUALITY CONTROL POLICY FOR IMPLEMENTATION OF THE BAY PROTECTION AND TOXIC CLEANUP PROGRAM

Adopted and Effective

__________ 1995

WATER QUALITY CONTROL POLICY FOR IMPLEMENTATION OF THE BAY PROTECTION AND TOXIC CLEANUP PROGRAM

INTRODUCTION

The Water Quality Control Policy for the Implementation of the Bay Protection and Toxic Program is intended to provide guidance on the development of Regional and Statewide Toxic Hot Spot Cleanup Plans (Water Code Sections 13390 et seq.)(Stats. 1989, Chapter 269; Stats. 1989, Chapter 1032; Stats. 1990 Chapter 1294; Stats. 1993, Chapter 1157). Pursuant to Sections 13140 and 13143 of the Water Code, the State Water Resources Control Board (SWRCB) finds and declares that Cleanup Plans are required to protect the quality of waters and sediments of the State from discharges of waste, in-place sediment pollution and contamination, any other factor that can impact beneficial uses of enclosed bays, estuaries and coastal waters. The SWRCB finds further that this policy shall be reviewed at least every three years to ensure that the guidance is adequate to complete the mandates of the Bay Protection and Toxic Cleanup Program (Water Code Section 13390 et seq.).

This Policy establishes requirements for the development of Toxic Hot Spot Cleanup Plans which includes a more specific definition of a Toxic Hot Spot, site ranking criteria, guidelines for standard monitoring methods and data reporting, contents of regional and Statewide Toxic Hot Spot Cleanup Plans. The guidelines, principals and water or sediment quality objectives contained in this policy apply to all enclosed bays, estuaries and coastal waters. The provisions of resulting cleanup plans shall apply to all dischargers (point and nonpoint) in whatever location in the State as long as the discharger can be reasonably linked to the identified Toxic Hot Spot.

Regional Water Quality Control Boards shall comply with this policy except as otherwise specifically provided in the Policy. Regional Water Boards shall develop Regional Toxic Hot Spot Plans in accordance with this Policy. Any site-specific variance from the Policy shall be approved by the State Water Resources Control Board.

PROCESS FOR DEVELOPMENT OF REGIONAL AND STATEWIDE HOT SPOT CLEANUP PLANS

In adopting Regional and Statewide Cleanup Plans, the State and Regional Water Boards shall comply with the provisions of the California Environmental Quality Act and the Administrative Procedure Act.

In addition to these requirements the RWQCBs shall involve all interested parties in the development of the Regional Cleanup Plans. The RWQCbs shall convene an advisory committee of local dischargers, likely responsible parties, environmental groups, trade organizations, and public health interests to advise them on the development of the Cleanup Plans. To the extent possible the RWQCBs shall solicit the voluntary assistance of likely responsible parties in the development of the Cleanup Plans. If information is needed and a likely responsible party is recalcitrant in providing assistance, the RWQCBs shall require participation of the likely responsible party under the authority granted by Water Code Section 13267.

Once a Regional Cleanup Plan is adopted by the RWQCB, the Plan will be submitted to the SWRCB for approval. The Regional Plan will be reviewed for concurrence with the Water Quality Control Policy for Implementation of the Bay Protection and Toxic Cleanup Program as well other Water Quality Control Plans and Policies of the SWRCB.

The SWRCB will compile all approved Regional Cleanup Plans and the required additional findings into a Statewide Toxic Hot Spot Cleanup Plan. The Statewide and Regional Toxic Hot Spot Cleanup Plans will be submitted at one time to the Office of Administrative Law. During the development of the Statewide Plan the SWRCB will seek advise of the BPTCP Advisory Committee (established by Water Code Section 13394.6).

CONTENTS OF REGIONAL AND STATEWIDE TOXIC HOT SPOT CLEANUP PLANS

The Regional and Statewide Toxic Hot Spot Cleanup Plans shall contain (at a minimum) the following information:

A priority ranking of all THS (including a description of each THS including a characterization of the pollutants present at the site).

The Regional Water Boards shall use the definition of a potential candidate and known toxic hot spot listed in this Policy. The Regional Water Boards will then rank sites using the appropriate Ranking criteria in this Policy. The Regional Water Boards shall create a two lists of toxic hot spots: (1) Candidate/Known Toxic Hot Spots and rank the list using the appropriate criteria, and (2) Potential Toxic Hot Spots and rank the list using the appropriate criteria.

Each ranked list shall be established in the Regional Cleanup Plan that contains the following information for each toxic hot spot:

1. Water body name. The name shall conform to the water body name in the Regional Basin Plan.

2. Segment Name. The Regional Water Boards shall list a descriptive name in the water body segment where the toxic hot spot is

located if the segment name is more descriptive than the water body name.

3. Site Identification. The Regional Water Boards shall list a station or site identifier that can be linked to a monitoring station location (e.g., BPTCP monitoring station, State Mussel Watch station, discharger self monitoring station, or any other appropriate identifier).

4. Reason for Listing. The Regional Water Boards shall list the reason for the site or station to be listed. The value given shall be the appropriate trigger value in the definition of a Toxic Hot Spot that is the cause for the listing.

5. Pollutants present at the site. The Regional Water Boards shall also list which chemicals are present at sufficiently high levels to be of concern.

6. Report reference substantiating toxic hot spot listing. All references support the designation of the toxic hot spot shall be listed with the other information required for designation of a toxic hot spot. The references shall include, but not limited to: author, year of publication, title of report, and other identifying information (e.g., name of journal (including volume and pages), regional Board file number, agency report, or other identifier that will allow the report to be independently located).

After the lists of toxic hot spots, each Candidate/Known Toxic Hot Spot shall be listed separately and the following information compiled for the site by the Regional Water Boards:

1. An assessment of the areal extent of the THS and Sediment Toxicity Identification Evaluations.

   The RWQCB shall characterize the areal extent of the Toxic Hot Spot. The RWQCB can either estimate the boundary, size and/or volume of the Toxic Hot Spot or the RWQCB can work with a potential responsible party to characterize the site. In determining the areal extent the RWQCB should consider a temporal component (i.e. the historic vs ongoing nature of the Toxic Hot Spot), the mix of chemicals present (routinely measured vs other anthropogenic pollutants), and the mix of biological effects (bioaccumulation, sublethal, and lethal effects in a range of organisms).

   Since this phase of assessment is a determination of the magnitude and extent of the Toxic Hot Spot, all these concerns should be considered in the design of the monitoring effort to characterize the areal extent of the toxic hot spot. Though these additional concerns can add significantly to the cost (either in funding or impact on beneficial use) of remediation, this expense is modest compared to remediating a larger or smaller area than is absolutely necessary. To avoid such a development, all interested parties (including Potential Responsible Parties) should be involved in the design of site characterization monitoring.

For areal extent determination, it is recommended that the RWQCBs use a stratified random sampling design to delineate horizontal extent of pollution; if sediment is layered, sample within distinct layers for vertical extent using sediment coring. For source confirmation, incorporate more intense sampling within the stratified random scheme (have more strata or more samples within a stratum) or utilize systematic random sampling (transects).

RWQCBs should also consider using sediment toxicity identification evaluation (TIE) methods to make a better estimate of the cause-and-effect relationship between chemicals and toxicity. TIEs provides strong scientific evidence that a chemical or chemical is causing toxicity. TIE procedures can also be used to remove the potential effects of ammonia or hydrogen sulfide on test organisms.

2. An assessment of the most likely sources of pollutants (responsible parties).

Regional Boards shall list potential responsible parties that are likely to have discharged or deposited the pollutants identified in the toxic hot spot lists.

This process may be somewhat straightforward when single sources are responsible. The process will become considerably more complex when an attempt is made to document the relative contribution of a variety of sources. Such an effort might involve a complex spatial and temporal array of, perhaps, both water and sediment monitoring stations as well as an investigation of chemical concentrations in the watershed. The Watershed approach described in the Prevention Section should be implemented.

Potential responsible party identification shall be dependent on factors such as, site location, pollutant type, mix of chemicals found to be present at the site, and identification and location of PRP. In cases where enough evidence has been accumulated to connect a THS to a PRP, it is required that the PRP be involved early in the development of the cleanup planning process by the RWQCB. The PRP shall assist in the development of alternative cleanup options.

In some cases, after a site is identified as a Toxic Hot Spot, there may not be any identified PRP to assume the financial responsibility of cleanup. In such cases the identified THS would remain reported as a THS in the Cleanup Plan lists. The Regional Water Quality Control Board and the State Water Resources Control Board would assume the role of leadership to initiate cleanup through the adoption of the Statewide Cleanup Plan.

In some cases a multi-agency response for Cleanup actions would be the most appropriate way to proceed. This alternative would be dependent on fiscal resources being available from other agencies or communities that would allow an integrated participation in the cleanup of the orphan site. Some basins where THS are identified may already have watershed plans in existence. Cleanup priority and the funding necessary to do cleanup would come under an already established watershed plan. Local agencies may have already initiated some cleanup actions, which may warrant some supplemental action by the State Board if the site ranks high on the known toxic hot spot list and if legislation has been passes to provide the state funds for such purposes.

3. A summary of actions that have been initiated by the regional boards to reduce the accumulation of pollutants at existing THSs and to prevent the creation of new THSs.

   The summary of actions shall contain descriptions of any issued waste discharge requirements, National Pollutant Discharge Elimination System permits, general permits (e.g., construction, industrial stormwater, etc.), cleanup and abatement orders, cease and desist orders, actions taken or initiated by other State or Federal agencies (e.g., Department of Defense Base Closure, Damage Assessment activities of the National Oceanic and Atmospheric Administration, etc.).

4. Preliminary Assessment of Actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions.

   The Regional Water Boards shall evaluate the alternatives listed in the Cleanup section of this policy. After evaluating the cleanup alternatives the Regional Water Boards shall list their assessment of the actions that could be implemented. This listing shall not be mandatory if a responsible party has been identified. Responsible parties shall be given every opportunity to develop a site-specific cleanup plan that cost-effectively plans for the remediation of the site.

5. An estimate of the total cost to implement the cleanup plan.

   Regional Water Boards shall estimate costs of cleanup plan implementation using the estimates provided in this Policy.

Regional Board may deviate from the costs estimate in the policy if clearly justified in the cleanup plan. If a potential responsible party has been identified the RWQCB shall require that the PRP prepare a proposal for site remedial actions.

6. An estimate of recoverable costs from responsible parties.

   The costs recoverable from responsible parties should be developed by the Regional Water Boards in consultation with identified or potential responsible parties. The costs should be justified in the cleanup plan.

7. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from responsible parties.

   The Regional Water Boards should develop a brief workplan for the implementation of the cleanup plans for sites without responsible parties identified. The workplan shall contain costs and estimated schedule for: finding polluted sediments (monitoring), assessment of areal extent of toxic hot spot, implementation of remedial actions including but not limited to sediment removal and disposal, treatment of removed sediments, or capping of polluted sediments. The expenditure plan should also contain funding for assessing the effectiveness of remediation.

The Statewide Toxic Hot Spot Cleanup Plan shall be a simple compilation of the Regional Toxic Hot Spot Cleanup Plans. In addition, the Statewide Plan shall contain a complete listing of all Known Toxic Hot Spots (ranked using the scores developed by the Regional Water Boards). All known sites with no responsible parties identified or with only partial responsibility parties identified shall be clearly indicated.

Before submittal to the Legislature (as required by Water Code Section 13394) the State Water Board will also develop Findings and recommendations concerning the need for funding a toxic hot spot cleanup program to cleanup or prevent the identified Known Toxic Hot Spots. These findings shall include, but not limited to: total funding needed to cleanup toxic hot spots with no responsible party identified, finding on any additional need to monitor potential toxic hot spots, recommendation for program modifications and funding needed to administer cleanup activities.

PROCESS FOR REMEDIATING POLLUTED SEDIMENTS

To comply with Section 13360 of the Porter-Cologne Act, the Regional Boards would attempt to notify responsible parties before beginning the three-step process. If responsible parties can not be identified or if the parties failed to specify cleanup methods in a timely manner, the Regional Boards would then follow the three-step process and suggest the means of compliance in the regional cleanup plan.

The three-step process for remediating polluted sediments is:

1. Establish a range of potential cleanup levels;

2. Perform a preliminary assessment of remedial actions; and

3. Select preferred remediation actions.

The information gathered shall be applied in the regional cleanup plans and in the ranking of known toxic hot spots on the statewide list. Regional boards could later compel responsible parties to propose additional cleanup plans for those sites for which responsible parties had not been previously identified, as required by Section 13360.

SPECIFIC DEFINITION OF A TOXIC HOT SPOT

Each region shall identify toxic hot spots within its jurisdictional boundaries according to the following:

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 specific definition provides the RWQCBs with a specific working definition and a mechanism for identifying and distinguishing between "<u>potential</u>," "<u>candidate</u>" and "<u>known</u>" toxic hot spots. A Candidate Toxic Hot Spot is considered to have enough information to designate a site as a Known Toxic Hot Spot except that the candidate hot spot has not been approved by the appropriate Regional Water Quality Control Board. Once a candidate toxic hot spot has been adopted into a toxic hot spot cleanup plan then the site shall be considered a known toxic hot spot and all the requirements of the Water Code shall apply to that site.

a. <u>Potential Toxic Hot Spot</u>

The Water Code 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 further as a "candidate" or "known" toxic hot spot are classified as "potential" toxic 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 test other than those specified by the State or Regional Boards;

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 advisory for migratory fish that applies to the whole water body has been issued for the site by OEHHA, DHS, or a local public health agency, the waterbody will be considered a potential toxic hot spot. Further monitoring is warranted to determine if health warnings are necessary at specific locations in the waterbody.

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.

b. <u>Candidate Toxic Hot Spot</u>:

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

1. The site exceeds water or sediment quality objectives for toxic pollutants that are contained in appropriate water quality control plans or exceeds water quality criteria promulgated by the U.S. Environmental Protection Agency.

   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 State Water Resource Control Board or the Regional Water Quality Control Boards.

   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 (e.g., the Bay Protection and Toxic Cleanup Program Quality

Assurance Project Plan). 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 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 a health advisory against the consumption of edible resident non-migratory organisms has been issued by OEHHA or DHS, on a site or waterbody, the site or waterbody is automatically classified a "candidate" toxic hot spot if the chemical contaminant is associated with sediment or water at the site or water body.

   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 in tissue are required. Residue levels established for one species for the protection of human health can be applied to any other consumable species.

   Shellfish: 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.

   Fin-fish: 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 measured in the environment 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. Each of the test shall be acceptable to the SWRCB or the RWQCBs.

Growth Measures: Reductions in growth can be addressed using suitable bioassays acceptable to the State or Regional Boards or through measurements of field populations.

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 "candidate" 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 the diminished numbers of species 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 "candidate" hot spots after generating information which satisfies any one of the five conditions constituting the definition. To use the working, a list of toxicity tests is presented in this policy. The list identifies toxicity tests for monitoring and surveillance activities partially satisfies the Water Code requirement [Section 13392.5(a)(2)] for standardized analytical methods.

c. <u>Known Toxic Hot Spot</u>:

A site meeting any one or more of the conditions necessary for the designation of a "candidate" toxic hot spot and has gone through a full State or Regional board hearing process, is considered to be a "known" toxic hot spot. A site will be considered a "candidate" toxic hot spot until approved as a known toxic hot spot in a Regional Toxic Hot Spot Cleanup Plan by the Regional Water Quality Control Board.

SEDIMENT QUALITY OBJECTIVES

The concentration of chemical substances in enclosed bay and estuarine sediments shall not impact beneficial uses.

The concentration of chemical substances (both metals and organic substances) in enclosed bay and estuarine sediments shall not increase to levels that would degrade aquatic life.

The concentration of chemical substances (both metals and organic substances) in fish, shellfish, or other enclosed bay or estuarine resources used for human consumption shall not bioaccumulate from sediments to the living resource to levels that are potentially harmful to human health.

RANKING CRITERIA

A value for each criterion described below should be developed provided appropriate information exists. Any criterion for which no information exists should be assigned a value of zero. The sum of the values for the six criteria will serve as the final ranking score. In developing the score for each criterion an initial value is identified and then adjusted by one or two correction factors as appropriate. The Alternative 4 weighted criteria follow:

A. Human Health Impacts

<u>Potential Exposure</u>: Select from the following the applicable circumstance with the highest value:

Human Health Advisory issued for consumption of non-migratory aquatic life from the site (assign a value of 5); Tissue residues in aquatic organisms exceed FDA/DHS action level (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[1] with a cancer potency factor or noncarcinogen 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 another pollutant potentially causing human toxicity (other than cancer)(3); other pollutants of concern (1).

B. Other Beneficial Use Impacts

1. 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 exposed to or dependent on the site (assign a value of 5), Threatened or rare species exposed to or dependent on the site (4), Endangered, 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 Criteria B1 value.

2. 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 with acute toxicity tests contained in this policy or acceptable to the SWRCB or the RWQCBs (4), Statistically significant toxicity demonstrated in chronic toxicity tests acceptable to the BPTCP (3), reproductive impairments documented (2), toxicity is demonstrated only occasionally and does not appear severe enough to alter resident populations (1).

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[1]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.

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.

3. Chemical measures[2]:

Any chemistry data used for ranking under this section should be no more than 10 years old, and should have been analyzed with appropriate analytical methods and quality assurance.

i. 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).

ii. Water quality objective or water quality criterion: Exceeded regularly (assign a value of 3), infrequently exceeded (2).

iii. Sediment values (sediment weight of evidence guidelines recommended for State of Florida): Above the Probable Effects Level (PEL)[3] (3), between the TEL[4] and PEL (2). For a substance with no calculated PEL: Above the effects range median[5] (ER-M) (2), between the effects range lowest 10 percent (ER-L) and ER-M (1).

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[2]The tissue residue guidelines and sediment values to be used in the ranking system are listed in Table XX. Water quality objectives to be used are found in Regional Water Quality Control Board Basin Plans or the California Ocean Plan (depending on which plan applies to the water body being addressed). Where a Basin Plan contains a more stringent value than the statewide plan, the regional water quality objective will be used.

[3]PEL is that concentration above which adverse biological effects are likely to occur. It is developed by taking the geometric mean of the 50th percentile value of the effects database and the 85th percentile value of the no-effects database.

[4]The Threshold Effects Level (TEL) is defined as the sediment concentration that is the upper limit of the minimal effects range. The value is derived by taking the geometric mean of 15th percentile of the ascending effects database and the 50th percentile of the ascending no-effects database.

[5]The ER-M is analogous to the PEL. It is that concentration above which adverse effects are likely. It is developed by taking the 50th percentile of the ranked adverse effects data in the Long and Morgan database. The ER-L is developed by taking the 10th percentile of the ranked adverse effects data.

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 (i) through (iii) above. Add the values for (i) through (iii) (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). If site can not be classified (assign a value of 1).

Table 1

Comparison of Sediment[6] Screening Levels Developed by NOAA and the State of Florida

SUBSTANCE	State of Florida[7] TEL	PEL	ERM[8]	NOAA ERL[9]	ERM[10]
Organics ug/kg					
Total PCBs	21.55	188.79	380	22.7	180
Acenaphthene	6.71	88.9	650	16	500
Acenaphthylene	5.87	127.89		44	640
Anthracene	46.85	245	960	85.3	1100
Fluorene	21.17	144.35	640	19	540
2-methyl naphthalene	20.21	201.28	670	70	670
Naphthalene	34.57	390.64	2100	160	2100
Phenanthrene	86.68	543.53	1380	240	1500
Total LMW-PAHs	311.7	1442.0		552	3160
Benz(a)anthracene	74.83	692.53	1600	261	1600
Benzo(a)pyrene	88.81	763.22	2500	430	1600
Chrysene	107.71	845.98	2800	384	2800
Dibenzo(a,h)anthracene	6.22	134.61	260	63.4	260
Fluoranthene	112.82	1493.54	3600	600	5100
Pyrene	152.66	1397.60	2200	665	2600
Total HMW-PAHs	655.34	6676.14		1700	9600
Total PAHs	1684.06	16770.54	35000	4022	44792
p,p'-DDE	2.07	374.17	15	2.2	27
Total DDT	3.89	51.70	350	1.58	46.1
p,p'-DDT	1.19	4.77			
Lindane	0.32	0.99			
Chlordane	2.26	4.79	0.5	6	
Dieldrin	0.715	4.30	0.02	8	
Endrin	0.02	45			
2-methylnaphthalene	65	670			
Metals mg/kg					
Arsenic	7.24	41.6	85	8.2	70.0
Antimony			2		2.5
Cadmium	0.676	4.21	9	1.2	9.6
Chromium	52.3	160.4	145	81.0	370.0
Copper	18.7	108.2	390	34.0	270.0
Lead	30.24	112.18	110	46.7	218.
Mercury	0.130	0.696	1.3	0.15	0.71
Nickel	15.9	42.8		20.9	51.6
Silver	0.733	1.77	2.5	1.0	3.7
Zinc	124	271.0	280	150.0	410.

[6]Values are for bulk sediment expressed on a dry weight basis

[7]McDonald, in press

[8]Long and Morgan, 1990

[9]Long et al., in press

TABLE 2

CHEMICAL SPECIFIC WATER QUALITY CRITERIA USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	WQC CMC d ug/l (Fresh)	WQC CCC d ug/l (Fresh)	WQC CMC d ug/l (Estuarine)	WQC CCC d ug/l (Estuarine)	WQC (Fresh) ug/l (10-6 risk for carcinogens)c	WQC (Estuarine) ug/l (10-6 risk for carcinogens)c
Antimony				14	a 4300	a
Arsenic	360 m	190 m	69 m	36 m	0.018a,b	0.14 a,b
Beryllium						
Cadmium	3.9 e,m	1.1 e,m	43 m	9.3 m		
Chromium (III)	1700e,m	210 e,m				
Chromium (VI)	16 m	11 m		1100 m	50 m	
Copper	18 e,m	12 e,m	2.9 m	2.9 m		
Lead	82 e,m	3.2 e,m	220 m	8.5 m		
Mercury	2.4 m	0.012 i	2.1 m	0.025i	0.14	0.15
Nickel	1400e,m	160 e,m	75 m	8.3 m	610 a	4600 a
Selenium	20	5	300 m	71 m		
Silver	4.1 e,m	2.3 m				
Thallium				1.7 a	6.3 a	
Zinc	120 e,m	110 e,m	95 m	86 m		
Cyanide	22	5.2	1	1	700 a	220000 a,j
Asbestos					7,000,000k	
2,3,7,8-TCDD (Dioxin)					0.000000013	0.000000014
Acrolein					320	780
Acrylonitrile					0.059 a	0.66 a
Benzene					1.2 a	71 a
Bromoform					4.3 a	360 a
Carbon tetrachloride					0.25 a	4.4 a
Chlorobenzene					680 a	21000 a,j
Chlorodibromomethane					0.41 a	34 a
Chloroethane						
2-Chloroethylvinyl ether						
Chloroform					5.7 a	470 a
Dichlorobromomethane					0.27 a	22 a
1,1-Dichloroethane						
1,2-Dichloroethane					0.38 a	99 a
1,1-Dichloroethylene					0.057 a	3.2 a
1,2-Dichloropropane						
1,3-Dichloroproplyene					10 a	1700 a
Ethylbenzene					3100 a	29000 a
Methyl bromide					48 a	4000 a
Methyl chloride						
Methylene chloride					4.7 a	1600 a
1,1,2,2-Tetrachloroethane					0.17 a	11 a
Tetrachloroethylene					0.8	8.85
Toluene					6800 a	200000a
1,2-Trans-dichloroethylene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane					0.60 a	42 a
Trichloroethylene					2.7	81
Vinyl chloride					2	525
2-Chlorophenol						
2,4-Dichlorophenol					93 a	790 a,j
2,4-Dimethylphenol						
2-Methyl-4,6-dinitrophenol					13.4	765
2,4-Dinitrophenol					70 a	14000 a
2-Nitrophenol						
4-Nitrophenol						
3-Methyl-4-chlorophenol						
Pentachlorophenol	20 f	13 f	13	7.9	0.28 a	8.2 a,j
Phenol					21000 a	4600000 a,j
2,4,6-Trichlorophenol					2.1 a	6.5 a
Acenaphthene						
Acenaphthylene						
Anthracene					9600 a	110000 a
Benzidine					0.00012 a	0.00054 a
Benzo(a)anthracene					0.0028	0.031
Benzo(a)pyrene					0.0028	0.031
Benzo(b)flouranthene					0.0028	0.031
Benzo(ghi)perylene						
Benzo(k)flouranthene					0.0028	0.031

CHEMICAL SPECIFIC WATER QUALITY CRITERIA USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	WQC CMC d ug/l (Fresh)	WQC CCC d ug/l (Fresh)	WQC CMC d ug/l (Estuarine)	WQC CCC d ug/l (Estuarine)	WQC (Fresh) ug/l (10-6 risk for carcinogens)c	WQC (Estuarine) ug/l (10-6 risk for carcinogens)c
Bis(2-chloroethyl) ether					0.031 a	1.4 a
Bis(2-chloroisopropyl) ether					1400 a	170000 a
Bis(2-ethylhexyl) phthalate					1.8 a	5.9 a
4-Bromophenyl phenyl ether						
Butylbenzyl phthalate						
2-Chloronaphthalene						
4-Chlorophenyl phenyl ether						
Chrysene					0.0028	0.031
Dibenzo(a,h)anthracene					0.0028	0.031
1,2-Dichlorobenzene					2700 a	17000 a
1,3-Dichlorobenzene					400	2600
1,4-Dichlorobenzene					400	2600
3,3'-Dichlorobenzidine					0.04 a	0.077 a
Diethyl phthalate					23000 a	120000 a
Dimethyl phthalate					313000	2900000
Di-n-butyl Phthalate					2700 a	12000 a
2,4-Dinitrotoluene					0.11	9.1
2,6-Dinitrotoluene						
Di-n-octyl phthalate						
1,2-Diphenylhydrazine					0.040 a	0.54 a
Flouranthene					300 a	370 a
Flourene					1300 a	14000 a
Hexachlorobenzene					0.00075 a	0.00077 a
Hexachlorobutadiene					0.44 a	50 a
Hexachlorocyclopentadiene					240 a	17000 a,j
Hexachloroethane					1.9 a	8.9 a
Indeno(1,2,3-cd)pyrene					0.0028	0.031
Isophorone					8.4 a	600 a
Naphthalene						
Nitrobenzene					17 a	1900 a,j
N-Nitrosodimethylamine					0.00069 a	8.1 a
N-Nitrosodi-n-propylamine						
N-Nitrosodiphenylamine					5.0 a	16 a
Phenanthrene						
Pyrene					960 a	11000 a
1,2,4-Trichlorobenzene						
Aldrin	3 g 1.3 g				0.00013 a	0.00014 a
alpha-BHC					0.0039 a	0.013 a
beta-BHC					0.014 a	0.046 a
gamma-BHC	2 g 0.08 g	0.16 g	0.019	0.063		
delta-BHC						
Chlordane	2.4 g	0.0043 g	0.09 g	0.004 g	0.00057 a	0.00059 a
4,4'-DDT	1.1 g	0.001 g	0.13 g	0.001 g	0.00059 a	0.00059 a
4,4'-DDE					0.00059 a	0.00059 a
4,4'-DDD					0.00083 a	0.00084 a
Dieldrin	2.5 g	0.0019 g	0.71 g	0.0019 g	0.00014 a	0.00014 a
alpha-Endosulfan	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a
beta-Endosulfan	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a
Endosulfan sulfate					0.93 a	2.0 a
Endrin	0.18 g	0.0023 g	0.037 g	0.0023 g	0.76 a	0.81 a
Endrin aldehyde					0.76	0.81
Heptachlor	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00021 a	0.00021 a
Heptachlor epoxide	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00010 a	0.00011 a
PCB-1242		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1254		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1221		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1232		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1248		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1260		0.014 g	0.03 g	0.000044a	0.000045 a	
PCB-1016		0.014 g	0.03 g	0.000044a	0.000045 a	
Toxaphene	0.73	0.0002	0.21	0.0002	0.00073 a	0.00075 a

Table 2 (Continued)

Footnotes:

a. Criteria revised to reflect current EPA q1* or RfD, as contained in the Integrated Risk Information System (IRIS). The fish tissue bioconcentration factor (BCF) from the 1980 criteria documents was retained in all cases.

b. The criteria refer to the inorganic form only.

c. Criteria in the matrix based on carcinogenicity (10-6 risk).

d. Criteria Maximum Concentration (CMC) = the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) without deleterious effects. Criteria Continuous Concentration (CCC) = the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. ug/l = micrograms per liter.

e. Freshwater aquatic life criteria for these metals are expressed as a function of total hardness (mg/l), and as a function of the pollutant's water effects ratio (WER) as defined in 40 CFR 131.36(c). The equations are provided in matrix at 40 CFR 131.36(b)(2). Values displayed above in the matrix correspond to a total hardness of 100 mg/l and a WER of 1.0.

f. Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH, and are calculated as follows. Values displayed above in the matrix correspond to a pH of 7.8. CMC=exp(1.005(pH)-4.830) CCC=exp(1.005(pH)-5.290)

g. Aquatic life criteria for these compounds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute values shown are final acute values (FAV) which by the 1980 Guidelines are instantaneous values as contrasted with a CMC which is a 1-hour average.

h. These totals simply sum the criteria in each column. For aquatic life, there are 30 priority toxic pollutants with some type of freshwater or saltwater, acute or chronic criteria. For human health, there are 91 priority toxic pollutants with either "water + fish" (fresh) or "fish only" (Estuarine) criteria. Note that these totals count chromium as one pollutant even though EPA has developed criteria based on two valence states.

i. If the CCC for mercury exceeds 0.012 ug/l more than once in a three year period in the ambient water, the edible portion of fish must be analyzed to determine whether the concentration of methyl mercury exceeds the Food and Drug Administration (FDA) action level (1.0 mg/kg).

j. No criteria for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even the results of such a calculation were not shown in the document.

k. The criterion for asbestos is the MCL (56 Federal Register 3526, January 30, 1991). The units for asbestos are fibers/l.

l. This letter not used as a footnote.

m. Criteria for these metals are expressed as a function of the WER as defined in 40 CFR 131.36(c).

TABLE 3

CHEMICAL SPECIFIC MAXIMUM TISSUE RESIDUE LEVELS (MTRL) FOR USED FOR RANKING TOXIC HOT SPOTS.

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
Antimony	14.00	4000
Arsenic	0.79	6.16
Beryllium	0	0
Cadmium	0	0
Chromium (III)	0	0
Chromium (VI)	0	0
Copper	0	0
Lead	0	0
Mercury	1000	1000
Nickel	29000	216000
Selenium	0	0
Silver	0	0
Thallium	200	700
Zinc	0	0
Cyanide	700	220000
Asbestos	0	0
2,3,7,8-TCDD (Dioxin)	0	0
Acrolein	69000	168000
Acrylonitrile	2.00	20.00
Benzene	6.25	369.91
Bromoform	35.69	2988
Carbon tetrachloride	4.69	83
Chlorobenzene	7000	216000
Chlorodibromomethane	1.54	128
Chloroethane	0	0
2-Chloroethylvinyl ether	0	0
Chloroform	21.38	1763
Dichlorobromomethane	1.01	83
1,1-Dichloroethane	0	0
1,2-Dichloroethane	0.46	119
1,1-Dichloroethylene	0.21	17.95
1,2-Dichloropropane	0	0
1,3-Dichloroproplyene	0	0
Ethylbenzene	116000	1088000
Methyl bromide	0	0
Methyl chloride	0	0
Methylene chloride	0	0
1,1,2,2-Tetrachloroethane	0.85	55
Tetrachloroethylene	24.48	270.81
Toluene	73000	2140000
1,2-Trans-dichloroethylene	0	0
1,1,1-Trichloroethane	0	0
1,1,2-Trichloroethane	2.7	189
Trichloroethylene	28.62	858.6
Vinyl chloride	2.34	614.25
2-Chlorophenol	0	0
2,4-Dichlorophenol	4000	32000
2,4-Dimethylphenol	0	0
2-Methyl-4,6-dinitrophenol	0	0
2,4-Dinitrophenol	100	21100
2-Nitrophenol	0	0
4-Nitrophenol	0	0
3-Methyl-4-chlorophenol	0	0
Pentachlorophenol	3.08	90.2
Phenol		

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
2,4,6-Trichlorophenol	3150000	6.9E+08
Acenaphthene	0	0
Acenaphthylene	0	0
Anthracene	0	0
Benzidine	0	0
Benzo(a)anthracene	0	0
Benzo(a)pyrene	0	0
Benzo(b)flouranthene	0	0
Benzo(ghi)perylene	0	0
Benzo(k)flouranthene	0	0
Bis(2-chloroethyl) ether	0.02	0.21
Bis(2-chloroisopropyl) ether	0.08	3.46
Bis(2-ethylhexyl) phthalate	82000	22100000
4-Bromophenyl phenyl ether	0	0
Butylbenzyl phthalate	0	0
2-Chloronaphthalene	0	0
4-Chlorophenyl phenyl ether	0	0
Chrysene	0	0
Dibenzo(a,h)anthracene	0	0
1,2-Dichlorobenzene	150000	945000
1,3-Dichlorobenzene	22000	145000
1,4-Dichlorobenzene	22000	145000
3,3'-Dichlorobenzidine	12.48	24.024
Diethyl phthalate	1680000	8760000
Dimethyl phthalate	11270000	1.0E+08
Di-n-butyl Phthalate	240000	1068000
2,4-Dinitrotoluene	0.17	34.58
2,6-Dinitrotoluene	0	0
Di-n-octyl phthalate	0	0
1,2-Diphenylhydrazine	1.00	13.45
Flouranthene	345000	426000
Flourene	0	0
Hexachlorobenzene	6.52	6.69
Hexachlorobutadiene	1.22	139
Hexachlorocyclopentadiene	1042	73780
Hexachloroethane	165	773
Indeno(1,2,3-cd)pyrene	0	0
Isophorone	36.82	2628
Naphthalene	0	0
Nitrobenzene	49.13	5491
N-Nitrosodimethylamine	0.00001794	0.2106
N-Nitrosodi-n-propylamine	0	0
N-Nitrosodiphenylamine	680	2176
Phenanthrene	0	0
Pyrene	0	0
1,2,4-Trichlorobenzene	0	0
Aldrin	0	0
alpha-BHC	0	0
beta-BHC	0	0
gamma-BHC	0	0
delta-BHC	0	0
Chlordane	8.04	8.32
4,4'-DDT	31.62	31.62
4,4'-DDE	31.62	31.62
4,4'-DDD	44.49	45.02
Dieldrin	0.65	0.65
alpha-Endosulfan	251	540
beta-Endosulfan	251	540
Endosulfan sulfate	251	540

SUBSTANCE	MTRL (Fresh) ug/kg	MTRL (Estuarine) ug/kg
Endrin	3000	3200
Endrin aldehyde	3000	3200
Heptachlor	2.35	2.35
Heptachlor epoxide	1.12	1.232
PCB-1242	0	0
PCB-1254	0	0
PCB-1221	0	0
PCB-1232	0	0
PCB-1248	0	0
PCB-1260	0	0
PCB-1016	0	0
Toxaphene	9.56	9.83

A 0 indicats that a MTRL could not be calculated for the chemical.

EPA recommends taht the FDA action level be used for fish contaminationif the water quality objective is exceeded (plese refer to footnote "i" in Table 4).

TABLE 4

NAS, FDA, and EPA Limits Relevant to the BPTCP
Marine Organisms
(ng/g or ppb wet weight)

Chemical	NAS Recommended Guideline[12] (whole fish)	FDA Action Level or Tolerance[13] (edible portion)	US EPA Screening Values[11] (edible portion)
Total PCB	500	2000**	10
Total DDT	50	5000	300
aldrin)	*	300**,***	-
dieldrin)	*	300**,***	7
endrin	*	300**,***	3000
heptachlor)	*	300**,***	-
heptachlor epoxide)	*	300**,***	10
lindane	50	-	80
chlordane	50	300	80
endosulfan	50	-	20,000
methoxychlor	50	-	-
mirex	50	-	2000
toxaphene	50	5000	100
hexachlorobenzene	50	-	70
any other chlorinated hydrocarbon pesticide	50	-	
dicofol	-	-	10,000
oxyfluorfen	-	-	800
dioxins/dibenzofurans	-	-	$7x10^{4}$
terbufos	-	-	1000
ethion	-	-	5000
disulfoton	-	-	500
diazinon	-	-	900
chlorpyrifos	-	-	30,000
carbophenothion	-	-	1000
cadmium	-	-	10,000
selenium	-	-	50,000
mercury	-	1000** (as methyl mercury)	600

* Limit is 5 ng/g wet weight. Singly or in combination with other substances noted by an asterisk.

** Fish and shellfish.

*** Singly or in combination for shellfish

[11]Use EPA values and references.

[12]National Academy of Sciences. 1973. Water Quality Criteria, 1972 (Blue Book). The recommendation applies to any sample consisting of a homogeneity of 25 or more fish of any species that is consumed by fish-eating birds and mammals, within the same size range as the fish consumed by any bird or mammal. No NAS recommended guidelines exist for marine shellfish.

[13]U.S. Food and Drug Administration. 1984. Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances. A tolerance, rather than an action level, has been established for PCB.

SEDIMENT CLEANUP METHODS

Each known and candidate toxic hot spot shall be evaluated to determine which technique or techniques would best remediate the hot spot. In determining the preferred remedial action(s), each RWQCB shall identify remediation techniques that are technically feasible and reasonable cost effective. Selection of the preferred alternative involves choosing the remediation option that is appropriate for the site (i.e., protective of its beneficial uses). The factor to be considered in evaluating remediation actions include:

1. Is the goal accomplished?

2. What is the cost/benefit?

3. What is the likelihood of success and the time involved?

Each of these factors must be considered with equal weight before a decision on the best remediation technique is made. While cost is an important factor, it is not the driving factor in the decision making process. Considerations include immediate and long-term costs and the cost of monitoring. An assessment of the effectiveness of treatment technologies in protecting other areas from pollution caused by the cleanup should also be provided.

Once equilibrium has been reestablished at a site after cleanup, a repeat of the bioeffects monitoring that led to the original designation as a Hot Spot is necessary. In contrast to the short term assessment of cleanup using chemical monitoring only, the combination of chemical and bioeffects monitoring represents the most complete assessment of the success of remediation efforts. It is critical, however, that this monitoring be performed within the context of a research design that is likely to clearly assess the true effectiveness of remediation. One of the most powerful designs is the before-after, control-impact (BACI) design where a set of control stations is matched to stations at the site with monitoring conducted both before and after remediation is performed. Such a design can be very expensive, not always foolproof, and difficult logistically but, if applied successfully, it can be a powerful tool in resolving conflicts over the relative costs and benefits of various site-specific remediation strategies. Once a particular strategy has been demonstrated to be effective on one of a class of sites, less expensive monitoring may be sufficient at the other sites in the class.

It must be emphasized that the remediation evaluation study should document both costs and benefits (although remediation is intended to lessen impacts on the bioeffects that led to the identification of the Hot Spot in the first place, it may have unintended negative impacts on a separate set of bioeffects). Moreover, the post-remediation evaluation study should be performed within the context of a long term, near coastal waters monitoring effort.

If a BACI design is chosen, it's important to realize that careful selection of sites for the "after" component may result in a significant cost savings. The "before" part of the design consists essentially of the confirmation phase of Hot Spot identification.

Each RWQCB shall provide a cost analysis of several treatment technologies or alternatives for comparison of the cost effectiveness of selecting various alternatives. The minimum list of alternatives to be considered follow.

1. Treatment of the site only.

   Site treatment involves the physical or chemical alteration of material. The treatment must reduce or eliminate the toxicity, mobility, or volume of contaminated material. Treatment may be either a) in-situ, or b) ex-situ. In-situ treatment requires uniform treatment and confirmation of effectiveness; however, in-situ methods generally have not been considered effective in marine sediments.

Ex-situ treatment requires a treatment area, or a dedicated site to assure effectiveness.

Types of treatment include:

- biological,
- dechlorination,
- soil washing,
- solvent extraction,
- solidification,
- incineration, and
- thermal desorption.

The treatment choice is contaminant specific. The choice depends upon the chemical characteristics of the contaminants, as well as physical and chemical characteristics of the sediments; for example, clay content, organic carbon content, salinity, and water content. Some treatment options produce by-products which require further handling. Although these technologies are currently being employed for soils, their effectiveness for use in marine sediments should be thoroughly evaluated. If the safety and effectiveness of treatment options are not well known, bench tests and pilot projects should be performed prior to authorization of the use of such treatment methods.

2. Dredging: Removal and Disposal or Reuse

Dredging may be combined with containment or offsite disposal. Selection of the method depends upon the amount of resuspension of sediments cased by the dredge at the removal site and at the disposal site. To reduce the transport of polluted sediment to other areas, silt curtains constructed of geotextile fabrics may be utilized to minimize migration of the resuspended sediments beyond the area of removal. Consideration must also be given to temporary loss of benthic organisms at the removal site and at the disposal site.

Selection of the dredging method should take into account the physical characteristics of the sediments, the sediment containment capability of the methods employed, the volume and thickness of sediments to be removed, the water depth, access to the site, currents, and waves. Consideration should also be given to placement site of the material once it is removed.

Typical dredging methods include mechanical or hydraulic dredging.

- Mechanical dredging often employs clamshell buckets and dislodges sediments by direct force. Sediments can be resuspended by the impact of the bucket, by the removal of the bucket, and by leakage of the bucket. Mechanical dredging generally produces sediments low in water content.

- Hydraulic dredging uses centrifugal pumps to remove sediments in the form of a slurry. Although less sediment may be resuspended at the removal site, sediment slurries contain a very high percentage of water at the end of the pipe.

Removal and consolidation often involves a diked structure which retains the dredged material. Considerations include:

a) construction of the dike or containment structure to assure that contaminants do not migrate,

b) the period of time for consolidation of the sediments,

c) disturbance or burying of benthic organisms,

d) Disposal to an offsite location, either upland (landfill), in-bay, or ocean. Considerations once the material has been dredged, for example Long Term Management Strategy (LTMS) for dredge disposal from San Francisco Bay.

1) staging or holding structures or settling ponds

2) de-watering issues, including treatment and discharge of wastewater,

3) transportation of dredged material, i.e., pipeline, barge, rail, truck,

4) regulatory constraints.

3. Containment

Containment can prevent human or ecological exposure, or prevent migration of contaminants. containment can be either in-place capping, or removal and consolidation at a disposal structure. Containment options such as capping clearly reduce the short-term exposure, but require long-term monitoring to track their effectiveness.

California does not have a consistent procedure for choosing the capping alternative at sediment sites.

The process for stabilization of sites using sub-aqueous capping to contain toxic waste at a site would be to follow the basic three-step approach and apply the criteria shown in USEPA 893-B-93-001 report, Selection of Remediation Techniques for Contaminated Sediment. This federal remediation document provides a list of performance considerations to test whether clean sediments consisting of sands and silts can be used to effectively contain the waste, either at the present location or at some other location. The list includes, in part:

a. Capping provides adequate coverage of polluted sediments and capping materials can be easily placed.

b. The integrity of the cap must be assured to prevent burrowing organisms from mixing of polluted sediments (bioturbation)

c. The ability of the contaminated sediment to support the cap, i.e. causing settlement or loading.

d. The bottom topography causing sloping or slumping of the capped material during seismic events.

e. Cap erosion or disruption by currents, waves, bioturbation, propeller wash, or ship hulls.

f. Future use of capped area, i.e. shipping channel.

Another consideration is presented in the EPA document concerning whether the no-action alternative would accomplish the same end as capping the site; however, this consideration should be considered as the last alternative as discussed under Process for choosing the no-remediation alternative.

In addition, if sub-aqueous capping is considered, provide a detailed assessment containing a discussion of all of these topics:

i. Point source discharges have been halted.

ii. The costs and environmental effects of moving and treating polluted sediment are too great.

iii. Suitable capping materials are available.

iv. Hydrologic conditions will not disturb the site.

v. The sediment will not be remobilized by human or natural activities.

vi. The bottom will support the cap.

vii. The area is amenable to dredging.

viii. Polluted sediments will not spread.

ix. The site will be noted on appropriate maps, charts, and deeds to document the exact location of the site.

4. No Remediation

This alternative consists of two elements, the first is known as institutional or access controls, or "natural remediation". For example, posting of warning signs, or monitoring of water, sediments, or organisms. Typically, would be protective of human health by providing warning signs for fishing, etc, but not protective of aquatic life. Is typically used to confirm that a remedial action has been achieved or to monitor the effectiveness of the remedy.

The second, is also known as the "no-action alternative". If by no action, the hot spot is to be left in place, because to move it, or to disturb it in any way would be detrimental, then this is an option. This would have to be proven beyond any doubt, and would not be "an easy way out" of dealing with a hot spot.

The approach suggested here contrasts with the federal approach in which the no-action alternative is considered first. It is proposed that in California the no-remediation/no-action alternative be considered only after all other alternatives have been studied. State Board Resolution 92-49 (as amended) requires that regional boards compel dischargers to clean up wastes to protect beneficial uses (III.G.). Resolution 92-49 also requires regional boards to consider "Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement..." (IV.D.).

An appropriate procedure to comply with Resolution 92-49 would be to follow the proposed three-step process and consider certain additional criteria. The following list of criteria was adapted from the sub-aqueous capping section the federal remediation selection guidance: 1) Point source discharges have been halted. 2) The costs and environmental effects of moving and treating polluted sediment are too great. 3) Hydrologic conditions will not disturb the site. 4. The sediment will not be remobilized by human or natural activities, such as by shipping activity or bioturbation.

Three additional criteria are recommended for protection of public health and aquatic life: 5. Notices to abandon the site have been issued to appropriate federal, state, and local agencies and to the public. 6. The exact location of the site and a list of chemicals causing the toxic hot spot and their quantities are noted on deeds, maps, and navigational charts. 7. A monitoring program is established to measure changes in discharge rates from the site.

To assure protection of beneficial uses, and compliance with Resolution 92-49, it is recommended that the State Board follow the three-step process and apply the seven criteria suggested above, in which the no-remediation/no-action alternative is considered only after all other alternatives have been considered.

If a no-remediation alternative is considered, provide an assessment of the geographic extent of the pollution, the depth of the pollution in the sediment, compelling evidence that no treatment technologies should be applied and that only the no-remediation alternative is feasible at the site, and a cleanup cost comparison of all other treatment technologies versus the no-remediation alternative.

If a no-remediation alternative is considered, the following information should be provided:

1. Sources of pollution which caused the toxic hot spot to exist

2. Detailed monitoring program, specifying the duration of the monitoring, and all organizations which will carry it out

3. Monitoring program which will show whether rates of pollutant release and the area of influence of the pollutants are not accelerating

4. Detailed assessment containing proof that all of the following statements are true:

    a. Pollutant discharge has been halted

    b. Burial or dilution processes are rapid

    c. Sediment will not be remobilized by human or natural activities

    d. Environmental effects of cleanup are more damaging than leaving the sediment in place

    e. Uncontaminated sediments from the drainage basin will integrate with polluted sediments through a combination of dispersion, mixing, burial, and/or biological degradation

    f. Polluted sediments at the site will not spread

    g. The site will be noted on appropriate maps, charts, and deeds to document the exact location of the site.

For no-remediation alternatives, a detailed and exact map of the area will be provided to the US Army Corps of Engineers, US Coast Guard, National Oceanographic and Atmospheric Administration, Coastal Commission, State Lands Commission, and harbor authorities to be included on official navigational charts and other maps to document the exact location of the site and the depth of the site and the pollutants encountered.

For no-remediation alternatives, the US Army Corps of Engineers, US Coast Guard, local harbor authorities, county health officer, California Coastal Commission, State Lands Commission, and State and federal fish and wildlife agencies will be provided with notice of intent to abandon the site and detailed information on the site including: all pollutants known or suspected, concentrations of pollutants, estimate of the total amount of pollutants, potential hazards to human health due to pollutants, potential toxicity and bioaccumulation potential in sport or commercial fish and shellfish. Notification to these other agencies will occur 180 days prior to a decision.

The process for choosing the no-remediation alternative at a site is as follows:

Follow the basic approach and apply the criteria shown in the USEPA Remediation Technique report. Also consider no remediation only if compelling evidence exists that no remediation is needed and that all other treatment options have been considered, cause the site to be noted on deeds and charts and notify all organizations of the intent to abandon the site.

SEDIMENT CLEANUP COSTS

Total costs for various remedial technologies is dependent upon many factors, some of the most important being contaminant concentration, cleanup level, physical characteristics of the sediment, and the volume of material to be remediated. In addition, overall costs of remediation will also include monitoring to evaluate the effectiveness of cleanup. Due to the large number of variables associated with remedial actions, the costs for any cleanup will be project specific. The following table are estimates of the various costs associated with several cleanup methods. The quotes listed should not be considered as absolute prices for specific remediation methods.

RWQCBs shall use either the estimates in Table 5 or obtain current estimates of cleanup costs. Currently agencies, such as US EPA, or other organizations publish documents on various aspects of contaminated sediment management. In some cases, the costs associated with remedial technologies are included, and may be either an estimate of a range of costs for a specific technology or are cited from actual case studies. Using these references to obtain cost estimates for a specific project is useful to get a sense of the magnitude of the expenditures involved. However, these references may not itemize the costs for equipment or materials necessary to carry out the project or may not segregate materials form labor costs. The costs for materials or labor will vary depending upon the size or scope of the project; vendors may charge an incrementally lower cost for a larger project. In some cases, costs for treatment technologies are based on pilot or bench scale projects and have not been proven for full scale. Most companies performing the work will charge mobilization and contingency costs.

The RWQCBs may obtain two or three direct quotes from reliable companies. Obtaining direct quotes assures that all aspects of the project are included in the final estimate. These will also help refine the remedial design and the selection of the technology. For instance, selecting the appropriate type of dredging method, designing the appropriate type of containment structure, determining the method for transport of dredged sediments, or selecting the type of pretreatment or effluent treatment methods. Obtaining two or three estimates will allow a more realistic comparison of the cost versus benefit of the selected alternative.

Table 5

Estimated Cost Ranges for Sediment Remediation

Alternatives	Volume	Cost
I. Removal		
A. mechanical		
1. dipper[4]	1 cu	$1 - 25
2. bucket ladder[4]	"	$1 - 25
3. dragline[4]	"	$1 - 25
4. clamshell[2]	1 cy	$10 labor
B. hydraulic		
silt screen[3]	10,000 sf	$30,000 mat/labor
1. plain suction[2,3]	1 cy	$7 - 10 labor
2. cutterhead[4]	1 cy	$7 - 10
3. dustpan		
C. pneumatic[4]	1 cy	>$10
II.	Transport (may depend upon if hazardous waste, and will affected by dredge and treatment selection)	
A. pipeline	TBD	TBD
B. barge[4]	TBD	TBD
C. rail[3] (includes 1500 miles of transporation and upland disposal of non-hazardous contaminants)	1 Ton	$53
D. truck[2]	1 cy	$200

Table 5
(Continued)
Estimated Cost Ranges for Sedient Remediation

Alternatives		Volume	Cost
III.	Pre-Treatment		
A.	dewatering pumping[3]	1 cy	$0.05 labor
1.	air drying		
	a. construct upland drying area	(size dependent)[2]	$5,000 labor
	wick drains, subdrain blanket[3]	1 sf or lf	$1 materials
	b. condition dredged sediment[3]	1 cy	$4 - 7 mat/labor
2.	mechanical		
	a. filtration[5b]	1 cm	$6
	b. centrifuge[7]	1 cm	<$6
	c. gravity thickening[7]	1 cm	<$6
B.	particle classification: for #2, 3, 4, and 5 below[5b] (sorting and separating)	1 cy	$6 - 100
	1. impoundment basins	1 cy	$6 - 100
	2. hydraulic classifiers	1 cy	$6 - 100
	3. hydrocyclones	1 cy	$6 - 100
	4. grizzlies	1 cy	$6 - 100
	5. screens	1 cy	$6 - 100

Table 5
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives		Volume	Cost
	C. slurry injections (may overlap with other treatment technologies)		
	1. chemicals	TBD	TBD
	2. nutrients	TBD	TBD
	3. microorganisms	TBD	TBD
IV.	Treatment (in some cases, costs associated with any particular treatment will be dependent upon contaminant concentration and cleanup levels required. Some of these technologies have been performed on sediments at the bench or pilot scale only, and are not proven for full scale.)		
	A. biological		
	1. biodegradation/bioremediation[5b]	1 ton	$25 - 100
	B. physical		
	1. solidification/stabilization[5]	1 cy	< $100
	C. chemical		
	1. chelation, chemical hydrolysis, detoxification[5a]	1 cy	$200 - 300
	2. solvent extraction[5b]	1 ton	$50 - 150
	3. electrokinetic soil washing[5b]	1 cy	$100 - 300

Table 5
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives			Volume	Cost
	D.	thermal		
		1. rotary kiln incineration[1]	< 6,700 cy	$675 - 2,025
			6,750 - 20,250 cy	$405 - 1,215
			20,250 - 40,500 cy	$270 - 810
			> 40,500 cy	$135 - 540
		2. cyclone furnace vitrification[5b]	1 ton	$450 - 530
		3. fluid bed incineration[5b]	1 ton	$50 - 175
V.	Disposal			
	A.	onsite upland[6] (includes unspecified dredging method **and** disposal)	1 cy	$3 - 4
	B.	offsite land		
		wetlands creation[6]	1 cy	$10 - 20
		class I disposal facility[5] (does not include hazardous waste generator fees)	1 ton	$200 - 300
		class II disposal facility[5]	1 ton	$55 - 65
		class III disposal facility[5]	1 cy	$30 - 40
	C.	aquatic		
		1. confined	TBD	TBD

Table 5
(Continued)
Estimated Cost Ranges for Sediment Remediation

Alternatives			Volume	Cost
2.	unconfined			
	a.	in-bay[6] (includes unspecified dredging method **and** disposal)	1 cy	$2 - 3
	b.	in-bay[6] (includes clamshell dredging **and** disposal)	1 cy	$1 - 8
	c.	ocean[6] (includes unspecified dredging method **and** disposal)	1 cy	$5 - 9

VI. Effluent/Leachate Treatment

		Volume	Cost
A.	set up carbon absorption system[2,3] (for organics: does not include O&M)	1 system	$25,000 -30,000 mat/labor

VII. Monitoring/Operation and Maintenance/Miscellaneous

		Cost
1.	surface water sampling and chemical analysis (chemical specific)	TBD
2.	sediment sampling and chemical analysis (chemical specific)	TBD
3.	biological monitoring (receptor specific)	TBD
4.	mobilization/demobilization	TBD

Table 5
(Continued)
Estimated Cost Ranges for Sediment Remediation

<u>References:</u>

[1] US EPA Office of Research and Development, *Contaminated Sediments Seminar* CERI-91-19, May 1991

[2] *Feasibility Study for the United Heckathorn Site, Richmond, California*, prepared by Levine Fricke - Emeryville, California, January 11, 1991

[3] *Feasibility Study for the United Heckathorn Superfund Site, Richmond, California*, prepared by Batelle/Marine Sciences Laboratory, Sequim, Washington, July 1994

[4] US EPA Office of Water, *Selecting Remediation Techniques for Contaminated Sediment* EPA-823-B93-001, June 1993

[5] Draft Report - Long-Term Management Strategy, *Analysis of Remediation Technologies for Contaminated Dredged Material*, prepared by Gahagan & Bryant Associates, Inc., Novato California in association with ENTRIX, Inc. Walnut Creek, California, October 25, 1993 (includes review and analysis of other documents:

[a] Texas A & M *Proceedings of 25th Annual Dredging Seminar*;

[b]*Sediment Treatment Technologies Database (SEDTEC)*, 2nd edition; Site Remediation Division, Wastewater Technology Centre, operated by Rockcliffe Research Management, Inc.) - submitted by technology developers and vendors from around the world;

[6] Long-Term Management Strategy Dredging Costs Survey for San Francisco Bay, Tom Gandesbery, RWQCB Region 2, personal communication June 1994

[7] US EPA Office of Research and Development, Handbook/Remediation of Contaminated Sediments, EPA/625/6-91/028, April 1991.

Estimated Cost Ranges for Sediment Remediation

EXPEDITED CLEANUP PROCESS

As the Regional Toxic Hot Spot Cleanup Plans are being developed by the RWQCBs, it may be in the best interests of potential responsible parties to begin full or partial remediation of the identified Toxic Hot Spot. In such case the RWQCBs are encouraged to accommodate the potential responsible party by assisting the PRP in implementing a site-specific cleanup plan. This expedited process does not excuse the RWQCB from including the toxic hot spot or the responsible party in the Regional Cleanup Plan.

The components of an expedited process could include:

1. Site is found to be a Candidate or Potential Toxic Hot Spot.

2. Development of a proposal for remediation by the responsible party (parties) that includes timelines for remediation.

3. Review of the proposal by the RWQCB and approval to implement.

4. Implementation of site-specific cleanup plan by the responsible party (parties).

5. RWQCB and responsible party evaluation of the effectiveness of the remediation

6. Site closure or further action.

PREVENTION OF TOXIC HOT SPOTS

In the process of developing strategies to prevent toxic hot spots, the RWQCBs should focus on designs that accomplish the following:

1. Consider use of any established prevention tool such as (a) voluntary programs, (b) Interactive cooperative programs, and (c) Regulatory programs, individually or in any combination that will result in an effective THS prevention strategy

2. Promote a watershed management protection approach focused on hydrologically defined areas (watersheds) rather than areas defined by arbitrary political boundaries (counties, districts, municipalities), that take into account all waters, surface, ground, inland, and coastal and address point and nonpoint sources of pollution that may have influence or has been identified to have influenced the identified Toxic Hot Spots.

3. Welcomes the participation and input of, interdisciplinary groups of interested parties (including all potential responsible

parties) able to cross over geographical and political boundaries to develop effective solutions for preventing Toxic Hot Spots.

4. develops prevention strategies with enough flexibility to be used as watershed protection plans where there is non established or have the ability to meld with a watershed protection plan that is already in force to address THS. Solutions developed should also be developed for, and applied at sites where it will do the most prevention and where it will be the most cost-effective at mitigating and preventing toxic hot spots at a watershed level.

PROGRAM OF IMPLEMENTATION

This section of the policy establishes deadline for the completion of the Toxic Hot Spot Cleanup Plan and for implementation of other sections of the Water Quality Control Policy.

The schedule and products to be completed are listed in Table 10.

Table 6

Schedule for the Development of Toxic Hot Spot Cleanup Plans

Activity	Schedule 1995	1996	1997	1998	1999
A. Report on identifying pollutant sources	(due 6 months after Policy adoption) --------------------X				
B. Report of identifying potential responsible parties.	(due 9 months after Policy adoption) -------------------X				
C. Report on development of Cleanup Plans (with assistance of interested parties).	(due 12 months after Policy adoption) -------------X				
D. Draft Cleanup Plan (Available for RWQCB hearing)		X			
E. Submission of the Adopted Regional Cleanup Plan			X		
F. Approval by the SWRCB			X		
G. Draft Statewide Cleanup Plan (Prepared with the advise of the BPTCP Advisory Committee)			X		
H. Completion of Final Statewide Cleanup Plan.				X	
I. Submittal of the Statewide Cleanup Plan to the Legislature.				X	

Implementation of Narrative Sediment Quality Objectives

The narrative sediment quality objectives should be implemented in three ways: (1) to evaluate the overall quality of water body, (2) to develop effluent limitations, and (3) to trigger the need for determining further actions (e.g., cleanup levels in toxic hot spot cleanup plans, additional site characterization, etc).

Narrative sediment quality objectives provide a means for evaluating the overall quality of a waterbody. Data from ambient sampling, collected either as part of ongoing monitoring programs or surveillance activities, should be compared to sediment quality objectives to determine if, in part, impairment is occurring. If appropriate, corrective actions can be undertaken as part of a toxic hot spot cleanup plan or through modification or issuance of waste discharge requirements. These narrative objectives should also be used in assessing if a site is a toxic hot spot (refer to the definition for candidate and known toxic hot spot).

The second use of sediment quality objectives is for the development of control measures including effluent limitations which are enforceable limits placed on individual dischargers and nonpoint source controls including the implementation of Best Management Practices (BMPs). Effluent limits define the contributions of pollutants allowable from a particular discharge. Effluent limitations also establish long term planning goals in the design of facilities and for the evaluation of best management practices and nonpoint source control measures. Established methods for the translation of sediment quality objectives into effluent limitations do not currently exist and the Regional Boards should use best professional judgement when establishing an effluent limit based on a narrative sediment quality objective. Regional Boards are not required to develop effluent limits to implement narrative sediment quality objectives unless there is substantial evidence that there is a substance in sediments that is impacting beneficial uses.

The third use of the sediment quality objective is for the development of cleanup levels or to study the areal extent of sediment pollution at a toxic hot spot or other known or suspected polluted site. These uses of narrative sediment quality objectives is described in the Cleanup Section of this policy.

Establishment of Cleanup Levels

Establishment of cleanup level by the RWQCBs shall be a step-wise process based on the amount of information available for a site or water body. RWQCBs shall evaluate the following options:

1. A Cleanup Level set at Background levels.

2. A Cleanup levels set at ambient levels in the specific water body.

3. A cleanup level set at the no Observed Effect Concentration (NOEC) for the specific pollutant of concern.

4. A Cleanup level should be set at the Apparent Effects Threshold for the available information collect from the water body. In lieu of meeting the AET if biological effects are absent the site could be considered cleaned up.

5. A Cleanup Level should be set at the ERM, PEL or EPA sediment quality criteria (if available).

If information are not available to develop each cleanup level the RWQCB may elect not to develop the cleanup level for the purposes of the Regional Cleanup Plan or may solicit the assistance of the potential responsible party (if identified).

In each case if an alternate cleanup level does not make sense, does not protect beneficial uses or does not implement water or sediment quality objectives contained in the Policy or other SWRCB and RWQCB plans or policies (including SWRCB Resolutions 68-16 and 92-49), the cleanup level shall be rejected from consideration. The RWQCB shall select the most reasonable cleanup level alternative.

SITE-SPECIFIC VARIANCES

A site-specific variance allows an alternate approach for developing a cleanup plan for one or more sites within the jurisdiction of the Regional Water Board. Application of a site-specific variance shall be made by a Regional Water Board to the State Water Resources Control Board.

An application for a site-specific variance shall include but not limited to:

1. A description of the provision from which the variance is requested.

2. A detailed description of the approach to be used. The proposed alternative program, method, or process shall be clearly identified.

3. Any specific circumstances on which the Regional Water Board relies to justify the finding necessary for the variance.

4. Clear and convincing evidence that the alternative approach will better protect beneficial uses.

5. Documentation that shows compliance with the California Environmental Quality Act.

   The Regional Board shall hold a hearing on the site-specific variance application. The Regional Water Board shall notify all interest parties and responsible parties of the hearing. Subsequent the hearing, the Regional Board shall submit the revised application to the Sate Water Resources Control Board for approval.

BIOLOGICAL METHODS TO ASSESS TOXIC HOT SPOTS

The tests below shall be used to measure water and sediment toxicity. Other tests may be added to the list as deemed appropriate by the State or Regional Water Boards provide the tests have a detailed written written description of the test method; Interlaboratory comparisions of the method; Adequate testing with water, wastewater, or sediments; and measurement of an effect that is clearly adverse and interpretable in terms of beneficial use impact.

Table 7

Water and Sediment Toxicity Tests That Meet the Criteria For Acceptability

Type of Toxicity Test	Organism Used: Common Name	Organism Used: Scientific Name	Reference
Solid Phase Sediment	Amphipod	Rhepoxinius	ASTM, 1993
	Amphipod	Eohaustorius	ASTM, 1993
	Amphipod	Ampelisca	ASTM, 1993
	Amphipod	Hyalella	ASTM, 1993
	Polychaete	Neanthes	Johns et. al., 1990
Sediment Pore Water	Bivalve larvae	Crassostrea	ASTM, 1993
		Mytilus	ASTM, 1993
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongy-locentrotus	Dinnel et al., 1987; 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	Horning and Weber, 1985
Ambient Water	Bivalve larvae	Crassostrea	ASTM, 1993
		Mytilus	ASTM, 1993
	Abalone larvae	Haliotis	Anderson et al., 1990
	Echinoderm fertilization	Strongylocen-trotus	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	Horning and Weber, 1985

SCREENING SITES AND CONFIRMING TOXIC HOT SPOTS

In order to identify known toxic hot spots a two-tier process shall be used. The first tier is a screening step where a suite of toxicity tests is used at a site. Sediment grain size, total organic carbon (TOC) and H_2S concentration are measured to differentiate pollutant effects found in screening tests from natural factors. Chemical analyses (metals and organics) will be performed on a subset of the screening samples.

If effects are found at sites by these screening steps, the sites will be retested to confirm the effects. In the confirmation step measurements will be replicated (if needed) and compared to reference sites. Chemical measurements (metals, organics, TOC, H_2S) and other factors (e.g., sediment grain size) will be measured. Measurements of benthic community structure and, if needed, bioaccumulation will also be made.

A Battery of Screening Tests

Selecting a battery of toxicity screening tests can improve cost-effectiveness by expanding the range of potential impacts to be evaluated. Although recurrent toxicity must be demonstrated to qualify a site as a "candidate" toxic hot spot, the degree of certainty for each of the measurements does not necessarily have to be equivalent. The cost of 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 the site.

Even though the list of acceptable tests is long (see Table 7 above), the State and Regional Water Boards should evaluate the use of the following tests first (Table 8).

Table 8

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/or anaphase aberration
Neanthes (Polychaete worm)	Bedded sediment	Survival and growth

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 or pore 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, and reproductive success 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.

Site Selection

Regional Monitoring Designs

Three somewhat different designs are used in BPTCP monitoring. Six of the coastal RWQCBs have used a design (summarized in Table 9 and Table 10) that combines toxicity testing, chemical analysis, and benthic community analysis in a two-phased screening-confirmation framework (Table 10).

The Central Valley RWQCB, 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 (metals and pesticides) constitutes the main program components. Sediment toxicity testing could be added to the monitoring design at a later stage.

Table 9

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 (see Table 5)	Repeat of positive results
Field replicates	None	Three (if needed)
Lab replicates	Five	Five
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	Occasionally (sites with no pre-existing bioaccumulation data)

Table 10

Sequence of Tasks for Designating Toxic Hot Spots

1. Select toxicity screening sites.
2. Sample screening sites.
3. Conduct battery of four 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 quality assurance requirements have been met.
9. Report on Items 7 and 8.
10. Select sites and toxicity tests for confirmation and reference sites.
11. Sample confirmation and reference sites.
12. Conduct subset of the battery of toxicity tests which were screening hits; analyze for hydrogen sulfide, TOC, and 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 program: (1) potential toxic hot spots base on existing information, (2) high risk sites based on existing information, (3) stratified random sites, and (4) reference sites. Potential toxic hot spots are the highest priority sites because some indication already exists that these sites have a pollution-related problem. These data are typically sites with information available on chemical contamination of mussel tissue, data documenting water and sediment toxicity, measurements of metals or organic chemicals in sediments, and, occasionally, biological impairment. These sampling efforts are typically point estimates.

There are many other sites that are considered "high risk" even though we have no monitoring information to support this contention. High risk sites are locations where a nearby activity (such as marinas, storm drains, and industrial facilities) are thought to be associated with a certain risk of toxicity. The measurements at high risk sites are either point estimates or selected probabilistically.

When little is known about the quality of a waterbody segment, the monitoring efforts should use 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 for the State and Regional Water Boards to make better estimates of area (percentage) of water bodies that is impacted. The State and Regional Water Boards shall consider the use the techniques used by the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program.

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 are reviewed. Since these sources yield an insufficient number of sites, fine-grained areas presumed to be relatively free of contamination are also examined. These sites may likewise prove to be rare, so sites with chemicals present, but experiencing low energy tidal flushing, will also be sampled. Sites with previous indication of no pollution, and those lacking sediment toxicity measurements will also be sampled. Finally, random selection of sites (as described above) may prove useful in locating reference sites.

Toxicity Screening

All tests will 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 the collection of a single field sample from each site (Table 10, Steps 1 and 2). Five laboratory replicates are 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 8, Step 3) to determine their relative contribution to any observed toxic affects. 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 after conducting confirmation testing (Table 10, Steps 4-9). 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.

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

With the identification and sampling of acceptable reference sites, all screening sites (Table 10, Steps 10 and 11) with at least one positive test result will be revisited 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 present or absent. Confirmation testing is more intensive because of (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 for the same test. 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 non-impacted sites can be distinguished (Table 10, 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 10, 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 appear to be due to human-causes 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. Similarly, when toxicity is not demonstrated but benthic impacts are observed, 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 (such as areal extent, range of effects, and source determination) will be described in the cleanup plan and is not intended (unless samples are collected using a random or stratified random design) under this phase of the program.

DEFINITIONS

ADVISORY LEVEL: a level of chemical contamination in seafood tissue found to be a significant potential human health threat based on a risk assessment of adequate tissue contamination data from a specific waterbody. Fish tissue levels are the most common data used when issuing consumption advisories for water bodies. Existing advisory levels for a water body could be applied to specific stations and used to designate toxic hot spots. Cleanup levels might not be the same as advisory levels.

ENCLOSED BAYS means indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works (refer to Water Code Section 13391.5(a) for complete definition).

ESTUARIES means waters, including coastal lagoons, located at mouth of streams which serve as areas of mixing for fresh and ocean waters (refer to Water Code Section 13391.5(b) for complete definition). Coastal lagoons and mouths of streams which are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters a re considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and sea water.

MIGRATORY FISH: Fish species that move between water bodies seasonally or at different life stages. They may move between water bodies to follow favorable feeding or water conditions, or over periods associated with reproductive cycles. These do not make good target species for tissue sampling because the type and concentration of chemicals in tissue is potentially accumulated or diluted in part from sites far removed from where the species is sampled.

MAXIMUM TISSUE RESIDUE LEVELS (MTRLS): tissue level of chemical contaminants in fish or seafood that fully protects beneficial uses. MTRLs are calculated from water quality objectives or water quality criteria intended to protect human health. MTRLs are calculated by multiplying the bioconcentration factor for a chemical by the chemical's water quality criterion or water quality objective.

NON-MIGRATORY FISH SPECIES are fish species that do not move between water bodies seasonally or at different life stages. These species are good targets for tissue sampling because the chemicals present in tissue are accumulated from a more restricted area.

OCEAN WATERS are the territorial marine waters of the State as defined by California law to the extent these waters are outside enclosed bays and estuaries as well as adjacent waters in the "contiguous zone" or "ocean" defined in Section 502 of the Clean Water Act (33 U.S.C. 1362).

ORPHAN SITE is defined as a known or candidate toxic hot spot site or station of any area in a water body that the RWQCB can not locate, assign, or determine a potential responsible party. In some cases the RWQCB may not be able to assign a portion of the potential responsibility for a site. In such a case the RWQCB shall determine the portion of the site to identified potential responsible party (Parties) and the remainder of the problem shall become an orphan site.

POTENTIAL RESPONSIBLE PARTY is defined (Section 107(a) of CERCLA) as:

1. The owner and operator of a vessel or facility,

2. Any person who at the time of disposal of any hazardous substance owned or operated any facility at which such hazardous substance were disposed of,

3. Any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances, and

4. Any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities, incineration vessels or sites selected by such person, from which there is a release, or a threatened release which causes the incurrence of response costs, of a hazardous substance.

SHELLFISH are organisms identified by the California Department of Health Services as shellfish for for public health purposes (e.g., edible bivalve species or crustacean species such mussels, clams, oysters, and crabs). These species typically have limited mobility. This makes them good sampling targets for detection and identification of local chemical contaminants.

SITE: an area with two or more adjacent stations whose toxicity, benthic community, and/or chemical concentrations are similar or complimentary.

STATION: the discrete point at which media samples are collected.

ENVIRONMENTAL CHECKLIST FORM

I. Background

1. Name of Proponent State Water Resources Control Board

2. Address and Phone Number of Proponent Division of Water Quality, P.O. Box 944213 Sacramento, CA 94244-2130 (916) 657-1108 Craig J. Wilson (Bays and Estuaries Unit)

3. Date Checklist Submitted ____________

4. Agency Requiring Checklist Resources Agency

5. Name of Proposal, if applicable: Development of a Water Quality Control Policy for the Implementation of the Bay Protection and Toxic Cleanup Program

II. Environmental Impacts

(Explanations of all "yes" and "maybe" answers are required on attached sheets.)

	Yes	Maybe	No
1. Earth. Will the proposal result in:			
a. Unstable earth conditions or in changes in geologic substructures?			X
b. Disruptions, displacements, compaction, or overcovering of the soil?		X	
c. Change in topography or ground surface relief features?		X	
d. The destruction, covering, or modification of any unique geologic or physical features?		X	
e. Any increase in wind or water erosion of soils, either on or off the site?		X	
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition, or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet, or lake?		X	
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?			X
2. Air. Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?		X	
b. The creation of objectionable odors?		X	
c. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?			X

	Yes	Maybe	No
3. Water. Will the proposal result in:			
a. Changes in currents, or the course of direction of water movements, in either marine or fresh waters.		X	
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?		X	
c. Alterations to the course or flow of flood waters?		X	
d. Change in the amount of surface water in any waterbody?		X	
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen, or turbidity?	X		
f. Alteration of the direction or rate of flow of ground waters?			X
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?			X
h. Substantial reduction in the amount of water otherwise available for public water supplies?			X
i. Exposure of people or property to water-related hazards such as flooding or tidal waves?			X
4. Plant Life. Will the proposal result in:			
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?		X	
b. Reduction of the numbers of any unique, rare, or endangered species of plants?		X	
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?			X
d. Reduction in acreage of any agricultural crop?			X
5. Animal Life. Will the proposal result in:			
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish, and shellfish, benthic organisms, or insects)?		X	
b. Reduction of the numbers of any unique, rare, or endangered species of animals?		X	

		Yes	Maybe	No
	c. Reduction of the numbers of new species of animals into an area, or result in a barrier to the migration or movement of animals?		X	
	d. Deterioration to existing fish or wildlife habitat?		X	
6.	Noise. Will the proposal result in:			
	a. Increase in existing noise levels?		X	
	b. Exposure of people to severe noise levels?		X	
7.	Light and Glare. Will the proposal produce new light or glare?			X
8.	Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?		X	
9.	Natural Resources. Will the proposal result in:			
	a. Increase in the rate of use of any natural resources?		X	
	b. Substantial depletion of any nonrenewable natural resource?			X
10.	Risk of Upset. Will the proposal involve:			
	a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals, or radiation) in the event of an accident or upset conditions?		X	
	b. Possible interference with an emergency response plan or an emergency evacuation plan?			X
11.	Population. Will the proposal alter the location distribution, density, or growth rate of the human population of an area?			X
12.	Housing. Will the proposal affect existing housing, or create a demand for additional housing?		X	
13.	Transportation/Circulation. Will the proposal result in:			
	a. Generation of substantial additional vehicular movement?			X
	b. Effects on existing parking facilities or demand for new parking?			X
	c. Substantial impact upon existing transportation systems?			X
	d. Alterations to present patterns of circulation or movement of people and/or goods?			X

	Yes	Maybe	No
e. Alterations to waterborne, rail, or air traffic?			X
f. Increase in traffic hazards to motor vehicles, bicyclists, or pedestrians?			X
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
a. Fire protection?			X
b. Police protection?			X
c. Schools?			X
d. Parks or other recreational facilities?			X
e. Maintenance of public facilities, including roads?			X
f. Other governmental services?		X	
15. Energy. Will the proposal result in:			
a. Use of substantial amounts of fuel or energy?		X	
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?		X	
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:			
a. Power or natural gas?			X
b. Communication systems?			X
c. Water?			X
d. Sewer or septic tanks?		X	
e. Storm water drainage?		X	
f. Solid waste and disposal?		X	
17. Human Health. Will the proposal result in:			
a. Creation of any health hazard or potential health hazard (excluding mental health)?		X	
b. Exposure of people to potential health hazards?		X	
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?		X	
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?		X	

		Yes	Maybe	No
20.	Cultural Resources.			
	a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site?		X	
	b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?		X	
	c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?		X	
	d. Will the proposal restrict existing religious or sacred uses within the potential impact area?		X	
21.	Mandatory Findings of Significance.			
	a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?		X	
	b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time, while long-term impacts will endure well into the future.)			X
	c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)		X	
	d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?		X	

III. Discussion of Environmental Evaluation
(See main body of report.)

IV. Determination

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment, and a FUNCTIONAL EQUIVALENT DOCUMENT equivalent to a NEGATIVE DECLARATION will be prepared. ____

I find that although the proposed could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A NEGATIVE DECLARATION WILL BE PREPARED. ____

I find the proposed project MAY have a significant effect on the environment and a Functional Equivalent Document equivalent to an ENVIRONMENTAL IMPACT REPORT will be prepared. __X__

______________ Date

______________________________ Signature

For State Water Resources Control Board

1b, 1c, 1d, 1e, 1f, 2a, 2b, 3a, 3b, 3c, 3d, 4a, 4b, 5a, 5b, 5b, 5c, 5d, 6a, 6b, 8, 9a, 10a, 12, 14f, 15a, 15b, 16d, 16e, 16f, 17a, 17b, 18, 20a, 20b, 20c, 20d, 21a, 21c, 21d.

It is extremely difficult to determine the impacts of the Policy on responsible parties and dischargers. The Policy will be used by the Regional Water Quality Control Boards to consistently implement the Bay Protection and Toxic Cleanup Program. Site-specific impacts will be assessed when the RWQCBs develop regional toxic hot spot cleanup plans. The Policy allows for some flexibility in developing the regional plans to account for site-specific circumstances.

It is possible that some responsible parties and dischargers may take steps to comply with the requirements of the Policy and resulting cleanup plans that would result in these secondary impacts. It is too speculative to be able to anticipate at this time what, if any, such projects would be proposed and what their impacts might be. It is also impossible to identify at this time what mitigation measure would be necessary to minimize these possible impacts.

3e. The Policy will improve water and sediment quality.

4a.& 5a. The Policy should increase the diversity of species and/or species abundance of plants or animals because the quality of water and sediment will improve.

19. The plan amendment should improve the quality and quantity of existing recreational opportunities that are dependent on surface water since the plan will improve water and sediment quality.

NOTICE OF FILING

TO: Any Interested Person **FROM:** State Water Resources Control Board
P.O. Box 944213
Sacramento, CA 94244-2130

SUBJECT: Notice of Filing Submitted Under Section 21080.5 of the Public Resources Code

Project Proponent: State Water Resources Control Board

Project Title: Development of the Water quality Control Policy for Implementation of the Bay Protection and Toxic Cleanup Program

Contact Person: Jody Guro (916) 657-0808

Project Location: The enclosed bays, estuaries and coast line of California

Project Description: Adoption of a new water quality control policy for the implementation of the Bay Protection and Toxic Cleanup Program (California Water Code Sections 13390 et seq.).

This is to advise that the State Water Resources Control Board is going to consider the adoption of a new Water Quality Control Policy for implementation of the Bay Protection and Toxic Cleanup Program. Action on the proposed Policy will be taken in accordance with a regulatory program exempt, under Section 21080.5 of the Public Resources Code, from the requirement to prepare an environmental impact report under the California Environmental Quality Act (Public Resources Code Section 21000 et seq.) and under other applicable laws and regulations.

A Functional Equivalent Document including a Environmental Checklist Form including reasonable alternatives and feasible mitigation measures to minimize any significant adverse environmental impacts will be distributed on ____________________, 1995, and may be obtained at that time from the Contact Person named above.

Comments on the proposed amendments should be submitted by ______________, 1995.

Signed: ____

Date: ____

STATE WATER RESOURCES CONTROL BOARD
PAUL R. BONDERSON BUILDING
901 P STREET
P.O. BOX 100
SACRAMENTO, CALIFORNIA 95812-0100
(916) 657-1108

APPENDIX D

NOTICE OF PUBLIC HEARING

WATER QUALITY CONTROL POLICY
FOR IMPLEMENTATION OF
REGIONAL AND STATEWIDE
TOXIC HOT SPOTS CLEANUP PLANS

(Date)

First-Floor Hearing Room
Paul R. Bonderson Building
901 P Street, Sacramento

NOTICE IS HEREBY GIVEN that the State Water Resources Control Board (SWRCB) proposes to adopt water quality control policy for implementation of the Regional and Statewide Toxic Hot Spot Cleanup Plans. The proposed policy document will set the general format ground rules, describes each cleanup plan document component, defines terms and provide general guidance on the preparation of the State and Regional Cleanup Plans.

The SWRCB has scheduled a hearing to receive testimony on the proposed policy document. All interested persons are invited to attend. At a Board meeting following the close of the public comment period, the State Board may adopt the proposed regulations or substantially similar regulations, following the rulemaking prescribed by the Administrative Procedure Act (Government Code Sections 11340-11356). The SWRCB will make the full text of the proposed regulations available to all interested persons at least 15 days before adoption if any substantive changes are made.

In accordance with Government Code Section 11346.5(a)(7), the SWRCB must determine that no alternative considered by the SWRCB would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

Authority to Adopt Regulations and Reference to Statutes Implemented

The SWRCB has authority to adopt the proposed regulation under Section 1-58 of the California Water Code, The purpose of this regulation is to implement, interpret, and make specific Section 13394 of the California Water Code.

Presentation of Written and Oral Testimony and Written Comments

Any interested person may present statements relevant to the SWRCB's proposed rulemaking at the hearing. The SWRCB requests that oral testimony at the hearing be summarized to the degree possible. The SWRCB may impose a time limitation on oral presentations therefore, it is advisable that written comments be submitted to ensure that all concerns are incorporated into the record of this proceeding.

Informative Digest

Section 13394 of the California Water Code requires the SWRCB that by January 1, 1998 each Regional Water Quality Control Board submit to the SWRCB a Toxic Hot Spot Cleanup Plan (THS Cleanup Plan) and that by June 30, 1999, the SWRCB in turn submit to the legislature a consolidated statewide THS Cleanup Plan. The THS Cleanup Plan will identify and rank THSs throughout the State's Bays and estuaries and outline remediation actions for cleanup, mitigation and prevention.

Submission of Comments and Additional Information

Written comments on the proposed regulations or the initial statement of reasons should be addressed to: Craig J. Wilson, Bays and Estuaries Unit, Division of Water Quality, State Water Resources Control Board, P.O. Box 100, Sacramento, California 95812-0100. Comments may be submitted by facsimile at 916/654-8375 to the attention of Craig J. Wilson. Questions concerning the public hearing or the rulemaking process should be directed to Craig J. Wilson at 916/657-1108.

Request for Documents

Requests for copies of the proposed Policy, or the initial statement of reasons should be addressed to: Jody Guro, Division of Water Quality, State Water Resources Control Board, P.O. Box 100, Sacramento, California 95812-0100. Telephone requests for the documents should be directed to Jody Guro at 916/657-0808.

Parking and Accessibility

The SWRCB's hearing room is accessible to persons with disabilities. For those driving to this hearing, public parking is available in the State Garage on Tenth Street between O and P Streets, in metered spaces on area streets, and in the public parking garage on Seventh Street between L Street and Capitol Mall.

Maureen Marché
Administrative Assistant to the Board

Date: