Final

Functional Equivalent Document

Appendix B

Consolidated Toxic Hot Spots Cleanup Plan

Volume II: Regional Cleanup Plans

June 1999

New Series No. 7
Division of Water Quality

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

State of California

STATE WATER RESOURCES CONTROL BOARD

CONSOLIDATED TOXIC HOT SPOTS CLEANUP PLAN

VOLUME II: REGIONAL CLEANUP PLANS

FINAL FUNCTIONAL EQUIVALENT DOCUMENT
APPENDIX B

June 1999

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 99 - 065

ADOPTION OF THE
CONSOLIDATED TOXIC HOT SPOTS CLEANUP PLAN

WHEREAS:

1. The Bay Protection and Toxic Cleanup Program (BPTCP) was established by the State Water Resources Control Board (SWRCB) to implement the requirements of Section 13390 et seq. of the Water Code.

2. Water Code Section 13394 requires the SWRCB and the Regional Water Quality Control Boards (RWQCBs) to develop a Consolidated Toxic Hot Spots Cleanup Plan (Consolidated Cleanup Plan).

3. The SWRCB adopted a Water Quality Control Policy for Guidance on the Development of Regional Toxic Hot Spot Cleanup Plans (Guidance Policy) to be used by the RWQCBs in preparing their cleanup plans.

4. Each of the seven coastal Regional Water Quality Control Boards (RWQCBs) used the Guidance Policy in the development of their Regional Toxic Hot Spots Cleanup Plans and has submitted the Plans to the SWRCB.

5. The SWRCB has consolidated the Regional Toxic Hot Spots Cleanup Plans into a Consolidated Cleanup Plan.

6. The SWRCB prepared and circulated a draft Functional Equivalent Document (FED) supporting the proposed Consolidated Cleanup Plan in accordance with provisions of the California Environmental Quality Act and Title 14, California Code of Regulations Section 15251(g).

7. In compliance with Water Code Section 13147, the SWRCB held a public hearing in Sacramento, California, on June 3, 1999 on the Consolidated Cleanup Plan and has carefully considered all testimony and comments received.

8. The SWRCB staff determined that the adoption of the proposed Consolidated Cleanup Plan will not have a significant adverse effect on the environment.

9. The SWRCB staff has prepared a final FED that includes the revised proposed Consolidated Cleanup Plan and has responded to the comments received.

10. The SWRCB consulted with the Department of Fish and Game (DFG) on the potential impacts of the amendments on fish and wildlife resources, including threatened and endangered species. DFG did not find that the Consolidated Cleanup Plan will jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of habitat essential to the continued existence of the species.

11. The SWRCB completed a scientific peer review of the draft FED as required by Section 57004 of the Health and Safety Code.

12. As directed at the June 3, 1999 public hearing, SWRCB staff met with representatives of the RWQCBs, DFG and interested parties to discuss specific comments and concerns, and has made minor revisions to the Consolidated Cleanup Plan accordingly.

13. The regulatory provisions of the Water Quality Control Policy do not become effective until the regulatory provisions are approved by the Office of Administrative Law (OAL).

THEREFORE BE IT RESOLVED THAT:

The SWRCB:

1. Approves the Final Functional Equivalent Document: Consolidated Toxic Hot Spots Cleanup Plan.

2. Adopts the Consolidated Toxic Hot Spots Cleanup Plan.

3. Approves the Central Valley RWQCB's request for a variance from the provision of the Guidance Policy in order to address pesticide regulation under the Clean Water Act Section 303(d) Total Maximum Daily Load (TMDL) process. The RWQCB shall report to the SWRCB annually on progress toward completing the TMDLs.

4. Directs the RWQCBs to consult with DFG on compliance with the California Endangered Species Act during the implementation of the Consolidated Cleanup Plan.

5. Authorizes the Executive Director, or his designee, to submit the Consolidated Cleanup Plan to the California Legislature by June 30, 1999 in compliance with Section 13394 of the California Water Code.

6. Authorizes the Executive Director, or his designee, to submit the regulatory provisions of the Consolidated Cleanup Plan to OAL for its approval.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 17, 1999.

Maureen Marché
Maureen Marché
Administrative Assistant to the Board

PREFACE

The Consolidated Toxic Hot Spot Cleanup Plan has two parts: (1) Volume I which contains the consolidated lists, policy statements and findings; and (2) Volume II which contains each of the Regional Toxic Hot Spot Cleanup Plans.

This is Volume II of the Consolidated Toxic Hot Spot Cleanup Plan that contains each of the Regional Toxic Hot Spot Cleanup Plans. Regional Cleanup Plans are included for the following Regional Water Quality Control Boards:

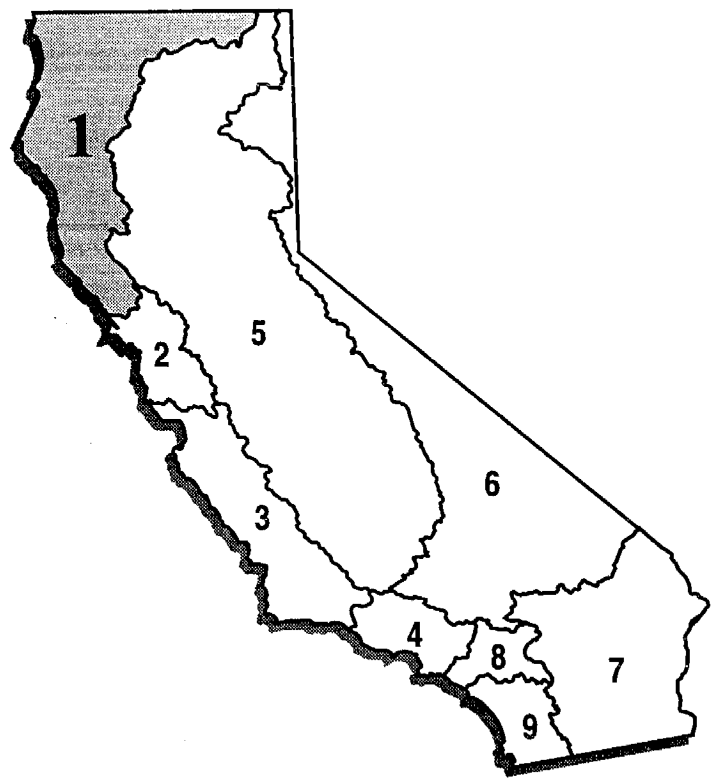
- North Coast (Region 1)
- San Francisco Bay (Region 2)
- Central Coast (Region 3)
- Los Angeles (Region 4)
- Central Valley (Region 5)
- Santa Ana (Region 8)
- San Diego (Region 9)

Each Regional Cleanup Plan in this volume is divided into the following sections:

- Toxic Hot Spot List
- Ranking Matrix
- Characterization and planning for remediation of high priority toxic hot spots
- Future needs

TABLE OF CONTENTS

REGIONAL WATER QUALITY CONTROL BOARD
NORTH COAST REGION



REGIONAL TOXIC HOT SPOT
CLEANUP PLAN

Region Description

The North Coast Region is defined in Section 13200(a) of the Porter-Cologne Water Quality Control Act as follows:

"North Coast Region, which comprises all basins including the Lower Klamath Lake and Lost River Basins draining into the Pacific Ocean from the California-Oregon state line southerly to the southerly boundary of the watershed of the Estero de San Antonio and Stemple Creek in Marin and Sonoma Counties."

The Region is divided into two natural drainage basins, the Klamath River Basin and the North Coastal Basin. The North Coast Region covers all of Del Norte, Humboldt, Trinity, and Mendocino Counties, major portions of Siskiyou and Sonoma Counties, and small portions of Glenn, Lake and Marin Counties.

The Region encompasses a total area of approximately 19,390 square miles, including 340 miles of scenic coastline and remote wilderness areas, as well as urbanized and agricultural areas.

The Region is characterized by distinct temperature zones. Along the coast, the climate is moderate and foggy and the temperature variation is not great. For example, at Eureka, the seasonal variation in temperature has not exceeded 63°F for the period of record. Inland however, seasonal temperature ranges in excess of 100°F have been recorded.

Precipitation over the North Coast Region is greater than any other part of California, and damaging floods are a fairly frequent hazard. Particularly devastating floods occurred in the North Coast area in December of 1955, December of 1964, and in February of 1986.

Ample precipitation in combination with the mild climate found over most of the North Coast Region has provided a wealth of fish, wildlife, and scenic resources. The mountainous nature of the Region, with its dense coniferous forests interspersed with grassy or chaparral covered slopes, provides shelter and food for deer, elk, bear, mountain lion, fur-bearers and many upland bird and mammal species. The numerous streams and rivers of the Region contain anadromous fish, and the reservoirs, although few in number, support both cold-water and warm-water fish.

Tidelands, and marshes too, are extremely important to many species of waterfowl and shore birds, both for feeding and nesting. Cultivated land and pasture lands also provide supplemental food for many birds, including small pheasant populations. Tideland areas along the north coast provide important habitat for marine invertebrates and nursery areas for forage fish, game fish and crustaceans. Offshore coastal rocks are used by many species of seabirds as nesting areas. Major components of the economy are tourism and recreation, logging and timber milling, aggregate mining, commercial and sport fisheries, sheep, beef and dairy production, and vineyards and wineries.

In all, the North Coast Region offers a beautiful natural environment with opportunities for scientific study and research, recreation, sport and commerce. To ensure their perpetuation, the resources must be used wisely.

Candidate Toxic Hot Spot List

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
Humboldt Bay		14001, Eureka Waterfront "H" Street (G&R Metals)	Bioassay toxicity EE	Pb, Ag, Sb, Zn, Methoxychlor, PAH	BPTCP data
Bodega Bay		10006, Mason's Marina	Bioassay toxicity RA; EE	Cd, Cu, TBT, PAH	BPTCP data
Bodega Bay		10028, Porto Bodega Marina	Bioassay toxicity EE	Cu, Pb, Hg, Zn, TBT, DDT, PCB, PAH	BPTCP data

Reference list:
State Water Resources Control Board, Bay Protection and Toxic Cleanup Program Database and Data Reports
Site File, G&R Metals

Ranking Matrix

Water body Name	Site Identification	Human Health Impacts	Aquatic Life Impacts	Water Quality Objectives	Areal Extent	Remediation Potential	Overall Ranking
Humboldt Bay	14001	Low	High	Low	1 to 10 acres	High	High
Bodega Bay	10006	Low	High	Low	Unknown	High	Moderate
Bodega Bay	10028	Low	High	Low	Unknown	High	Moderate

High Priority Candidate Toxic Hot Spot, G&R Metals Foot of H Street Between First Street and Humboldt Bay Eureka, California (scrap yard)

A. Areal extent of the Toxic Hot Spot:

The areal extent of the toxic hot spot has been estimated to be 3.5 acres with an average depth of contamination of 2 feet. The total contaminated soil quantity is about 10,000 cubic yards. The constituents of concern are lead, arsenic, chromium, cadmium, cobalt, copper, mercury, zinc, and PCBs.

B. Most likely Sources of Pollutants:

The site is located on the shore of Humboldt Bay and has been used for industrial activities since the early part of the century. It has been operated as a scrap metal facility since the early 1950s. Operations at the site included disassembly, incineration, and crushing of automobiles, storage of metals, batteries, radiators, metals reclamation from electrical transformers, and miscellaneous refuse. These operations occurred across the site. All industrial activities have ceased at the site but the historic uses have resulted in an area contaminated with PCBs, PAHs, metals and Methoxychlor. Cleanup and abatement activities remain to be performed at this site. These activities include: a.) performing an ecological and human health risk assessment, b.) conducting a feasibility study assessing remedial alternatives, and c.) performing appropriate cleanup and abatement activities.

C. Summary of actions that have been initiated by the Regional Water Board to reduce the accumulation of pollutant at existing Toxic Hot Spots and to prevent the creation of new Toxic Hot Spots:

The site has not been used since 1980. On-going activity is limited to site assessment work to determine the extent of the contamination and the appropriate remediation needed to clean up the site. The Regional Water Board issued a draft Cleanup and Abatement

Order on June 4, 1998 requiring cleanup of the site. The final order will be issued sometime in fiscal year 1998/99.

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

The cleanup alternatives are limited to the removal of highly contaminated soils and capping of the site to prevent migration of metals to ground and surface waters. Dredging of the offshore area may be necessary for a complete cleanup.

E. An estimate of the total cost to implement the Cleanup Plan.

It is estimated that the cost to implement the chosen cleanup plan will be between $500,000 and $5 million dollars. These costs are based on a $500.00 per ton cost for hauling and tipping fees at a hazardous waste disposal site. The exact amount of material that will be removed from the site will be determined at a later date when the assessment work is completed.

F. An estimate of recoverable costs from potential Dischargers.

The responsible parties will be required to pay for the cleanup. It appears that the responsible parties have the ability to pay for the entire cleanup effort.

G. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from potential dischargers.

Not applicable.

H. Benefits.

The cleanup plan, when implemented, will restore the beneficial uses that have been impacted on and around the site. The beneficial uses of Humboldt Bay are:

Navigation; Commercial and Sport Fishing; Wildlife Habitat; Rare, Threatened or Endangered Species; Marine Habitat; Migration of Aquatic Organisms; Spawning, Reproduction, and Development; Shellfish Harvesting; Estuarine Habitat; and Aquaculture. The benefits will include the general improvement of the ecosystem which will result in more abundant benthic life and lower concentrations of pollutants in fish and shellfish.

Future Needs

A number of sites have shown toxicity, sediment chemistry problems or other indications of pollutants, but insufficient evidence is currently available to consider them "candidate toxic hot spots". Additional data and information is needed to confirm them as Toxic Hot Spots or remove them from further consideration. Sites of Concern are listed in a later Section in this report.

Four sites are listed as Candidate Toxic Hot Spots. Three do not include a cleanup plan. Additional information is necessary to determine the areal extent of the contamination and the need for cleanup or mitigation at those sites.

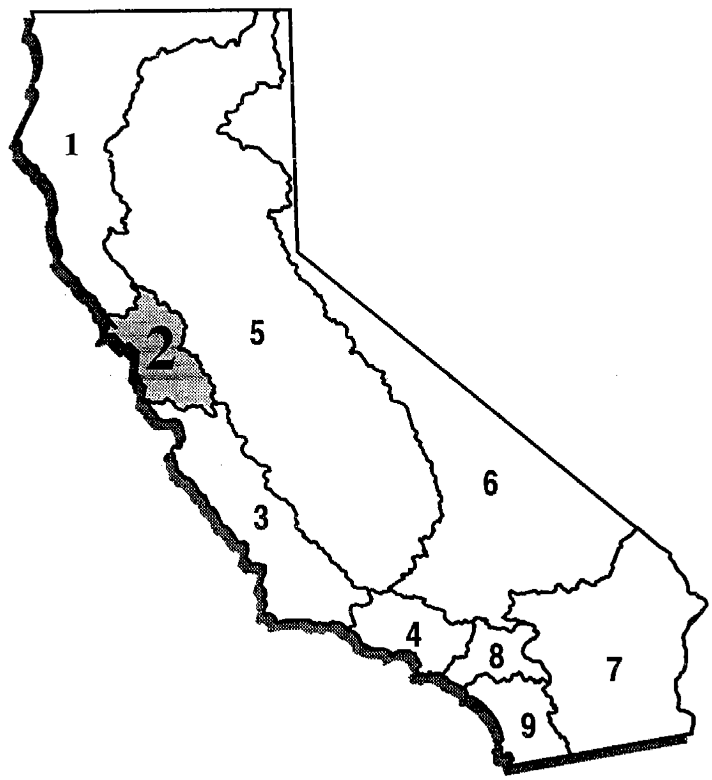
Sites of Concern (Sites that do not qualify as Candidate Toxic Hot Spots)

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
Humboldt Bay		14002, Eureka, "J" Street	Bioassay toxicity EE	Methoxychlor, PAH	BPTCP data
Humboldt Bay		10017, Eureka Slough	Bioassay toxicity RA	Cr, Cu, Hg	BPTCP data
Humboldt Bay		10020, Del Norte St., Old Pacific Lumber Site	Bioassay toxicity RA	PAH	BPTCP data
Humboldt Bay		10038, Fuel Dock, "C" Street	Chemistry, Pb, hg, PAH, PCB	Sb, Cd, Cu, Pb, Hg, PAH, PCB	BPTCP data
Humboldt Bay		10023, Small Boat Basin, Waterfront Drive	Chemistry, PAH	Dieldrin, PAH	BPTCP data
Arcata Bay		10004, McDaniel Slough	Bioassay toxicity RA		BPTCP data
Arcata Bay		10026, Jolly Giant Slough	Chemistry, Pb, Zn, PCB	Pb, Zn, Chlordane, DDT, Dieldrin, Methoxychlor, PCB, PAH	BPTCP data

Reference list

State Water Resources Control Board, Bay Protection and Toxic Cleanup Program Database and Data Reports

REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION



REGIONAL TOXIC HOT SPOT
CLEANUP PLAN

Region Description

The San Francisco Bay Region is comprised of most of the San Francisco estuary up to the mouth of the Sacramento-San Joaquin Delta (Figure 1). The San Francisco estuary conveys the waters of the Sacramento and San Joaquin rivers into the Pacific Ocean. Located on the central coast of California, the Bay system functions as the only drainage outlet for waters of the Central Valley. It also marks a natural topographic separation between the northern and southern coastal mountain ranges. The region's waterways, wetlands and bays form the centerpiece of the fourth largest metropolitan area in the United States, including all or major portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma counties.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) has jurisdiction over the part of the San Francisco estuary which includes all of the San Francisco Bay segments extending east to the Delta (Winter Island near Pittsburg). Coastal embayments including Tomales Bay and Bolinas Lagoon are also located in this Region. The Central Valley RWQCB has jurisdiction over the Delta and rivers extending further eastward.

The Sacramento and San Joaquin rivers, which enter the Bay system through the Delta at the eastern end of Suisun Bay, contribute almost all of the freshwater inflow to the Bay. Many smaller rivers and streams also convey fresh water to the Bay system. The rate and timing of these freshwater flows are among the most important factors influencing physical, chemical and biological conditions in the estuary. Flows in the region are highly seasonal, with more than 90 percent of the annual runoff occurring during the winter rainy season between November and April.

The San Francisco estuary is made up of many different types of aquatic habitats that support a great diversity of organisms. Suisun Marsh in Suisun Bay is the largest brackish-water marsh in the United States. San Pablo Bay is a shallow embayment strongly influenced by runoff from the Sacramento and San Joaquin Rivers. The Central Bay is the portion of the Bay most influenced by oceanic conditions. The

South Bay, with less freshwater inflow than the other portions of the Bay, acts more like a tidal lagoon. Together these areas sustain rich communities of aquatic life and serve as important wintering sites for migrating waterfowl and spawning areas for anadromous fish.

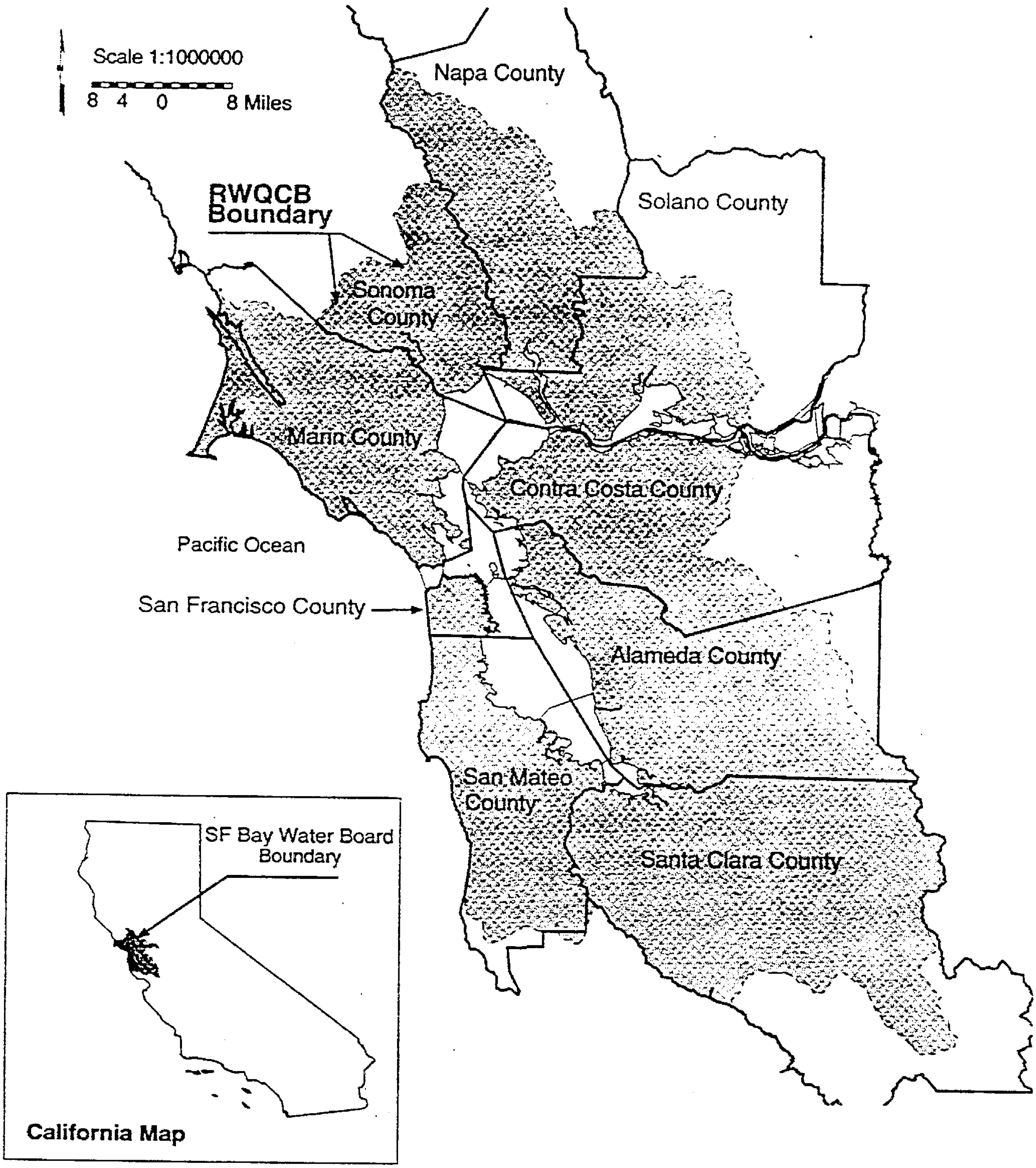


Figure 1. San Francisco Bay Region

Maps: Basins, Counties

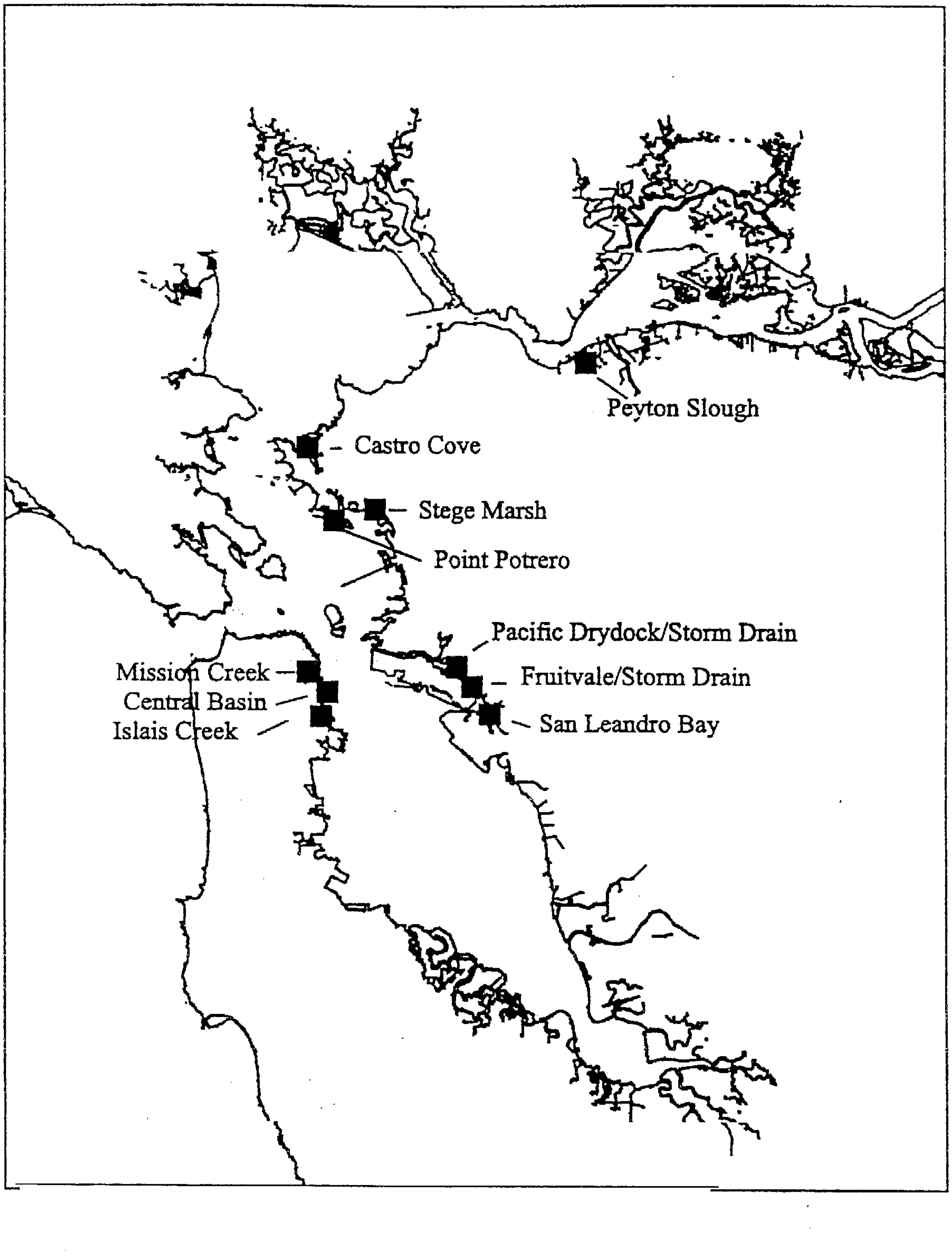


Figure 2. Candidate Toxic Hot Spots

Candidate Toxic Hot Spots (except for San Francisco Bay, sites are listed from north to south)

Water body Name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
S.F. Bay	S.F. Bay	S.F. Bay	Human Health	Hg, PCBs, dieldrin, chlordane, DDT, dioxin,	12, 24, 26, 27, 28, 30, 31, 32, 35, 54
Suisun Bay	Suisun Bay	Peyton Slough	Aquatic Life	Ag, Cd, Cu, Se, Zn, PCBs, chlordane, ppDDE, pyrene	3, 12, 35, 39, 40, 41, 42, 43, 44
S.F. Bay	San Pablo Bay	Castro Cove	Aquatic Life	Hg, Se, PAHs, dieldrin	7, 8, 9, 11, 12, 27, 33, 34, 35, 55
S.F. Bay	Central Bay	Stege Marsh	Aquatic Life	As, Cu, Hg, Se, Zn, chlordane, dieldrin, ppDDE, dacthal, endosulfan I, endosulfan sulfate, dichlorobenzophenone, heptachlor epoxide, hexachlorobenzene, mirex, oxadiazon, toxaphene, PCBs	19, 29, 35, 37, 45, 46, 47, 48, 49, 50, 51, 52
S.F. Bay	Central Bay	Point Potrero/ Richmond Harbor	Human Health	Hg, PCBs, Cu, Pb, Zn	2, 4, 14, 15, 16, 17, 18, 24, 35, 36
S.F. Bay	Oakland Estuary	Pacific Dry Dock #1 (area in front of stormdrain)	Aquatic Life	Cu, Pb, Hg, Zn, TBT, ppDDE, PCBs, PAHs, chlorpyrifos, chlordane, dieldrin, mirex	25, 35, 38
S.F. Bay	South Bay	Mission Creek	Aquatic Life	Ag, Cr, Cu, Hg, Pb, Zn, chlordane, chlorpyrifos, dieldrin, mirex, PCBs, PAHs, anthropogenically enriched H_2S & NH_3	20, 35, 56

Water body Name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference
S.F. Bay	Oakland Estuary	Fruitvale (area in front of stormdrain)	Aquatic Life	chlordane, PCBs	35
S.F. Bay	South Bay	Central Basin, S.F.	Aquatic Life	Hg, PAHs	35
S.F. Bay	South Bay	Islais Creek	Aquatic Life	PCBs, chlordane, dieldrin, endosulfan sulfate, PAHs, anthropogenically enriched H_2S & NH_3	1, 5, 6, 20, 21, 22, 23, 35, 53, 55
S.F. Bay	South Bay	San Leandro Bay	Aquatic Life	Hg, Pb, Se, Zn, PCBs, PAHs, DDT, chlordane, dieldrin, ppDDE, hexachlorobenzene, heptachlor, chlorpyrifos	10, 13, 35

Reference list

1. Anderson, S. L., J. P. Knezovich, J. Jelinski, and D. J. Steichen. 1995. The Utility of Using Pore-Water Toxicity Testing to develop Site-Specific Marine Sediment Quality Objectives for Metals. Report LBL-37615 UC-000, Lawrence Berkeley National Laboratory, University of California, Berkeley, CA.
2. California Department of Fish and Game (CDFG). 1997. California Sport Fishing Regulations, Public Health Advisory on Fish Consumption, Richmond Harbor Channel, California.
3. CH2MHILL. 1986. Equivalent Protection Study for Stauffer Chemical Company, Martinez Sulfuric Acid Plant. Prepared for Stauffer Chemicals. December 1986. 78 p. and Appendices.
4. California Office of Environmental Health Hazard Assessment (OEHHA). 1994. Public Health Advisory on Fish Consumption, Richmond Harbor Channel, California.
5. Chapman, P.M., R.N. Dexter, and E.R. Long. 1987. Synoptic Measures of Sediment Contamination, Toxicity and Infaunal Community Composition. The Sediment Quality Triad in San Francisco Bay. Marine Ecology Progress Series 37:75-96.
6. City and County of San Francisco, Department of Public Works, Bureau of Water Pollution Control, 1990-1993. Southeast and Islais Creek Sediment Data.

7. Entrix. 1990a. Surface Sediment Monitoring Program for Castro Cove and Areas Adjacent to the Deep Water Outfall. Final Report Prepared for Chevron U.S.A., Richmond Refinery. 96 pp. and Appendices.
8. Entrix. 1990b. Benthic Community Monitoring Program for Castro Cove and Areas Adjacent to the Deep Water Outfall. Final Report Prepared for Chevron U.S.A., Richmond Refinery. 100 pp. and Appendices.
9. E.V.S. Consultants, Inc. 1987. A Chemical And Toxicological Evaluation of Sediments from San Pablo Bay. Prepared for Chevron Environmental Health Center, Inc. Project No. 2/320-01. Seattle, WA.
10. E.V.S. Consultants, Inc. 1990. Bioassay and Chemical Characterization of Sediments from San Leandro Bay. Prepared for Alameda County Flood Control and Water District. Hayward, CA. 22 pp.
11. E.V.S. Consultants, Inc. 1991. Chemical and Toxicological Analyses of Sediments From Castro Cove, San Francisco Bay. Prepared for Chevron USA, Richmond
12. Flegal, A. Russel, R W. Risebrough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program: Sediment Studies, Final Report for San Francisco Bay Regional Water Quality Control Board. July 1994.
13. General Electric. 1980. Sediment Survey for PCBs in Drainage Courses Below the Oakland Facility on November 20, 1980. SFBRWQCB.
14. Hart Crowser, Inc. 1993. Final Remedial Investigation Report, Volume I, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.
15. Hart Crowser, Inc. 1994. Final Feasibility Study Operable Unit 1: Soil and Groundwater, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.
16. Hart Crowser, Inc. 1995. Final Remedial Action Plan, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.
17. Hart Crowser, Inc. 1997. Final Work Plan for Supplemental Sediment Characterization, Port of Richmond, Shipyard No. 3 Scrap Area Site, Operable Unit 2 and Operable Unit 3. Richmond, CA.
18. Herzog, Donald and Associates, Inc. 1989. Final Report, Remedial Investigation/Feasibility Study, Seacliff Marina, Richmond Shipyard No. 3, Richmond, California.
19. ICF Kaiser. 1997. Wetlands Area Sampling Program Zeneca Ag. Products Richmond Facility
20. CH2MHILL. 1979. Bayside Overflows. Report for City and County of San Francisco.
21. Advanced Biological Testing Inc. 1998. Results of Chemical, Physical, and Bioassay Testing of Sediments for Maintenance Dredging at Pier 80A, San Francisco, California, Prepared for the Port of San Francisco.
22. Long, E.R. and R. Markel. 1992. An Evaluation of the Extent and Magnitude of Biological Effects Associated with Chemical Contaminants in San Francisco Bay, California. NOAA Tech Memo NOS ORCA 64. National Oceanic and Atmospheric Administration. 86 pp. + appendices.

23. MEC Analytical Systems, Inc. 1997. Sampling and Analysis of Sediment at Islais Creek, San Francisco, CA. Prepared for the City and County of San Francisco, San Francisco, CA.
24. Office of Environmental Health Hazard Assessment (OEHHA). 1994. Health Advisory on Catching and Eating Fish-Interim Sport Fish Advisory for San Francisco Bay. Sacramento, CA.
25. PTI Environmental Services. 1994. Supplemental Inshore Sediment Impairment Study. Crowley Marine Services, Inc. Pacific Dry-dock Yards I & II, June 1994. Volume I.
26. Risebrough, R.W. 1994. Contaminants in San Francisco Bay Sediments-Relationships with Toxicity Studies. SFBRWQCB, SWRCB and U.S.EPA.
27. San Francisco Estuary Institute (SFEI). 1995. 1996 Annual Report. San Francisco Estuary Regional Monitoring Program for Trace Substances, Richmond, Ca.
28. SFBRWQCB, SWRCB, CDFG. 1994. Contaminant Levels in Fish Tissue from San Francisco Bay
29. SFBRWQCB. 1997. Chemical Analytical Results for a Zeneca Sediment.
30. San Francisco Estuary Institute (SFEI). 1994. 1993 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances, Richmond, CA.
31. SFEI. 1995. 1994 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances, Richmond, CA.
32. SFEI. 1996. 1995 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances, Richmond, CA.
33. Spies, R.B., A.J. Gunther, J. Stegeman, B. Woodin, R. Smolowitz, B. Saunders, and L. Hain. 1993. Induction of Biochemical, Genetic and Morphological Markers of Contamination in Speckled Sanddabs Citharichthys stigmaeus Experimentally Exposed to Sediments from San Francisco Bay. Prepared for the SFBRWQCB.
34. State Water Resources Control Board (SWRCB). 1995. State Mussel Watch Program, 1987-1993 Data Report, 94-1WQ. State Water Resources Control Board, California Environmental Protection Agency.
35. Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, K. Taberski, C. Wilson, M. Stephenson, H. Puckett, R. Fairey, J. Oakden. 1998. Sediment Quality and Biological Effects in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 188 + appendices A-E.
36. U.S. Army Corps of Engineers and Port of Richmond. 1996. Final Supplemental Environmental Impact Statement/Environmental Impact Report, Richmond Harbor Navigation Improvements.
37. URS Consultants, Inc. 1994. CERCLA Site Inspection, Stauffer Chemical Company, Richmond CA. Prepared for U.S. EPA Region IX, San Francisco, CA.
38. Versar. 1992. Revised Inshore Sediment Impairment Study, Pacific Dry Dock and Repair Yard I, Oakland , California. Prepared for Crowley Maritime Corporation.
39. Harding Lawson Assoc. (HLA). 1998. Results - Peyton Slough Sediment Investigation. For Rhodia Inc. Martinez. Ca.

40. The MARK Group. 1987. Interim Report of Subsurface Conditions. Stauffer Chemical Company, Martinez, California.
41. The MARK Group. 1988. Work Plan - Site Investigations Report. Sulphur Products Facility. Stauffer Chemical Company, Martinez, California.
42. The MARK Group. 1988. Two Solar Evaporation Surface Impoundments. Amended Closure Plan. Stauffer Chemical Company, Martinez, California.
43. The MARK Group. 1989. Site Investigation Report. Sulfur Products Facility. Stauffer Chemical Company, Martinez, California.
44. The MARK Group. 1989. Addendum to Site Investigation Report. Sulfur Products Facility. Stauffer Chemical Company, Martinez, California.
45. ICI Americas Inc. 1987. Assessment of Surface Impoundments at ICI Americas, Richmond, CA for TPCA.
46. ICI Americas Inc. 1990. Solid Waste Assessment Test Proposal. July 23, 1990.
47. The Mark Group. 1988. Report of Field Investigations Stege Plant. Prepared for ICI Americas. January 22, 1988.
48. The Mark Group. 1991. Water Quality Solid Waste Assessment Report, Cinder Fill Area, ICI Americas Inc., Richmond, California. Prepared for ICI Americas. July 1, 1991.
49. May, M. 1995. Tidal Marsh Evolution and Breakwater Construction, Richmond, California. Unpublished.
50. Pacific Eco-Risk Laboratories. 1998. Initial Data Report for the Phase I: Stage 2 Evaluation of Stege Marsh Sediments, Draft. September 30, 1998.
51. Stauffer Chemical Company. 1987. Proposed Sample and Analysis Plan for NPDES Impoundments per the Toxic Pits Clean-up Act (TPCA). July 16, 1987.
52. Woodward-Clyde Consultants. 1993. Supplemental Site Subsurface Investigation at Zeneca's Agricultural Facility, Richmond, California. Prepared for Zeneca Agricultural Products. June 23, 1993.
53. Advanced Biological Testing Inc. 1998. Results of Chemical, Physical, and Bioassay Testing of Sediments for Maintenance Dredging at Pier 80A, San Francisco, California. Prepared for the Port of San Francisco.
54. Hornberger, M.I., S.N. Luoma, A. van Geen, C. Fuller, R. Anima. 1999. Historical Trends of Metals in the Sediments of San Francisco Bay, California. Mar. Chem. 64: 39-55.
55. Hunt, J.W., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, M. Stephenson, M, Puckett, R. Fairey, R. Smith, K. Taberski. 1998. Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 132. Appendix A-D.
56. S.R. Hansen & Assoc. 1996. Development and Application of Estuarine Sediment Toxicity Identification Evaluations. Prepared for San Jose State Foundation. pp. 79. Appendix A&B.

Ranking Matrix (except for San Francisco Bay sites within an overall rank are listed from north to south)

Water body Name	Site Identification	Human Health Impacts [1]	Aquatic Life Impacts	Water Quality Objectives	Areal Extent	Remediation Potential	Overall Rank
S.F. Bay	S.F. Bay	High	NA	NA	> 10 acres	Moderate	High
Suisun Bay	Peyton Slough	High	High	NA	1-10 acres	High	High
S.F. Bay	Castro Cove	High	High	NA	> 10 acres	High	High
S.F. Bay	Stege Marsh	High	High	NA	> 10 acres	High	High
S.F. Bay	Point Potrero/ Richmond Harbor	High	Low	NA	1-10 acres	High	High [2]
S.F. Bay	Mission Creek	High	High	NA	1-10 acres	High	High
S.F. Bay	Islais Creek	High	High	NA	1-10 acres	Moderate	High
S.F. Bay	Pacific Drydock	High	Moderate	NA	<1 acre	High	Moderate
S.F. Bay	Fruitvale	High	Moderate	NA	<1 acre	High	Moderate
S.F. Bay	San Leandro Bay	High	Moderate	NA	unknown [3]	Moderate	Moderate
S.F. Bay	Central Basin	High	Moderate	NA	<1 acre	High	Moderate

1. All sites within San Francisco Bay were ranked high in this category because a health advisory on fish consumption applies to the entire Bay and elevated levels of mercury and PCBs are found throughout the Bay.
2. This site was ranked high because it is in the area where the health advisory on fish consumption applies, the health advisory is based on PCBs and mercury and this site had the highest PCB and mercury concentrations in over 600 samples collected statewide in the BPTCP. In addition, this site ranked high in other ranking criteria.
3. A study is currently being conducted through the San Francisco Estuary Institute to define the areal extent of contamination at this site.

High Priority Candidate Toxic Hot Spot Characterization

Site A -- San Francisco Bay

Description of site/ Background

San Francisco Bay is part of an estuarine system which conveys the waters of the Sacramento and San Joaquin rivers to the Pacific Ocean. This is a highly complex system that includes large brackish marshes, tidal lagoons and freshwater rivers and creeks. The diversity of these ecosystems support a wide variety of organisms. While the upper part of the estuary has been widely used for mining and agricultural activities the San Francisco Bay region has been heavily urbanized and is the site of many industrial activities and ports.

The San Francisco estuary has high concentrations of metals due to contributions from numerous sources, both natural and anthropogenic. Natural sources include drainage of water from formations that are naturally enriched in some metals, such as the Franciscan Formation that is exposed throughout the Bay area, and the rocks that make up the Sierra Nevada Mountains. This drainage flows into the streams that empty into the Bay. Localized concentrations of these metals were exploited in a great wave of mining activity from the 1820's continuing, in some cases, into the 1970s.

Mercury was mined at numerous locations in the Coastal Range and then transported to the Sierra Nevada foothills to be used in the amalgamation of gold in placer and hydraulic mining. Drainage from natural mercury deposits, mine tailings, and directly from mining activities have had a major impact on the San Francisco Bay and estuary.

San Francisco Bay is an extremely dynamic depositional environment. Sediments flow from the major river systems and are deposited in the Bay. Strong winds and tidal currents resuspend and redeposit these sediments resulting in a system where sediments are well mixed. Bioaccumulative contaminants attach to sediments and are distributed and mixed by the same physical processes. Therefore, the sediment acts as a sink for contaminants. The sediment, however, is also a source of contaminants to organisms in the aquatic food chain and ultimately to humans.

Although the San Francisco estuary extends from the ocean up through the river systems, the jurisdiction of the San Francisco Bay RWQCB only extends to the area just west of Antioch. The Central Valley RWQCB includes the Delta and extends through the river systems. Since the health advisory on fish consumption effects both Regions, it is important that a coordinated strategy is developed, especially in regard to mercury contamination.

Reason for listing

In 1994, the BPTCP conducted a study to measure the levels of contaminants in fish in San Francisco Bay (SFBRWQCB, 1995). Results from the study indicated that six chemicals exceeded the screening levels based on U.S. EPA guidance (U.S. EPA, 1993, 1995) that were established prior to the study. These chemicals were PCBs, mercury, DDT, chlordane, dieldrin and dioxins. In response to the results of the study, the Office of Environmental Health Hazard Assessment (OEHHA) issued a health advisory on consuming fish caught in San Francisco Bay and the Delta. The health advisory was primarily based on elevated levels of PCBs and mercury in fish tissue and the human health risk related specifically to these chemicals. While, DDT, dieldrin, chlordane and dioxins were also listed as chemicals of concern as a result of exceedance of screening values, OEHHA determined that the health concerns associated with these chemicals were less than for PCBs and mercury. ~~available data was insufficient to establish an advisory based on these other four chemicals.~~ Therefore, while the general discussion in Part B will include DDT, dieldrin, chlordane and dioxins, the remediation plan (Part D) for San Francisco Bay will focus on mercury and PCBs.

A. Assessment of the areal extent of the THS

The San Francisco Bay and Delta cover approximately 1631 square miles.

B. Assessment of the most likely sources of pollutants

Mercury

Mercury was mined in the Coast Range from the early 1800s through the mid-1900s. Initially most of the mercury was used in the amalgamation of gold in placer and hydraulic mining operations. Mining activity introduced mercury into the San Francisco Estuary system in a number of ways. Runoff from mercury mines within the region transported sediment rich in mercury to the Bay and estuary. In the Sierra, mercury was added to sediment to aid in the separation of gold from waste in placer and hydraulic mining operations. Most of this mercury ended up in the aquatic system, becoming attached to sediment particles flushing downstream. The mining of gold and silver ores may also expose surrounding rock that was enriched in mercury by the same geologic processes that created the gold and silver deposits, again introducing sediment enriched in mercury to the stream systems that drain into San Francisco Bay. Ongoing drainage from these mines has introduced mercury and other metals into the streams that drain into the estuary.

Core samples of Bay sediment indicate background concentrations of mercury of 0.06 +/- 0.02 ppm dw (Hornberger et al., 1999). Superimposed upon these background levels are concentrations that reflect historic and ongoing loadings. Core samples of Bay sediment indicate that an historic gradient of contaminated sediment (up to 0.9 ppm Hg) entered the Bay from the Sacramento- San Joaquin Delta during the Gold Rush, then diffused into cleaner sediment as it moved seaward towards the Golden Gate. These core samples indicate a contaminated (0.5-0.9 ppm Hg) layer buried in the sediment, the depth of which varies from location to location, with the most concentrated levels of mercury in the upper estuary. Surficial sediments throughout the Bay system generally contain 0.3 to 0.4 ppm mercury, except in areas of the lower South Bay affected by drainage from the New Almaden mining area. Mixing between these two sediment layers is a key factor in determining the concentration of mercury in surficial sediments, the mass balance of mercury in the Bay and the rate at which concentrations can change.

The estuary, therefore, has become a sink for sediments rich in mercury and an ongoing source for the bioaccumulation of mercury up the food chain. Monitoring data from the BPTCP shows that mercury concentrations in the estuary are elevated and highly dispersed. There are a number of individual sites around the margins of the Bay where mercury concentrations higher than these generally elevated levels are found. These are usually due to past industrial practices such as the smelting of ore.

Although there is very little active mining in the San Francisco Bay drainage system, runoff from abandoned mines and mine tailings continue to be an ongoing source of mercury to the estuary. Data from the Sacramento River indicate that the Cache Creek drainage and the Sacramento drainage above the Feather River are major, ongoing sources to the lower watershed. In the southern part of San Francisco Bay, the major ongoing source is the drainage from New Almaden mining region. Other less significant sources include urban runoff, POTWs, industrial discharges and aerial deposition. Recent pollution prevention audits indicate that human waste, water supplies, laundry waste, household products, ~~thermometers,~~ and waste from hospitals and dental facilities are the most significant sources to POTWs. Known industrial discharges of mercury are from raw materials used in the facilities. About half the aerial deposition appears to come from global fuel combustion and the other half from local fuel combustion.

The key environmental concern about mercury in the San Francisco Bay system is the extent to which it bioaccumulates in the food chain. Bioaccumulation, in turn, is governed by the level of methyl mercury in the aquatic environment. Methyl mercury is formed primarily by microbial activity, and only under certain physical and chemical conditions. A complex set of factors influence the rate and net production of methyl mercury by bacteria. These include chemical factors that change the oxidation state of mercury in the aquatic system; "habitat" characteristics that promote the growth of methylating bacteria such as the availability of sulfur compounds used as food and the presence of anoxic zones conducive to these bacteria; and much larger scale processes such as wind, tide, and runoff patterns that serve to mix and transport particle bound mercury throughout the estuary. Significant changes in any of these factors may potentially change the rate of mercury methylation. These processes must be better understood in order to appropriately manage environmental risks associated with the existing reservoir of mercury, as well as to regulate ongoing sources. A particular concern is to prevent the creation of environments, that is some subset of these physical and chemical factors, that may increase the rate of mercury methylation.

PCBs

PCBs have also accumulated in the sediments of the estuary due to historic use. This class of chemicals is comprised of 209 compounds called congeners. Mixtures of congeners have been manufactured in the U.S. since 1929 and sold under the trade name Aroclor. These mixtures were used extensively in the U.S. prior to 1979 when their manufacture, processing, use and application was banned, except in totally enclosed applications such as transformers. PCBs were used for industrial applications requiring fluids with thermal stability, fire and oxidation resistance, and solubility in organic compounds. PCBs have proven to be extremely persistent in the environment. RMP monitoring data indicate that in the water column PCBs exceed non-promulgated U.S.EPA water quality criteria throughout the estuary. This is most probably due to resuspension from the sediments, although ongoing sources may still contribute a significant amount of PCBs. BPTCP monitoring has shown that, except for a few areas (see Sites of Concern and Candidate Toxic Hot Spots), PCBs are fairly well mixed in the sediments of the estuary where they provide an ongoing source to organisms in the food chain.

Although the use of PCBs has been banned there are historic deposits in the sediment and on land. Point Potrero, at the Port of Richmond, had ten times the PCB concentration (19.9 ppm) of any other sample collected under this region's BPTCP and the highest concentration of any BPTCP sample in the state. Stormwater events can mobilize PCBs deposited on land and transport them into the estuary. Recent monitoring by the RMP has shown that there seems to be current sources contributing to PCB loads in the South Bay from Coyote Creek. In addition, a recent RMP workgroup evaluating PCBs has come to the preliminary conclusion that there are probably significant ongoing sources of PCBs to the Bay. Increased monitoring is necessary to identify and cleanup any ongoing sources.

Chlorinated Pesticides

Three chlorinated pesticides exceeded screening levels in the BPTCP fish study: DDTs, chlordanes and dieldrin. All three have similar properties in that they are extremely persistent in the environment and highly lipid soluble. Since these lipid soluble compounds are not easily metabolized or excreted, they are stored in fatty tissue and can readily bioaccumulate in fish tissue with high lipid content.

Although all three of these chemicals have been banned for use in the U.S. for approximately 20 years they are still commonly detected in sediments and in tissue. These compounds are dispersed in the sediments throughout the estuary. One large historic source of DDT, Lauritzen Canal in Richmond Harbor, has been recently cleaned up. Other sources may be detected through increased monitoring of stormwater.

Dioxins

Dioxins are released into the environment as by-products of thermal and chemical processes. These chemicals are not intentionally manufactured. Stationary sources include the incineration of municipal, hospital and chemical wastes, paper pulp chlorine bleaching, oil refining and the manufacturing of pesticides and PCBs. Mobile sources include combustion engines in cars, buses and trucks, particularly those that use diesel fuel. Since the great majority of dioxins are emitted directly to the air, their primary source to the aquatic environment is through aerial deposition and runoff. The Bay Area Air Quality Management District has estimated that 69% of the current dioxin emissions in the Bay area is from on and off road mobile sources and 15% from residential wood burning. The San Francisco Bay RWQCB staff has estimated that greater than 90% of dioxins entering the Bay are transported by stormwater runoff or result from direct deposition from the air to the Bay.

C. Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs

Mercury

The Regional Board has developed a draft regulatory policy and program for mercury in the Region. The proposed strategy would, in the long term, reduce mercury concentrations in the estuary. It is not feasible to clean up the diffuse, historic sink of mercury in Bay sediments. Natural processes such as outflow through the Golden Gate and capping by the natural deposition of cleaner sediments may effectively isolate this mercury. Therefore, the proposed mercury strategy emphasizes the need to control all controllable sources. The two goals of the strategy are to: (1) reduce the inflow of controllable sources so that natural cleanup rates will be maximized and (2) identify human activities that may increase the rate of mercury methylation in the system and to prevent the creation of environments that may increase that rate.

To ensure that controllable sources are controlled, the strategy sets up a process to focus on the most cost-effective measures first. A preliminary evaluation indicates that the most cost-effective measures are to: (1) remediate abandoned mine sites on the western side of the Central Valley and the New Almaden district in the South Bay, (2) step up recycling programs for mercury users such as miners on the east side of the Central Valley, dentists and hospitals, (3) improve household product substitution such as ~~laundry bleach~~ products produced by the mercury caustic cell process ~~and thermometers~~ and (4) verify the status of the use of scrubber systems on sludge incinerators. Many permitted entities in the San Francisco and Sacramento Regions have already implemented these measures. In addition, as part of the mercury strategy, dischargers are implementing clean sampling and analytical techniques. This will result in improved loading estimates and improve the evaluation of the most cost-effective remedial alternatives.

The RWQCB has worked with dischargers to set up programs for pollution prevention and source control of mercury and other chemicals of concern. The Palo Alto Regional Water Quality Control Plant and the City and County of San Francisco have devoted significant resources in their service areas into identifying sources of these contaminants and determining methods of decreasing loads to their facilities.

In addition to these control measures, the draft strategy includes a provision for a pilot offset program for point source dischargers. If successful, the pilot offset program would create an administrative tool that can help direct regulatory efforts toward cost-effective measures first.

The initial step has been taken to begin implementation of this strategy with the formation of watershed council for mercury. This council includes broad representation from dischargers and public interest groups. The first phase has been the establishment of three workgroups. One work group is focused on pollution prevention and the identification of opportunities to remove or replace products or practices that may contain or generate mercury. A second group is reviewing a separate workplan developed by Regional Board staff for the completion of a total maximum daily load for mercury for San Francisco Bay. The third group is investigating the possibility of including pollution credit trading as part of the overall control strategy.

The second goal of the proposed mercury strategy, to minimize the environmental risk associated with existing levels of mercury in the Bay system, requires a better understanding of the processes that control mercury methylation and the subsequent bioavailability of mercury to the food chain. This understanding is necessary in order to determine whether methylation can be managed. The proposed regional pollutant policy includes provisions for defining water quality based effluent limits for point source discharges, and a series of actions to be taken by nonpoint source control agencies and entities. These provisions may serve as a TMDL for all segments of San Francisco Bay except possibly the extreme South Bay where a separate TMDL may be developed. Adequate funding to complete both the TMDL Basin Planning process and the methylation research and management efforts has not been identified. However, a grant from CALFED that has been awarded with the Department of Fish and Game as the principal investigator will provide significant information to assist in resolving these questions.

In order to identify and cleanup mercury sources under the jurisdiction of the Central Valley RWQCB, interregional coordination is necessary. Because these sources contribute such a high proportion of the load to the estuary, control of these sources as part of the San Francisco Bay Region's mercury strategy is essential. However, due to liability issues the State and interested private parties are limited in their ability to clean up mines in which there are no responsible parties. An amendment to the Federal Clean Water Act is needed in order to resolve this issue. In April 1998, the RWQCB completed a survey of all of the region's abandoned mines. In total, 41 mines were surveyed and mines that had actual or potential impacts to water quality were identified. The survey documented conditions at the mines through field inspections, photographs and chemical analyses. Five mercury mines with drainages to the San Francisco estuary were identified as having actual or potential impacts to water quality. The New Almedan mine was one of these mines and was by far the largest with the highest water quality impact. Recommendations were made for monitoring or controlling waste in these mines. The RWQCB is currently monitoring all of the North Bay tributaries to the Bay to identify areas with elevated mercury concentrations.

The New Almaden mercury mine was the second largest mercury mine in the world during its operation. The mine consists of several mines: those located within Santa Clara Almaden Quicksilver Park and those located outside the Park. Those mines located within Santa Clara County Almaden Quicksilver Park are currently being remediated under CERCLA. The Department of Toxic Substances Control is the lead agency, while the RWQCB provides input on water quality issues on this project.

Remediation of the mines within Santa Clara Almaden Quicksilver Park was divided into two phases: Phase 1: remediation of Hacienda Furnace Yard, and Phase 2: remediation of the rest of the Park. The Hacienda Furnace Yard was identified as the highest priority area, from a water quality perspective, of six areas in need of cleanup. In this location mine tailings were eroding directly into Los Alamitos Creek, a tributary to San Francisco Bay. Cleanup of this area began in the spring of 1996 and was completed in December 1997. Phase 2 of the project, which includes remediation of Mine Hill, San Francisco Open Cut, Enriquita Mine, San Mateo Mine, and Senator Mine was started in August 1998 and is scheduled to be completed January 1999. Mine Hill, San Francisco Open Cut and Enriquita Mine were identified as potential sources of mercury laden sediment that flow directly to Guadalupe and Almaden Reservoirs with surface runoff. Because mercury strongly binds to particulates, these reservoirs may be serving as a sink for mercury, therefore minimizing fluxes to the Bay. However, these reservoirs are currently posted with a health advisory on consuming fish because of mercury contamination.

With the completion of Phase 2 of the project, all known mine waste piles located within Santa Clara County Almaden Quicksilver Park will be either capped in place or moved to somewhere else in the Park and capped. However, other remaining sources of potential mercury contamination, i.e. those mines located outside the Park and mercury laden sediment from the overburden natural formations within the greater watershed areas of Guadalupe and Almaden Reservoirs, are yet to be addressed.

PCBs

PCBs are ubiquitous and diffuse in the sediments throughout San Francisco Bay. Although several areas have been identified that have elevated sediment concentrations (see Sites of Concern and Candidate Toxic Hot Spots), these levels do not approach sediment concentrations that have been measured in the Great Lakes or many East Coast harbors. Yet, the mass of PCBs in the estuary's sediment and possible ongoing sources have contributed to levels in fish that are a potential threat to human health. Sites with historically elevated levels of PCBs should be evaluated for cleanup (see Cleanup Plan for Point Potrero/Richmond Harbor), however, identification and cleanup of ongoing sources is extremely important.

The RWQCB has been working with dischargers, both point and nonpoint, and the RMP to identify sources of PCBs to the estuary. An article in the 1996 RMP annual report (SFEI, 1997) indicates that ongoing sources of PCBs are discharging to the Bay. To further this evaluation a RMP workgroup has been set up to evaluate PCB data from the Bay, perform a preliminary model of loadings and come up with conclusions and recommendations for future monitoring and studies. Preliminary results indicate that there may be significant ongoing sources. Results of a 1997 RMP fish pilot study indicate that fish from Oakland Harbor have distinctly higher levels of contaminants than at other areas monitored in the Bay. This was particularly true for mercury, PCBs, DDTs and dieldrin. Additional monitoring needs to be conducted in Oakland Harbor, particularly of stormwater runoff, to identify sources of these contaminants. A study was recently conducted by SFEI, with funds from an ACL from the Port of Oakland, in San Leandro Bay, a toxic hot spot just south of Oakland Harbor. Contaminants from San Leandro Bay may accumulate in the fish from Oakland Harbor that were sampled. The purpose of the study was to identify the extent and general sources of contamination. The results of this study are not yet available.

Chlorinated Pesticides

Lauritzen Canal is an area in Richmond Harbor that had extremely elevated levels of DDT. This site was recently cleaned up under CERCLA. Although U.S.EPA was the lead agency, the RWQCB coordinated with U.S.EPA and other agencies to implement the cleanup.

As with the other chemicals previously discussed, it is important to monitor discharges (both point and nonpoint) to the estuary for the identification and cleanup of sources of chlorinated pesticides. The Regional Board is working with dischargers and the RMP to identify sources of these contaminants. However, as was discussed under Future Needs, increased resources for watershed monitoring and assessment are needed to address this issue in a significant manner.

Dioxins

The Regional Board has requested the assistance of the California Environmental Protection Agency in addressing the problem of dioxin contamination, due to the cross-media issues that are involved in identifying and controlling any ongoing dioxin sources. Coordination with the Bay Area Air Quality Management District and the State Air Resources Board is essential in addressing this issue since the predominant source of this contaminant is through aerial deposition. A meeting was held in 1997 for scientists to present information on dioxin to the Regional Water Quality Control Board. Since the majority of dioxins in the Bay Area is likely generated by fixed and mobile combustion of diesel fuel and emission into the air, regulation of point source discharges into the Bay is unlikely to have an impact on the concentration of dioxin in sediment or organisms. Since even areas removed from sources contain background levels of dioxins that are potentially harmful to humans and other organisms, and since this group of contaminants are very persistent and can be spread great distances through aerial deposition, a global strategy is truly needed. This will probably require that the U.S. EPA take the lead in cooperation with the California Environmental Protection Agency in addressing this problem including instituting any additional control measures.

Summary of actions by government agencies in response to health advisory

Due to the large reservoir of mercury and PCBs in the estuary it may take decades for contaminant levels in fish to reach acceptable levels, even with full implementation of the cleanup plan. Therefore, interim measures should be taken to: (1) determine the rate of change in chemical concentrations in fish to determine if natural processes and required cleanup measures are having an effect, and over what time scale, (2) determine the risk of consuming fish from the Bay and identify high risk populations and (3) conduct public outreach and education programs, especially to high risk populations, in order to minimize their risk.

The RWQCB has been leading an effort through the RMP to conduct studies to address the first two issues. Several committees have been put together with representatives from State and Federal agencies, environmental groups and dischargers (who fund the program). A five year plan has been developed to: 1) measure contaminant levels in fish throughout the Bay every three years, 2) conduct special studies on specific species, organs or chemicals of concern and 3) conduct a consumption study to quantify the parameters that would go into a risk assessment for San Francisco Bay and to identify high risk populations for public outreach and education.

The second monitoring study of contaminant levels in fish tissue in the Bay, after the BPTCP study, was carried out through the RMP in the summer of 1997 by the Department of Fish and Game. Results will be published in the RMP's 1997 Annual Report. A special study was conducted in the spring of 1998 to measure contaminant levels in resident clams that are collected by clammers. A special study will be conducted in the spring of 1999 to measure contaminant levels in crabs. The State Department of Health Services has been hired to conduct the consumption study and this study is currently underway.

The Department of Health Services has been chairing a committee for Public Outreach and Education on Fish Contamination. As a result, County Health Departments and the East Bay Regional Parks District have posted signs at public fishing areas in six different languages describing the advisory. Currently, the committee is developing a strategy to more effectively educate the public on this issue. This strategy, however, is limited due to the lack of funding for this effort and the fact that there is no legal mandate that requires any agency to address this issue. Environmental groups have been using various forums to educate people who eat Bay fish on how to decrease their risk, but their funding is also very limited.

D. <u>Preliminary assessment of actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions</u>

1. Finish the cleanup of the New Almaden Mine.

2. Clean up sediment at Point Potrero that is high in PCBs (see Cleanup Plan Site B).

3. Finalize the Basin Plan amendment process to add the proposed TMDL, pilot permit offset program, and regional requirements for ongoing mercury sources. Once adopted, implement the two main components of the Region-wide Mercury Strategy. The first component is controlling ongoing, controllable sources, thereby enhancing the natural cleanup process and accelerating mine remediation work. The second component involves developing new technical information about mercury methylation and sediment fate and transport within different zones of the estuary. This information is needed to enable the Regional Board to manage methylation and bioaccumulation to the greatest extent possible.

4. Increase investigations into ongoing sources of mercury and PCBs and develop remediation plans for those sources. This action would require an increase in watershed monitoring and assessment (see Future Needs) and in the case of mercury would require coordination with the Central Valley RWQCB. PCBs should be fingerprinted to distinguish the difference between historic and ongoing sources. Biomarker methods could be used to more inexpensively screen for PCBs. The highest priority for monitoring should be in areas where fish contain higher levels of contaminants (Oakland Harbor), areas where sources of PCBs or mercury have been identified, and areas where these chemicals are or were used or produced.

5. Continue RMP studies on fish contamination issues.

6. Increase public education to:

   a. Inform people who consume San Francisco Bay fish, especially high risk populations, about the health advisory and ways to decrease their risk and,

   b. Inform the public on product use and replacement in order to decrease concentrations of chemicals of concern. This could include the use of dioxin free paper, the substitution or conservation of diesel fuel, limiting the use of fireplaces and wood stoves and the substitution of mercury containing products~~ such as thermometers~~.

   Endangered species consultations will take place for any part of this plan for which it is required.

E. <u>Estimate of the total cost to implement the cleanup plan</u>

1. Cleanup of New Almaden Mine - $10 million (includes the amount already spent for cleanup, $5 million, and the additional amount expected to be needed to complete the cleanup).

2. Point Potrero cleanup - $ 800,000 - $3,000,000

3. Implement Mercury Strategy - $10-20 million

   a. Finalize and implement Basin Plan amendment
   b. Technical studies including:

Fate and transport of particle-bound mercury in Bay system
Mercury methylation studies

4. Ongoing sources

    a. Watershed investigations to identify ongoing sources of the chemicals of concern in the San Francisco Bay and Central Valley Regions - $4 million over 5 years

    b. Costs of cleanup once sources are identified - Unknown

5. RMP studies (including monitoring of contaminant levels in fish every three years and special studies) - Average $75,000/year (1998-99 special studies and consumption study are already funded)

6. Public Education

    a. Outreach and education to people consuming fish from the Bay to reduce their health risk (including DHS staff, translations, training and educational materials) - $150,000 for first two years then $50,000/year

    b. Educational efforts on source control and product substitution - $50,000

Total to Implement Plan - Approximately $25 to $45 million (not including cleanup of ongoing sources that have not yet been identified)

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of mercury and PCBs in San Francisco Bay that are accumulating in fish. These concentrations have lead to a human health advisory on consuming fish but probably also impact other higher trophic organisms, such as marine mammals and birds that have a much higher consumption rate than humans, as well as possibly the fish themselves. The beneficial uses that are impacted are OCEAN, COMMERCIAL AND SPORTFISHING (COMM), MARINE HABITAT (MAR), ESTUARINE HABITAT (EST), WATER CONTACT RECREATION (REC1), NONCONTACT WATER RECREATION (REC2) and probably WILDLIFE (WILD) and SHELLFISH HARVESTING (SHELL). Implementation of this plan is intended to lower concentrations of these chemicals in fish and minimize or eliminate the impacts on beneficial uses. For a more thorough description of the benefits to restoring beneficial uses see Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

Ongoing RMP studies are currently funded by dischargers at approximately $75,000/year. Cleanup of the New Almaden Mine in Santa Clara Almaden Quicksilver Park ($5 million) and Point Potrero ($0.8 - $3.0 million) will be paid for in full by the responsible parties. The total equals approximately $5.8 million to $8 million plus $75,000/year for RMP studies.

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

Although funding is available for continuation of the RMP studies and the cleanup of Point Potrero and the part of New Almaden Mine in Santa Clara Almaden Quicksilver Park there is little or no funding for the other parts of the cleanup plan.

References

Flegal, A.R., R.W. Riseborough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program: Sediment Studies. Final Report for San Francisco Bay Regional Water Quality Control Board. July, 1994.

Hornberger, M.I., S.N. Luoma, A. van Geen, C. Fuller, R. Anima. 1999. Historical Trends of Metals in the Sediments of San Francisco Bay, California. Mar. Chem. 64: 39-55.

Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, K. Taberski, C. Wilson, M. Stephenson, H. Puckett, R. Fairey and J. Oakden. 1998. Sediment Quality and Biological Effects in San Francisco Bay. pp.188 + Appendices A-E.

Office of Environmental Health Hazard Assessment (OEHHA). 1994. Health Advisory on Catching and Eating Fish-Interim Sport Fish Advisory for San Francisco Bay. Sacramento, CA.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), SWRCB, CDFG. 1995. Contaminant Levels in Fish Tissue from San Francisco Bay.

SFBRWQCB. 1998. Mines Report. pp.75.

San Francisco Estuary Institute (SFEI). 1994. 1993 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

SFEI. 1995. 1994 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

SFEI. 1996. 1995 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA

SFEI. 1997. 1996 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA

U.S. EPA. 1993. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1. Fish Sampling and Analysis. EPA 823-R-93-002. Office of Water. Washington, D.C.

U.S. EPA. 1995. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1. Fish Sampling and Analysis. Second Edition. EPA 823-R-95-007. Office of Water. Washington, D.C.

Site B -- Peyton Slough

Description of site

Peyton Slough is located in Martinez, northern Contra Costa County, California. The slough discharges into the San Francisco estuary at the confluence of Suisun Bay and the Carquinez strait, near Bull Head Point, just east of the Benicia Bridge (Figure B-1).

Sediments in Peyton Slough are comprised of firm clays that do not appear to erode easily (CH2MHILL, 1986). Sediments from Peyton Slough appear to have been dredged in the past with the dredge spoils deposited on the east and west shore forming levees. There are openings in the east levee downstream of the tidal gate that provide exchange between Peyton Slough and a large brackish wetland to the east of the slough.

During the winter, Peyton Slough receives fresh water discharge from the Contra Costa Canal and storm water runoff from the surrounding area. During the dry weather months, Peyton Slough receives fresh water treated discharge primarily from a waste water treatment plant (Mountain View Sanitary District) through a tidal gate. Some minor flow from the Contra Costa Canal may also occur during the dry months. A tidal gate had been configured such that fresh water from upstream can be released when the water level is greater on the upstream side of the gate. In 1998, this tidal gate was replaced with a newer gate which will allow water to flow from the bay into a wetland area situated upstream from Peyton Slough.

Two major historical industrial activities have taken place in the vicinity of Peyton Slough on a site currently owned and operated by Rhodia: sulfuric acid production and the smelting of copper. ~~Currently, treated waste water is discharged into Carquinez Straits via Peyton Slough by Mountain View Sanitary District.~~ Historically, the first recorded industrial use near Peyton Slough was by the Mountain Copper Company (MOCOCO). This company used the site for a copper smelting operation from the early 1900s until 1966 at which time it was purchased by Stauffer Chemical Company. During the smelting of copper, a fused

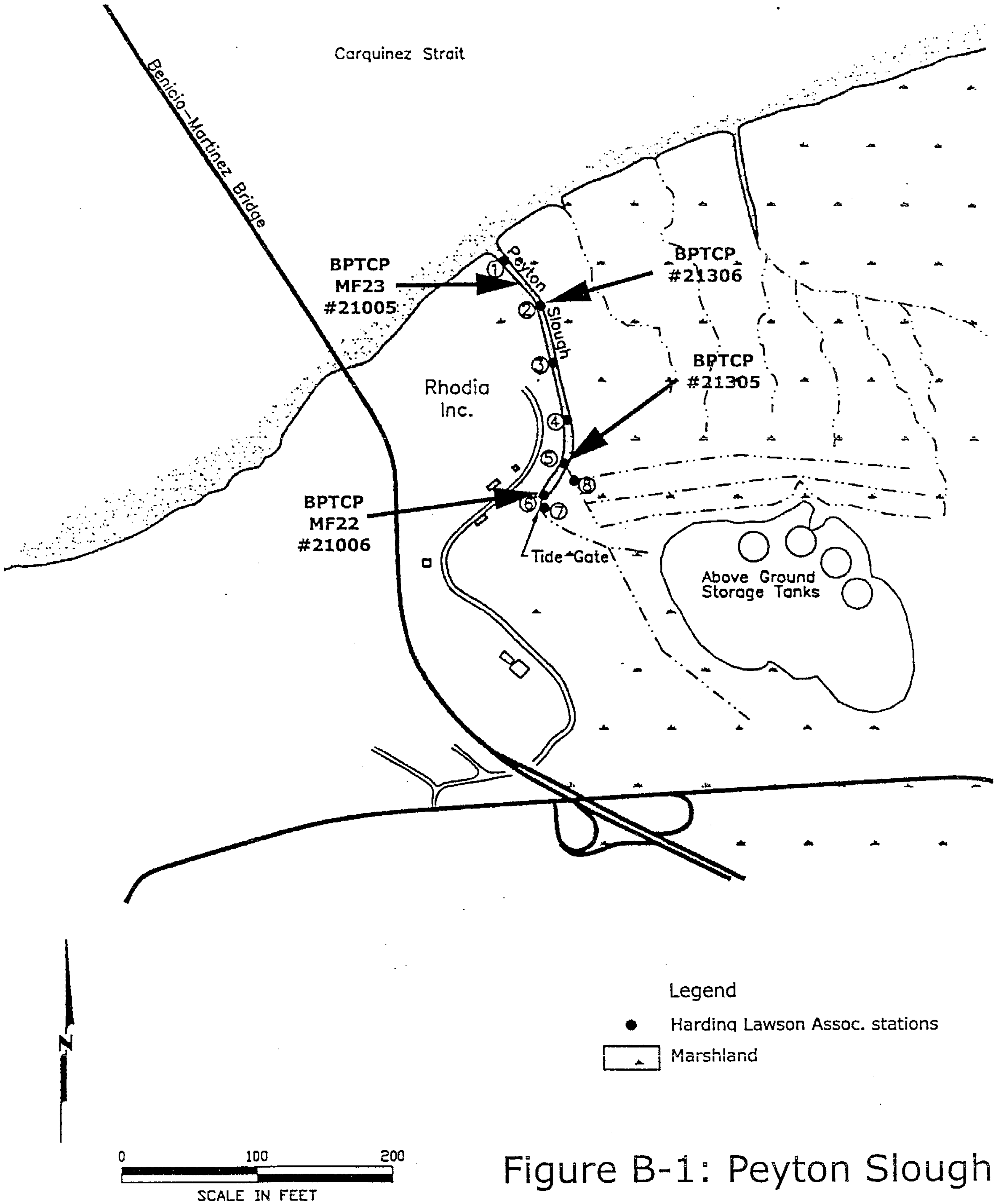


Figure B-1: Peyton Slough

silicate slag was generated which was discharged over the north and south sides of the hillside housing the smelter. MOCOCO also roasted pyrite ore to recover its sulfur. Resulting cinders remain on site.

Cinder and slag, classified as Class B Mining Waste, from the smelting operations were stored in large piles on the site. The north cinder/slag area covers 8.3 acres, while the south cinder/slag covers 7.1 acres. Due to their weights, the cinder and slag piles subsided 30 to 35 feet into the softer bay mud below the existing ground surface. Stauffer Chemical Company bought the site from MOCOCO and removed the cinder/slag piles to the depth of the water table, but it is estimated that over 500,000 tons of waste material remains below the surface. The remaining north and south cinder/slag piles have been capped with a minimum of two feet of low permeability soil in 1978 and 1980 respectively.

In 1972, a leachate removal and containment system (LRCS) was installed in response to a cease and desist order No. 71-21 issued by the RWQCB (The MARK Group, 1988b). The LRCS prevented leachate from moving to Carquinez Strait and Peyton Slough by a cut-off wall consisting of compacted bay mud along the bay shoreline. Prior to 1988, the leachate from the north cinder/slag area was pumped to a north solar evaporation pond. Leachate from the south cinder/slag piles was pumped from two deep sumps to the south solar evaporation pond. Starting in 1988, the Process Effluent Purification (PEP) system was installed and began treating this leachate prior to discharge to a deep water outfall. Cutoff walls were not constructed along Peyton Slough. However, to date there is no evidence that leachate is being discharged into the slough.

Currently, the Contra Costa Mosquito Vector Control District (CCMVCD) is planning a restoration project in Shell marsh. This project intends to restore the marsh south of Peyton Slough back to a brackish marsh with regular inputs of salt water from San Francisco Bay. As part of this project, the CCMVCD has replaced the tidal gate in Peyton Slough and is proposing to dredge Peyton Slough to allow for higher flows of saline water up the slough into Shell marsh. This project is partially funded by Caltrans to mitigate for discharge from Route 680 and to prevent flooding of the highway. Rhodia is also working with CCMVCD to coordinate the dredging of Peyton Slough. Regional Board staff has been helping to coordinate completion of the marsh restoration project in order to remediate the toxic hot spot, restore Shell marsh and alleviate flooding on Route 680.

Reason for listing

Multiple investigations have shown that sediments from Peyton Slough have elevated concentrations of metals, especially copper and zinc. Copper and zinc concentrations (Table B-1) in Peyton Slough were the highest from over 600 samples analyzed statewide by the BPTCP. The metal contamination can be traced to past activities at a nearby industrial site, and perhaps also to the continued presence of slag and cinder below the water table. The contaminated sediment was shown to exhibit recurrent toxicity over time to two different aquatic organisms (Table B-2), and the Toxicity Identification Evaluation (TIE) points to metals as the source of toxicity (Table B-3). In addition, although benthic community indices categorized this site as transitional, the upper and end stations rated only slightly higher than the cutoff of 0.3 (Table B-4).

CH2MHILL (1986)

This study was conducted to determine the chemical constituents of the effluent discharged from Stauffer Chemical Company (SCC). Since 1988, this discharge has been released to the deepwater outfall in Carquinez Strait. The potential impacts of the effluent discharge on the aquatic habitat in Peyton Slough was also analyzed. As part of this study, the following components were examined: water quality, benthic organisms, plankton and fish larvae, fish, and mussel bioaccumulation.

The mean metal concentrations in effluent were greater than the chronic marine Ambient Water Quality Criteria (AWQC) for lead and zinc and the acute AWQC for copper and zinc. Sediment metals also had elevated concentrations of copper and zinc. Although the abundance and diversity of benthic infauna varied more in Peyton Slough than in Carquinez strait, this report concluded that benthic infauna do not seem to be impacted by SCC discharge. No significant bioaccumulation of copper and zinc in mussel tissue was detected in Peyton Slough.

The MARK Group (1988a, 1988b, 1989a, 1989b)

The MARK Group conducted several investigations at the former Stauffer Chemical Co. site. The studies on the cinder/slag area and the solar evaporation ponds relate to potential sources of metals released to Peyton Slough. The results of these investigations are described below.

The sludge in both solar evaporation ponds had elevated zinc concentrations. Cadmium, chromium, copper, lead and mercury were released by the WET procedure from both pond sludges at concentrations greater than the, Title 22, STLC (The MARK Group, 1988b).

The concentrations of metals were measured in both north and south cinder piles. Cinders in the north area had elevated copper and zinc concentrations of 3150 mg/kg and 6600 mg/kg respectively. Cinders from the south area had elevated copper, lead and zinc concentrations of 1580, 1030 and 1190 mg/kg respectively.

Bay Protection and Toxic Cleanup Program

Pilot Regional Monitoring Program (Flegal et al., 1994)

As part of the Pilot Regional Monitoring Program (PRMP), two marsh sediment samples were collected in Peyton Slough on July 24, 1991: one from the mouth and the other at the south end. Both samples were analyzed for chemical constituents (Table B-1). The sample from the south end of Peyton Slough had the greatest concentrations of cadmium (19.5 mg/kg), copper (2960 mg/kg), and zinc (4390 mg/kg) detected in San Francisco estuary marsh sediments as part of the PRMP. In toxicity tests, mortality of *Eohaustorius estuarius* for the sediment sample collected from the south end of Peyton slough was significantly higher than a home sediment from Monterey Bay (Table B-2).

Screening and Confirmation Studies (Hunt et al., 1998)

Under the Bay Protection and Toxic Cleanup Program, the RWQCB collected two screening and three confirmation samples from Peyton Slough (Figure B-1). Sampling location 21006 (1995 and 1997) is located in the upper portion of Peyton Slough.

Sample location 21305 (1997) is located mid-gradient in the slough. Sample locations 21306 (1997) and 21005 (1995) are located end-gradient and at the mouth of the slough respectively.

One 1995 sample (21006) and all three 1997 samples were analyzed for chemical constituents. Table B-1 compares analytical results to ambient concentrations in San Francisco Bay and to NOAA's Effects Range Median (ERMs) values. Elevated concentrations of cadmium, copper, lead, silver and zinc were detected in these sediments. Copper and zinc concentrations of 7800 mg/kg and 6000 mg/kg were the highest detected in over 600 samples collected statewide in the BPTCP. Mean ERM quotients of 3.58 and 2.35 were measured in the 1995 and 1997 upper site samples (21006). Mean ERM quotients greater than 0.5 are believed to represent elevated concentrations of mixtures of chemicals.

The sediments collected at the upper portion of the site, location 21006, exhibited recurrent toxicity in the 10-day solid phase amphipod test in 1995 and 1997 (Table B-2). Toxicity to *Eohaustorius estuarius* was also found in the mid and end-gradient sediments (21305 and 21306) collected in 1997. Sea urchins, *Strongylocentrotus purpuratus,* also exhibited recurrent toxicity in porewater and sediment-water interface exposures.

Toxicity Identification Evaluations (TIEs) were performed on porewater from the upper Peyton Slough site. Reduction of toxicity was shown for the treatments that remove metals from solution, such as EDTA and STS. The evidence from the TIE results indicate that toxicity to aquatic organisms could be linked to metals such as copper and zinc, which are present at elevated concentrations in these sediments (Table B-3).

Benthic community analyses of the three confirmation samples showed transitional aquatic communities. However, at the upper and end stations, the Relative Benthic Index (RBI) was just greater than the BPTCP cutoff of 0.3 for significantly impacted benthic communities. The RBI is a calculated value considering the total fauna, total mollusk species, crustacean species and indicator species at a site. A RBI of less than or equal to 0.3 is an indicator that pollutants or other factors are negatively impacting the benthic community (Table B-4). The RBI ranges from 0 - 1.0.

Harding Lawson Associates (1998)

Under direction from the RWQCB, Rhodia asked Harding Lawson Associates (HLA) to conduct a site investigation in Peyton Slough. HLA collected sediment cores of varying depths at eight sampling locations in Peyton Slough. Multiple depth intervals from each core were analyzed for selected metals. Elevated concentrations of cadmium, copper, lead and zinc were detected throughout Peyton Slough (Table B-5). In specific locations, vertical extent of contamination could not be determined as the deepest sample, 8 feet below the sediment surface, still showed elevated concentrations of one or more metals.

Table B-1. Selected Concentrations of Analytes in Peyton Slough Sediments
A. BPTCP Studies (Pilot RMP and Screening/Confirmation Studies)

ANALYTE	Ambient Values[a]	ERM[b]			Sampling Location			
			MF22 (7/24/91)	MF23 (7/24/91)	21006 (5/1/95)	21006 (4/2/97)	21305 (4/2/97)	21306 (4/2/97)
METALS (mg/kg)								
Arsenic	15.3	70	NA	NA	53.5	32.1	36.3	20.5
Cadmium	0.33	9.6	19.5	0.32	27.9	19.6	2.14	0.82
Chromium	112	370	124	78.5	277	127	141	76.8
Copper	68.1	270	2,960	92.2	7,800	3,780	386	132
Lead	43.2	218	62.6	14.2	214	1,140	63.1	23.8
Mercury	0.43	0.71	NA	NA	0.568	0.268	0.31	0.258
Nickel	112	51.6	101	79.4	145	NA	NA	NA
Selenium	0.64	NA	NA	NA	2.27	0.623	1.16	0.536
Silver	0.58	3.7	1.76	0.53	3.81	5.85	2.02	0.23
Tin	NA	NA	NA	NA	45.2	72.7	3.84	2.95
Zinc	158	410	4,390	234	6,000	4,680	741	718
CHLORINATED ORGANICS (ug/kg)								
Chlordanes, total	1.1	NA	7.17	0.985	20.9	5.8	1.3	1.8
PCBs, total	14.8	180	80.3	14.5	217	41.9	59.8	54.0
DDTs, total of 6 isomers	7	46.1	22.1	3.5	95.7	23.4	16.4	19.5
POLYNUCLEAR AROMATIC HYDROCARBONS (ug/kg)								
PAHs, total	3,390	44,792	1727	469	9,251	1,027	691	2,744
High molecular weight PAHs, total	434	9,600	1,537	429	8,115	887	578	1,192
Low molecular weight PAHs, total	3,060	3,160	40.9	40	1,137	140	113	1,552
a) San Francisco Bay Ambient Concentrations (SFB-RWQCB, 1998)								
b) NOAA Effects Range-Medium (Long et al., 1995)								
NA Not Available								

Table B-2. BPTCP Bioassay Results for Sediments from Peyton Slough

Species	End Point	Medium	Duration	a) Sampling Location						
				MF22 (7/24/91)	MF23 (7/24/91)	21005 (5/1/95)	21006 (5/1/95)	21006 (4/2/97)	21305 (4/2/97)	21306 (4/2/97)
Strongylocentrotus p.	Percent normal development	100% Pore Water	96 hours	NA	NA	63	0*	0*	NA	NA
Strongylocentrotus p.	Percent normal development	50% Pore Water	96 hours	NA	NA	84	0*	0*	NA	NA
Strongylocentrotus p.	Percent normal development	25% Pore Water	96 hours	NA	NA	89	1*	0*	NA	NA
Strongylocentrotus p.	Percent normal development	Sediment-water interface	96 hours	NA	NA	NA	NA	1*	0*	81
Eohaustorius e.	Percent survival	Bulk sediment	10 days	60*	80	87	1*	69*	59*	14*

NA - Not Applicable - Test not performed

* Samples toxic

Table B-3 Toxicity Identification Evaluation (TIE) for Upper Site Sediment Peyton Slough

Percent Normal Development					Effective Treatment
TIE Treatment	Porewater Concentration (%)				
	0	3	5	15	
Baseline	87	98	69	0	-
EDTA	96	97	97	97	Yes
STS	76	98	96	79	Yes
Aeration	98	85	79	0	
Filtration	95	72	96	94	Yes
C18 Column	95	95	100	94	Yes
Methanol Eluate	99	98	96	99	Yes
pH 7.9	97	45	52	0	
pH 8.1	97	94	84	0	
pH 8.4	95	96	51	0	
PBO	97	95	79	0	

Table B-4. Community Analysis Results for Sediments from Peyton Slough BPTCP Study

Sampling Location	Station	Total Individuals	Number of Species	Benthic Index
Upper (#1)	21006	250	4.3	0.36
Mid (#2)	21305	1,296	7.7	0.51
End (#3)	21306	29	3.0	0.34

Table B-5. Concentration of Selected metals in Peyton Slough Sediments HLA Study (1998)

Sampling Location	Sample Depth	Analyte			
		Cadmium	**Copper**	**Lead**	**Zinc**
1	0' to 1'	7	817	55	1,700
	1' to 2'	8	1,610	72	2,120
	2' to 3'	15	3,200	54	2,530
	4' to 5'	NA	455	NA	852
2	0' to 1'	3	278	62	1,640
	1' to 2'	2	501	65	1,180
	2' to 3'	ND (1)	97	43	581
	3' to 5'	NA	29	NA	112
3	0' to 2'	19	3,980	72	2,830
	2' to 3'	32	6,540	73	3,920
	3' to 4'	6	1,250	70	1,860
	5' to 6'	NA	341	NA	1,330
4	0' to 3'	47	10,300	77	7,260
	3' to 4'	40	7,630	75	5,300
	4' to 5'	17	3,660	59	3,700
	5' to 6'	NA	1,800	NA	2,760
5	0' to 4'	133	61,100	400	21,700
	4' to 5'	118	28,400	115	15,400
	5' to 6'	63	18,600	93	11,000
	7' to 8'	NA	12,200	NA	7,130
6	0' to 2'	6	2,980	67	1,220
	2' to 3'	6	3,700	61	1,300
	3' to 4'	3	2,530	32	667
	5' to 6'	NA	70	NA	97
7	0' to 4'	25	49,900	201	6,360
	0' to 2'	NA	121,000	NA	7,680
	2' to 4'	NA	6,280	NA	5,480
	4' to 5'	ND (1)	131	ND (20)	101
	5' to 6'	ND (1)	64	ND (20)	88
8	0' to 1'	ND (1)	51	ND (20)	71
	1' to 2'	ND (1)	35	ND (20)	81
	2' to 3'	ND (1)	33	ND (20)	79
Culvert Site	NA	2	245	ND (20)	522
40 Pole Site	NA	3	73	ND (20)	427

A. Assessment of areal extent of the THS

Elevated metal concentrations were detected from the mouth of Peyton Slough all the way to the tidal gate. Toxicity to aquatic organisms was found at all BPTCP locations, but recurrent toxicity was only measured at the upper sampling location. The areal extent of the channel is approximately 1.25 acres.

B. Assessment of the most likely sources of pollutants

The most likely source of contaminants in Peyton Slough is the historical industrial activity associated with the creation of the cinder/slag piles. Potential current subsurface transport of metals in groundwater from the buried cinder piles to Peyton Slough is not known.

C. Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs

In 1972, a leachate removal and containment system (LRCS) was installed in response to a cease and desist order No. 71-21 issued by the RWQCB (The MARK Group, 1988b). The LRCS prevented leachate from moving to Carquinez Strait and Peyton Slough by a cut-off wall consisting of compacted bay mud along the bay shoreline. Prior to 1988, the leachate from the north cinder/slag area was pumped to a north solar evaporation pond. Leachate from the south cinder/slag piles was pumped from two deep sumps to the south solar evaporation pond. Starting in 1988, the Process Effluent Purification (PEP) system was installed and began treating this leachate prior to discharge to a deep water outfall. Cut-off walls were not constructed along Peyton Slough, however, to date there is no evidence that leachate is being discharged in to the slough.

Waste Discharge Requirements for Rhodia have been regulated under the National Pollution Discharge Elimination System (NPDES) Permit No. CA 0006165 and Order 93-060 in June 1993, which was amended by order 96-033 in March 1996. Recently, the SFB-RWQCB reissued Waste Discharge Requirements, under Order No. 97-121, which rescinded previous Orders. Leachate from the onsite cinder and slag piles are mixed with the treated process waste water. Until recently, this discharge was located in the tidal section of Peyton Slough about 800 yards upstream of its confluence with Carquinez Strait and 200 feet downstream of the tidal gate. Currently, this discharge goes to a deepwater outfall located in the Carquinez Strait. Another source of discharge from the Rhodia site originates from storm water runoff from the Caltrans I-680 and Benecia bridge, and from the western highlands drain collection system located on this property. This runoff flows via a pipeline into a usually submerged discharge point in Peyton Slough.

As part of the reissuance of Waste Discharge Requirements in Order No. 97-121, Rhone Poulenc, now Rhodia, was asked to submit a workplan, including a detailed schedule, for investigation of metal contamination in Peyton Slough sediments. The workplan has been submitted, and a site investigation is being completed. Results of this site investigation are provided in a previous section (Reason for Listing). The RWQCB has asked Rhodia to provide a remedial workplan based on these results.

Mountain View Sanitary District (MVSD) discharges an average of 1.47 million gallons per day MGD to 21 acres of intensively managed marsh ponds at a location 1,000 yards upstream of the tidal gate under NPDES Permit No. CA 0037770, Order 93-001. Wet weather flows have been approximately 3.5 MGD, with wet weather peaks of 11.1 MGD allowed. Effluent in Peyton Slough backs up onto 68 acres of wetland also managed by the discharger.

D. <u>Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions</u>

The CCMVCD Shell marsh restoration project needs to deepen Peyton Slough in order to enhance salt water flow into Shell marsh. Rhodia is currently coordinating their remediation plan for Peyton Slough with this project, and is studying the feasibility of various other activities. Dredging of contaminated sediments to three feet below needed depth and back filling with clean materials has been proposed for Peyton Slough since contamination has been shown to extend to at least 8 feet below the sediment surface. Dredging and capping with clean compatible fill seem to be the most feasible alternative since contamination is so deep and the slough is so narrow removal of all contaminated sediment would cause instability of the sidewalls. Follow-up monitoring would be required to make sure that the cap stays in place and is effective. Contaminated sediments to be dredged are estimated at 12,000 cubic yards and will be disposed at a regulated off site landfill. An endangered species consultation with all appropriate agencies is currently in progress.

E. Estimate of the total cost to implement the cleanup plan

Based on the proposed remediation, the estimated cost is for 12,000 cubic yards of sediments to be dredged and disposed, and for a three-foot cap to be put in place in the entire slough. The range of costs are approximately $400,000 to $1,200,000 depending on the methodology followed for the cleanup, and other potential activities such as building a subsurface cut-off wall or a cap on the sidewall along the slough to control groundwater discharge. Follow-up monitoring would cost approximately $5,000 -$10,000/year. RWQCB staff costs are estimated at $10,000 to $50,000 over the entire course of the project.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of chemicals at this site. The beneficial use that is impacted is ESTUARINE HABITAT (EST). Sediments from this site cause toxicity to test organisms and may have an impact on the benthos. Since Peyton Slough will be the main conduit of water from Carquinez Straits to the restored Shell marsh, cleanup of this site will prevent other marsh organisms from being exposed to chemicals from the slough. Implementation of this plan will minimize or eliminate this impact on the beneficial use. For a more thorough description of the benefits to restoring beneficial uses see Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs incurred as a result of site cleanup at Peyton Slough as well as the cost for RWQCB and other regulatory staff oversight. However, Caltrans has budgeted $300,000 toward the CCMVCD restoration project which can be partially used to defray the cost of dredging.

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

The responsible party or parties are accountable for all costs incurred as a result of site investigations and cleanup at Peyton Slough as well as the cost of RWQCB and other regulatory staff oversight.

References

CH2MHILL. 1986. Equivalent Protection Study for Stauffer Chemical Company, Martinez Sulfuric Acid Plant. Prepared for Stauffer Chemicals. December 1986. 78 p. and Appendices.

Flegal, A. R., R. W. Risebrough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program, Sediment Studies, Final Report, July, 1994.

Harding Lawson Associates (HLA). 1998. Results-Peyton Slough Sediment Investigation-Rhodia Inc. Martinez, CA.

Hunt J.W., B.S. Anderson, J. Newman, R.S. Tjeerdema, K. Taberski, C.J. Wilson, M. Stephenson, H.M. Puckett, R. Fairey and J. Oakden. 1998. Sediment Quality and Biological Effects in San Francisco Bay. Final Technical Report. Pp. 118. Appendices A-E.

The MARK Group. 1987. Interim Report of Subsurface Conditions. Stauffer Chemical Company, Martinez, California. August 1987.

The MARK Group. 1988a. Work Plan-Site Investigations Report. Sulphur Products Facility. Stauffer Chemical Company, Martinez, California. May 1988.

The MARK Group. 1988b. Two Solar Evaporation Surface Impoundments. Amended Closure Plan.

The MARK Group. 1989a. Site Investigation Report. Sulfur Products Facility. Stauffer Chemical Company, Martinez, California. March 1989.

The MARK Group. 1989b. Addendum to Site Investigation Report. Sulfur Products Facility. Stauffer Chemical Company, Martinez, California. May 1989.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments. May 1998.

Site C - Castro Cove

Description of site

Castro Cove is a protected embayment located in the southern portion of San Pablo Bay in Richmond, CA (Figure C-1). Castro Cove is defined as the cove enclosed by a line drawn from the Point San Pablo Yacht Club breakwater to the northwest corner of the West Contra Costa Sanitary Landfill. The embayment is protected by diked margins on the west, south and most of its eastern margin. The southeastern portion, where Castro Creek enters the cove, is a salt marsh. Castro Cove is shallow with extensive mudflats and marshlands that are subject to tidal action. Castro Creek empties into a channel that is about 30 to 75 feet wide and about three to six feet deep at mean lower low water.

Reason for listing

Since studies started in 1987 for Chevron's deep water outfall, petroleum hydrocarbons have been detected in Castro Cove. Several studies showed high levels of PAHs in the southwest portion of Castro Cove, the area where an historic outfall was located. The last surface sample collected in Castro Cove by the BPTCP, in 1995, had the highest concentration of PAHs measured in over 600 samples analyzed for PAHs statewide. The concentration of PAHs in this sample (227,800 ppb) was over four times the ERM and was collected in the top five centimeters of sediment. This was the highest concentration of PAHs ever collected at this site. Individual PAHs also exceeded ERMs. Several studies, including the BPTCP, also showed levels of mercury exceeding the ERM. In the last BPTCP sampling, chlordane was measured at levels exceeding the ERM and selenium and dieldrin were measured at elevated concentrations.

Toxicity tests have been conducted on sediments from Castro Cove on five separate occasions. Significant toxicity has been observed in several species of amphipods and in urchin and bivalve development tests during the five sampling events. The southwest portion of the cove always showed toxicity when sampled. The last samples collected by the BPTCP, in 1995, had 0% amphipod survival and 0% normal urchin development.

For three years, from 1988 to 1990, the State Mussel Watch Program deployed mussels in Castro Cove. Their results showed increasing concentrations of PAHs over these three years. In addition, the last sample collected had the second highest PAH concentration (40,210 ppb dry weight) of any sample measured statewide in the 20 year history of the program.

The benthic community at Castro Cove has been sampled three times, in 1989, 1990 and 1991. All three sampling events identified species in Castro Cove that were indicative of stressed or frequently disturbed environments. An evaluation of the 1991 data in the 1996 RMP Annual Report categorized this site as a moderately contaminated sub-assemblage due to the presence of species indicative of stressed environments.

As part of the PRMP gradient study conducted in Castro Cove in 1991, speckled sanddabs were exposed to Castro Cove sediment in the laboratory. Results showed increasing effects with increasing PAH concentrations. The most significant effects were seen in fish exposed to sediment from the area of the old outfall. Fish exposed to sediments collected at stations in Castro Cove showed statistically significant gill histopathology. Gill histopathology was significantly correlated with PAH concentration of the sediment, as well as with P4501A content in the gills and hepatic EROD activity, both indicators of exposure to PAHs. These studies are described in more detail below.

E.V.S. investigations (1987)

This study was performed in order to comply with State Order 86-4 and an NPDES permit requiring an investigation of sediment quality along a deep-water outfall. The 1987 E.V.S. study was undertaken to determine the quality of deep sediments at sites along the location of the deepwater outfall. As part of this investigation, three replicate cores from five stations in San Pablo Bay, including a reference site, were collected. Two of these stations were in Castro Cove. The three replicate cores from each station were composited and homogenized.

All five samples were analyzed for grain size, percent moisture, total organic carbon, total petroleum hydrocarbons, biochemical oxygen demand, and total and dissolved sulfides. Additionally, two sediment toxicity tests, a ten-day amphipod survival bioassay and a 48-hour suspended phase bivalve larvae development test, were performed for all five composite samples.

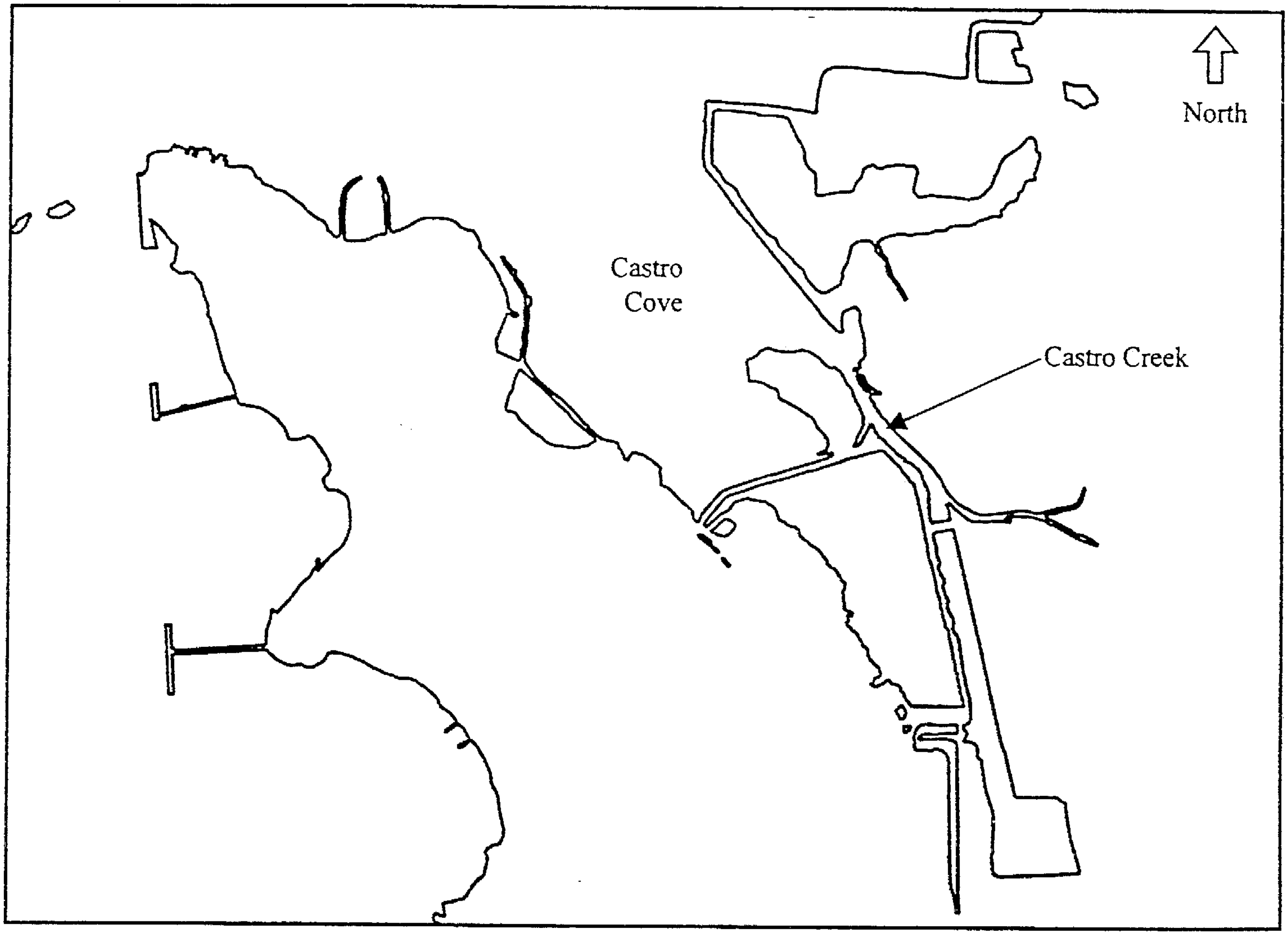


Figure C-1. Castro Cove

Oil and grease and petroleum hydrocarbons were detected at one location just outside Castro Cove. The results of the amphipod survival test showed lower survival rates with sediments from stations in Castro Cove. For the bivalve larvae bioassay, all five test samples had significantly lower rates of normal development than the sediment control.

Entrix Investigations (1990a, 1990b)

Entrix conducted a three-year monitoring program at Castro Cove and the adjacent portions of San Pablo Bay to monitor potential changes in sediment chemistry, benthic organisms, and eelgrass chemistry after relocation of the effluent discharge. The monitoring activity results are presented in two reports (Entrix, 1990a, 1990b). Ten surface sediment locations within Castro Cove were sampled six times over a three-year period. Sediment and tissue samples were also collected at offshore and shoal locations. Sediment samples were analyzed for chemical and physical parameters, as well as for benthic organisms. Tissue samples were analyzed for metals only.

Castro Cove sediments were finer than those from Castro Creek and from San Pablo Bay. Oil and grease was detected both in Castro Cove and in offshore sediments. The greatest concentrations of oil and grease within Castro Cove were usually detected where Castro Creek enters Castro Cove. Mercury was detected at concentrations greater than the ERM in Castro Cove.

The Benthic Community Monitoring Program Report (Entrix, 1990b) presented the results of the October 1989 and May 1990 sediment sampling and analysis. In both sampling events, the number of benthic taxa was greatest in Castro Cove followed by the area around the deep water outfall diffuser. The Castro Creek sampling locations had lower numbers of benthic taxa then the Castro Cove stations. The top four species detected in Castro Cove in both surveys were the same and are considered indicators of stressed or frequently disturbed environments.

E.V.S. study (1991)

This study was undertaken to complement the previous EVS study (EVS, 1987) to complete the requirements of State Order 86-4. An NPDES permit also required Chevron to monitor sediments for metals, organic compounds and benthic organisms in Castro Cove and offshore areas. Core and grab samples were collected at 11 stations within Castro Cove and at two reference locations in San

Pablo Bay. The sediment analyses included physical and chemical parameters, and two toxicity tests. Physical parameters consisted of grain size and percent solids. Chemical parameters consisted of oil and grease, total organic carbon, total sulfide, eight metals, SVOCs, phenols and organochlorine pesticides. A 10-day amphipod survival test and a 48-hour bivalve larvae development test were performed on the top 0.5-foot section of each core sample.

Most sediment samples had detected concentrations of oil and grease. Elevated concentrations of oil and grease were detected in the southwest portion, the area of the historic discharge, and at the entrance of Castro Cove. SVOCs were detected in surface sediments in the southwest of Castro Cove.

The surface sediments showed significantly decreased amphipod survival at both stations in Castro Creek and at five of nine stations in Castro Cove compared to that for reference and control sediments. Sediments from the southwest and northeast portions of Castro Cove exhibited the highest amphipod mortality. Sediments from the northeast and southern portion of Castro Cove exhibited significantly higher abnormal development in bivalves when compared to a control.

Mussel Watch Program (1988, 1990)

As part of the State Mussel Watch Program, bioaccumulation of contaminants was measured in Castro Cove (SWRCB, 1995). Mussels were deployed on three separate sampling events. They were collected on January 18, 1988, December 29, 1988, and on March 21, 1990. PAHs were detected in mussel tissues at concentrations of 12,530, 24,960 and 40,210 ppb dry weight, for those respective dates. The concentration of PAHs from mussels collected on March 21, 1990 was the second highest concentration measured statewide in the 20 year history of the State Mussel Watch Program.

Bay Protection and Toxic Cleanup Program

Castro Cove was sampled three different times under the BPTCP to determine if sediments were being naturally capped. Chemical analyses and toxicity tests were performed to determine if concentrations of contaminants or the levels of toxicity were decreasing. Samples were collected in Castro Cove under the Pilot Regional Monitoring Program, the Reference Site Study and the Screening/ Confirmation Studies.

Pilot Regional Monitoring Program (Flegal et al., 1994)

As part of the PRMP, sediment quality was assessed along a contamination gradient in Castro Cove in May 1991. The gradient study objectives were to evaluate sediment sampling, chemistry and toxicity test methods for the BPTCP and the RMP. Several different sediment toxicity tests were evaluated for a series of sampling stations for which previous studies had shown a gradient of chemical contamination. Three stations located in the southwest, middle and northeast of Castro Cove were sampled along with a reference site. The southwest station was located near the historic outfall. Shallow and subsurface sediments were collected. Subsurface sediments had a noticeable smell of petroleum hydrocarbons. The sediments were analyzed for selected trace metals, PCBs, chlorinated pesticides, and PAHs. Toxicity tests performed were a 10-day amphipod survival test and elutriate and porewater bivalve larval development tests. Some experimental tests were also performed.

All sediment samples had mean metal concentrations less than their respective ERM. In this study selenium, arsenic and mercury were not measured. The southwest sediment station, which was closest to the old outfall, had a PAH concentration greater than the ERM at depth and greater than the ERL on the surface.

In the amphipod test, all stations from Castro Cove, in both shallow and deep samples, showed toxicity when compared to control and reference sediment. However, amphipod mortality was greatest in the samples from the southwest and northeast stations. In a dilution series experiment, sediment from the southwest station had to be mixed with over 80% reference sediment in order to increase amphipod survival to acceptable levels. Porewater and elutriate tests on bivalve larvae showed no discernible trends for the shallow layers. Porewater development tests for the deep core layers indicated significant toxicity at three of the four Castro Cove sites, including the southwest station, relative to the reference site. Only the southwest station exhibited toxicity in the deep core elutriate urchin larvae development test.

The benthic infauna displayed similar number of taxa at all stations within Castro Cove with the highest diversity at the northeast location and the lowest at the southwest location. Faunal assemblages were similar for all stations, with one or two species dominant in each of the three major taxonomic groups (amphipod, crustacean and polychaete). A reevaluation of the benthic assemblages concluded that the benthic community at Castro Cove was representative of a moderately contaminated sub-assemblage due to the presence of species indicative of stressed environments (SFEI, 1996).

As part of this same study, the effects of exposure to sediments on speckled sanddabs was investigated (Spies et al., 1993). This study compared sediments from three stations in Castro Cove with reference and control samples. The results showed increased biological effects with increasing PAH concentrations in the sediments. The most significant biological effects were seen at the station closest to the historic outfall. This station also had the highest concentration of PAHs. All sediments collected at stations in Castro Cove caused slight but statistically significant alteration of gills of speckled sanddabs. Gill histopathology was significantly correlated with PAH concentration of the sediment, as well as with P4501A content in the gills and hepatic EROD activity, both indicators of exposure to PAHs.

Reference site study (Hunt et al., 1998a)

Under the BPTCP's reference site study, samples were collected in the southwest corner of Castro Cove in 1994. Ten-day amphipod survival tests were performed with two species, Ampelisca abdita and Eohaustorius estuarius. Echinoderm larvae development tests were performed on the sediment with two different exposures, porewater and sediment-water interface. In both amphipod species there was a statistically significant increase in mortality in the Castro Cove sediment as compared to reference and control sediments.

Screening/confirmation studies (Hunt et al., 1998b)

Under the BPTCP's screening/ confirmation studies, samples were collected from the top 5 cm. of sediment in southwest Castro Cove in 1995. The sediment was analyzed for chemical parameters including metals, PAHs, PCBs and pesticides. Both the 10-day amphipod survival test and the urchin development test in porewater were performed on the sediment. Grain size and total organic carbon were measured in the sample. Ammonia and hydrogen sulfide were measured at the beginning and end of the toxicity tests.

This 1995 sample had the highest total PAH concentration (227,800 ppb) of the more than 600 sediment samples analyzed for PAHs statewide in the BPTCP. This was the highest level of

PAHs ever collected in sediments at this site. Mercury and chlordanes were detected at concentrations greater than the ERM. Selenium and dieldrin also had elevated concentrations. Toxicity test results showed 100% amphipod mortality and 100% abnormal development in the urchin development test.

A. Assessment of areal extent of the THS

Based on the distribution of oil and grease and PAHs, two main areas of contamination can be delineated: the south/southwest and the north/northeastern portions of Castro Cove. Similar patterns in the surface distribution of mercury are also evident. The distribution of biological effects is slightly more extensive than the chemical distribution, but overlays the spatial area delineated by detection of oil and grease and PAHs. Although horizontal extent has not been bounded, the contaminated area is estimated to range between 10 and 100 acres based on past studies and the established boundaries of Castro Cove. The depth of contamination has not been determined, but in one set of core samples the depth of visible petroleum hydrocarbons seemed to extend from the surface to approximately three feet below the sediment surface, the maximum depth of the cores.

B. Assessment of the most likely sources of pollutants

The Chevron refinery and the San Pablo Sanitary District discharged effluent directly into Castro Cove until the 1980s. Currently, the refinery and San Pablo Sanitary District discharge their waste effluent into San Pablo Bay via two separate deep-water outfalls. Contaminants may have also entered Castro Cove via Castro Creek due to urban runoff.

From the turn of the century, Chevron discharged wastewater which was only treated by an oil water separator into Castro Creek up to a rate of 50 MGD. The Chevron U.S.A. refinery discharged treated effluent into Castro Cove from 1972 until 1987. San Pablo Sanitary District discharged untreated sewage into Castro Creek near the confluence with Wildcat Creek until 1955 when construction of a municipal treatment plant was completed. From 1955 to 1981, the district discharged treated effluent directly into the cove through a channel running along the southern end of the West Contra Costa Landfill. In 1981, the district relocated its outfall to a deep-water site offshore of Point Richmond. These discharges were not associated with the Chevron Refinery effluent discharges.

Based on the historical discharge of untreated waste by the Chevron refinery and the presence of petroleum related contaminants (oil and grease and PAHs), Chevron is the most likely source of the contamination in Castro Cove.

C. <u>Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs</u>

RWQCB actions regarding Castro Cove have been to control the sources of contamination through NPDES permitting and ACLs. All municipal and industrial point source discharges to Castro Cove were eliminated by 1987. Process effluent discharge from the Chevron refinery into Castro Cove was prohibited after July 1, 1987 under NPDES permit CA0005134, thereby eliminating the source of contaminated effluent into Castro Cove. This NPDES permit regulates discharges from the deep-water outfall. Discharges regulated by this NPDES permit include: thermal waste, cooling tower blowdown, gas scrubber blowdown from an incinerator, treated process wastewater, cooling water, and storm water. As stated previously, the San Pablo Sanitary District discharge was relocated to an offshore deep-water site which is also under permit. The City of Richmond is required by its municipal stormwater permit to implement and document the effectiveness of best management practices to reduce or prevent pollutant discharge through the city's stormwater runoff collection system.

The RWQCB has also conducted sampling and analysis of sediments in Castro Cove as discussed in the previous section. State Order 86-4 required Chevron to evaluate the quality of the sediments in Castro Cove resulting in the Entrix and EVS studies. In June 1998, RWQCB staff requested, under section 13267 of the California Water Code, that Chevron submit a workplan and schedule for characterization of sediment contamination in Castro Cove due to sources from the refinery. Specific items that RWQCB staff requested the workplan to address included: (1) a delineation of sediment contamination gradients originating from refinery-related source areas, (2) an evaluation of the effects of the bioavailable layer of sediment on aquatic organisms by means of concurrent toxicity and chemistry testing, (3) a characterization of the vertical extent of sediment contamination in conjunction with an estimation of sediment deposition and erosion rates, and (4) an evaluation of the bioaccumulation/biomagnification potential for contaminants in the sediment.

Chevron submitted a workplan in August 1998 that proposed a tiered ecological risk assessment consisting of a new round of surficial sediment sampling and chemical analysis with subsequent comparison of the resulting chemical concentrations to established ecological benchmarks. If chemicals likely associated with refinery releases exceed the proposed benchmarks and complete exposure pathways exist, Chevron proposed conducting a second tier risk assessment to address specific ecological concerns. This second tier may contain bioassays and a bioaccumulation/biomagnification evaluation in addition to a refined predictive risk assessment. The workplan also proposed conducting a bathymetric survey and comparing the results to a previous survey made in 1989 to evaluate sediment accretion or erosion rates in Castro Cove. RWQCB staff conditionally approved the workplan in September 1998 with the provision that additions would be made to the plan. RWQCB staff collected five core samples in Castro Cove in November 1998 to begin characterization of the vertical contaminant profile. In December 1998 Chevron took deep core samples in Castro Cove.

D. Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions

Corrective actions for Castro Cove sediments will require the following phases:

1. Preparation of a Sampling and Analysis Plan (SAP) in order to delineate vertical and horizontal extent of contamination,
2. Completion of a Site Investigation to complete goals of SAP,
3. Preparation of a Feasibility Study (FS) based on the findings of the Site Investigation (at a minimum the following cleanup options will be considered: natural recovery, in-place containment, dredging with various disposal options and dredging and capping),
4. Sediment clean up following option(s) selected from the FS and,
5. Follow-up monitoring to make sure that the site has been cleaned up.

An endangered species consultation with all appropriate agencies will be conducted before remediation plans are finalized.

E. Estimate of the total cost to implement the cleanup plan

The uncertainty regarding the horizontal and vertical extent of sediment contamination results in a range of potential cleanup costs. All options including natural recovery, dredging, dredging with upland disposal and capping will be considered for remediation. The cost is estimated based on a contaminated area ranging from a minimum of 10 acres to a maximum of 100 acres. Sediments will be assumed to be contaminated to a depth of at least three feet below the sediment surface. The cost of performing a full site investigation and feasibility study is estimated at $2,000,000. The cost of remediating Castro Cove, depending on the chosen remedial alternative, and follow-up monitoring is estimated at $1,000,000 to $20,000,000. Follow-up monitoring will be required regardless of the chosen remedial alternative. RWQCB staff costs are estimated at $200,000 over the entire course of the project.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of chemicals at this site. The beneficial use that is impacted is ESTUARINE HABITAT (EST). Implementation of this plan will minimize or eliminate this impact on the beneficial use. For a more thorough description of the benefits to restoring beneficial uses see Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Castro Cove as well as the cost for RWQCB and other regulatory staff oversight.

G. Two-year expenditure schedule identifying funds to implement the plans that are nor recoverable from potential dischargers

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Castro Cove as well as the cost for RWQCB and other regulatory staff oversight.

References

California Department of Fish and Game (CDFG). 1995. State Mussel Watch Program, 1987-1993 Data Report, 94-1WQ. State Water Resources Control Board.

Entrix. 1990a. Surface Sediment Monitoring Program for Castro Cove and Areas Adjacent to the Deep Water Outfall. Final Report Prepared for Chevron U.S.A., Richmond Refinery. 96 pp. and Appendices.

Entrix. 1990b. Benthic Community Monitoring Program for Castro Cove and Areas Adjacent to the Deep Water Outfall. Final Report Prepared for Chevron U.S.A., Richmond Refinery. 100 pp. and Appendices.

E.V.S. Consultants, Inc. 1987. A Chemical And Toxicological Evaluation of Sediments From San Pablo Bay. Prepared for Chevron Environmental Health Center, Inc. Project No. 2/320-01. Seattle, WA.

E.V.S. Consultants, Inc. 1991. Chemical and Toxicological Analyses of Sediments From Castro Cove, San Francisco Bay. Vol. 1. For Chevron USA, Richmond

Flegal, A. R., R. W. Risebrough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program,: Sediment Studies, Final Report, July, 1994.

Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, M. Stephenson, M. Puckett, R. Fairey, R. Smith, K. Taberski. 1998a. Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 133 + Appendices A-D.

Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, K. Taberski, C. Wilson, M. Stephenson, H. Puckett, R. Fairey and J. Oakden. 1998b. Sediment Quality and Biological Effects in San Francisco Bay. pp.188 + Appendices A-E.

SFEI. 1996. Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. Prepared by the San Francisco Estuary Institute, Richmond, CA. 324 p.

Spies, R.B., A.J. Gunther, J. Stegeman, B. Woodin, R. Smolowitz, B. Saunders and L. Hain. 1993. Induction of Biochemical, Genetic and Morphological Markers of Contamination in Speckled Sanddabs *Citharichthys stigmaeus* Experimentally Exposed to Sediments from San Francisco Bay. Prepared for the SFBRWQCB.

Site D - Stege Marsh

Description of site

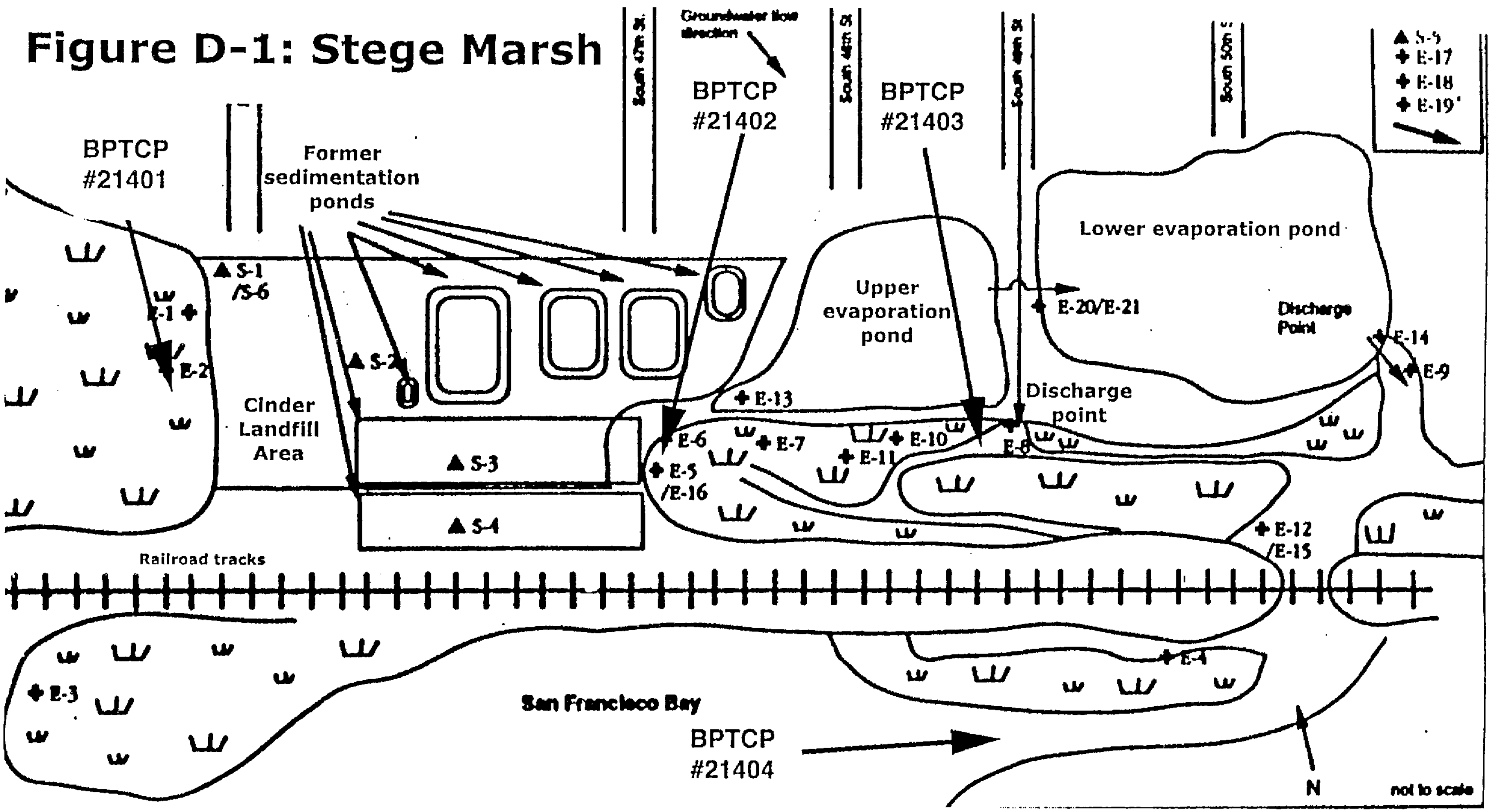
Stege marsh occupies approximately 23 acres on the western margin of San Francisco Bay in the City of Richmond, California (Figure D-1). Eastern Stege marsh is located on property currently owned by Zeneca Agricultural Products. Western Stege marsh is currently owned by the University of California Richmond Field Station. The cinder landfill separates east and west Stege marsh (Figure D-1). The East Bay Parks District currently owns the land south of the historic railroad track which is now a hiking trail.

Eastern Stege marsh rests directly on the alluvial fan-deltaic deposits of Carlson Creek interspersed with Bay mud. Bedrock at the site is likely to be Franciscan Formation rocks, cretaceous and younger in age, consisting of an assemblage of marine sedimentary and volcanic, and some metamorphic rocks (The Mark Group, 1988). Western Stege Marsh is fed by Meeker Creek. Between 1947 and 1969, a railroad track was constructed just south of Stege marsh resulting in siltation and thus the extension of the tidal marsh into a previously subtidal area (May, 1995).

Stauffer Chemical Company is the prior owner of the Zeneca industrial facility and associated marsh. Stauffer Chemical Company utilized the site to roast pyrite ores for the production of sulfuric acid from about 1919 until 1963. This industrial process resulted in the production of cinders, which were placed on the site surface. Elevation at the bottom of the cinders is at mean sea level throughout the facility, which indicates past placement of cinders at ground level. The presence of a layer of peaty silt under the base of the cinders also supports that cinders were disposed of on the site surface. The cinder pile extends along the north and east sides of eastern Stege marsh (Figure D-1). The cinders were covered with a one-foot clay layer, with a permeability of 10^{-7} cm/sec or less, that was itself covered by a one-foot layer of topsoil to comply with RWQCB Order No. 73-12 and its 1974 amendment.

Besides pyrite cinders, other products that have been generated or utilized on the site include fuels, sulfuric acid, ferric sulfate, proprietary pesticides, solvents and alum. Until recently, Zeneca produced proprietary agricultural chemicals on the

Figure D-1: Stege Marsh



industrial portion of the site. Currently, Zeneca uses the site solely as a research laboratory. The discharges resulting from past industrial activities were treated through a series of settling, neutralization and alum mud ponds ending in two evaporation ponds situated just north of the marsh. Effluent from the evaporation ponds was discharged into the marsh southeast of the evaporation ponds (discharge 001). Another discharge (002) consists of untreated storm water from building roofs, parking lots and streets. Most of the ponds were closed in the early 1970s and replaced with new lined ponds. The discharge of stream waste to the marsh ended in the 1980s. Since then, treated effluent has been discharged from the evaporation ponds into the Richmond sanitary sewer system. Under wet weather conditions, when the city of Richmond cannot handle inflow and the holding capacity of the Zeneca Facility are exhausted, discharges to the marsh are permitted. Contaminated groundwater from the industrial portion of the site is being removed by an intercept trench, treated and discharged with the treated industrial effluent.

In western Stege marsh several explosives manufacturing companies had been in production since the 1840s. During this time various areas were used for the production of mercury fulminate, manufacturing of ammunition shells and blasting caps, and storage and testing of explosives (Jonas and Associates 1990).

Reason for listing

In 1991, URS Corporation performed a site investigation for U.S.EPA and found elevated concentrations of metals and metalloids (arsenic, copper, lead, mercury, selenium, and zinc) and organic contaminants (DDTs and PCBs) (Table D-2). A follow up sediment investigation by ICF Kaiser also found elevated concentrations of metals and metalloids (arsenic, copper, lead, and zinc) (Table D-4). Organic contaminants were not detected by ICF Kaiser, but were reported with elevated detection limits due to analytical interferences. Zeneca and the RWQCB independently analyzed a split sediment sample from the north-western section of the eastern marsh and found elevated concentrations of metals, metalloid and organic contaminants (Table D-5).

The BPTCP collected screening sediment samples at three locations: 21401 in the Richmond field station, 21402 in the north-west section of eastern Stege marsh and 21403 near outfall 002, as well as a reference sample in Carlson Creek (21404). All three marsh samples had elevated concentrations of metals, metalloids and organic compounds (Table D-6), and resulted in 100% mortality of *Eohaustorius estuarius*. Locations 21401 and 21402 were resampled as part of the BPTCP confirmation sampling. Both sediment samples were toxic to *Eohaustorius estuarius* with 99 and 100 % mortality respectively. The Relative Benthic Indices of 0 were measured at these two sampling locations, indicating the lack of living organisms present at the time of the sampling. Stege marsh falls in the high priority toxic hot spot category due to elevated chemistry (including the highest concentrations of arsenic, selenium and several pesticides measured by the BPTCP statewide), recurrent sediment toxicity, and impairment to in-situ benthic organisms.

A summary of investigations conducted at Stege marsh is presented in the following sections.

ICI Americas Investigations (1987)

In 1987, ICI Americas sampled 10 foot cores of sludge and the underlying soil in the neutralization pond, surge pond, carbon column pond, agriculture yard pond and both evaporation ponds. The sludge samples were analyzed for total and WET extractable metals. Elevated concentrations of arsenic, copper and zinc were found in samples from the two evaporation ponds. Soluble threshold limit concentrations (STLC) were also exceeded for arsenic and lead in samples from the evaporation ponds. Effluent from these two evaporation ponds was regularly discharged to the marsh in the past. Samples from other ponds had elevated concentrations of copper, lead, selenium and zinc. These samples also had detected concentrations greater than STLCs for copper and zinc. Metal contaminated soil below the sludge in the ponds may contribute to these concentrations since both soil and sludge were sampled and homogenized. Relevant analytical results are listed in Table D-1. This study indicates that the evaporation ponds may have been a source of contaminants to Stege marsh.

The Mark Group Investigations (1990, 1991)

These two reports present the results of an underground site investigation of the cinder area next to Stege marsh. Hydrologic data are also reported but are not discussed in this report.

These investigations resulted in the production of cross-sections depicting the horizontal and vertical extent of the cinders in upland soils. Potential presence of cinders in the marsh was not investigated, although the presence of subsurface cinders was mapped in upland soils up to the edges of Stege marsh. Also, the chemical constituents of the cinders were not reported as part of this site investigation. Cinders may have been and/or remain a potential source of contamination in or near Stege marsh.

URS Corporation Investigation (1991)

URS Corporation performed an investigation of the chemistry of the marsh sediments in 1992 for the U.S. EPA. The relevant data obtained in this investigation are listed in Table D-2. Elevated concentrations of arsenic, copper, lead, mercury, selenium, zinc, DDTs and PCBs were detected in samples throughout Stege marsh during this investigation. Results are presented in Table D-2. This investigation indicated that Stege marsh is contaminated with multiple chemicals.

Woodward-Clyde Consultants Investigation (1993)

Woodward-Clyde Consultants performed a subsurface investigation next to Stege marsh of the extent of cinders and groundwater hydrology and chemistry. Cinders were found next to the marsh, but the marsh was not investigated for the presence of cinders. Groundwater chemistry results showed low pH and elevated solution concentrations of metals and metalloids in some monitoring wells next to Stege marsh (Table D-3). This investigation suggests that subsurface transport of chemicals was and/or remains a pathway for contamination in Stege marsh.

ICF Kaiser Investigation (1997)

In 1997, ICF Kaiser undertook a follow-up investigation to that by URS Corporation. Arsenic, copper, lead and zinc were again detected with elevated concentrations (Table D-4). Mercury and selenium concentrations were detected but at lower concentrations than in the URS Corp. investigation. Since chemical concentrations were reported on a wet weight basis in this study, comparisons to other analytical results and to screening guidelines are not possible. DDTs, DDEs and DDDs were not detected in sediment samples in this investigation likely due to the elevated detection limits reported for these compounds. Mercury concentrations were not as elevated as in the URS investigation, but the areas with elevated mercury concentrations were not sampled by ICF Kaiser. As with the URS Corporation investigation, contamination of Stege marsh by metals and metalloids was evident in these data.

Zeneca and RWQCB sediment sample (1997)

In 1997, Zeneca and SFB-RWQCB jointly collected a sediment sample in the northwest corner of Stege marsh based on a complaint received by the SFB-RWQCB of a barren area in this location. Split samples were sent to two independent laboratories for chemical analyses. Metal results show elevated concentrations of arsenic, cadmium, copper, lead, selenium and zinc. Organic compounds detected at concentrations above San Francisco Bay ambient sediment concentration include chlordanes, dieldrin, hexachlorohexanes, DDTs and PCBs. Analytical results are presented in Table D-5. Again note that the results from the Zeneca split sample are reported on a wet weight basis. Contamination of Stege marsh is evident by the elevated concentration of chemicals reported.

Bay Protection and Toxic Cleanup Program (1998)

Under the Bay Protection and Toxic Clean-up Program, the RWQCB collected three screening and two confirmation samples from Stege marsh, as well as a reference sample from Carlson Creek. Sampling location 21401 is located in the Richmond field station in the vicinity of the cinder pile. Sampling location 21402 is situated in the barren portion of the Stege marsh on Zeneca property. This is in the vicinity of the SFB-RWQCB sample discussed in the previous section. Sample location 21403 is situated in Stege marsh south of evaporation pond 1 near outfall 002. Reference samples (location 21404) were also collected from Carlson Creek during both screening and confirmation sampling events.

The three screening samples were analyzed for chemical constituents. As with the URS Corp. study, elevated concentrations of arsenic, copper, mercury, selenium, zinc and DDTs were detected at concentrations much greater than both ERM and ambient concentrations (Table D-6). Arsenic and selenium concentrations were the highest measured in 544 samples collected statewide in the BPTCP. In these samples, PCBs were also detected at concentrations much greater than both ERM and ambient concentrations. Also, multiple chlorinated pesticides were detected at elevated concentrations. Dieldrin, endosulfan sulfate, mirex, oxadiazon and toxaphene were detected in Stege marsh at the highest concentrations from over 600 samples collected statewide by the BPTCP. The mean ERM quotients were 2.7 (21401), 0.61 (21402) and 2.59 (21403). Mean ERM quotients greater than 0.5 are believed to represent elevated concentrations of mixtures of chemical compounds. These chemicals are detected at concentrations in Stege marsh that are believed to pose a threat to waters of the state.

Exposure to all three sediment samples from Stege marsh resulted in 100 percent mortality to *Eohaustorius estuarius* in the 10-day solid phase bioassay (Table D-7). The two confirmation samples also exhibited high mortality (99 and 100 percent) for the same bioassay. Urchin development bioassays using a sediment-water interface exposure resulted in 100 percent abnormal development for the two sediment screening samples. These results denote a significant impact of the sediments to these test species.

Benthic community analysis of the two confirmation samples from Zeneca marsh found no living individuals (Table D-8). The measured Relative Benthic Index was zero denoting the total absence of benthic organisms in these sediments. This represents a significant impact to the marsh biota.

Pacific Eco-Risk Laboratories

In 1998, Zeneca Agricultural performed a site investigation in sloughs and the northwest corner of eastern Stege marsh. The results showed elevated concentrations of arsenic, copper, lead, mercury, selenium and zinc in the sediments (Table D-9). Toxicity to the bivalve embryo *Mytilus edulis* was found at multiple locations in the sloughs and in the northwest corner of eastern Stege marsh (Table D-10). Toxicity to *Eohaustorius estuarius* was found at all locations sampled in Stege marsh (Table D-10). The pH of sediment and porewater samples at this site was, in general, unusually low. The pH of several highly acidic sediment and porewater samples was adjusted to a normal pH and toxicity tests were repeated. Although pH adjustment lowered the toxicity of most samples, high levels of toxicity remained in all undiluted porewater samples and in 1 out of the 2 sediment samples in which pH was successfully adjusted. In addition, there was toxicity at stations with normal pH. Low pH seems to contribute to toxicity at some stations at this site, however, it is clear that other factors play a significant role. Benthic community analyses showed decreased populations in the northwest corner of eastern Stege marsh.

Table D-1. Selected Maximum and Total Soluble Metal Concentration in Sludges from Various Stauffer Chemical Company Field Investigations

Pond	Total					Soluble				
	Arsenic	Copper	Lead	Selenium	Zinc	Arsenic	Copper	Lead	Selenium	Zinc
	mg/kg dry weight					mg/L				
Neutralization	60	429	522	67	448	1.6	0.06	18.2	0.5	NA
Surge	15	456	134	24	832	NA	11.4	0.9	0.7	23
Carbon Column	7.4	999	193	20	7,275	NA	ND (0.04)	0.04	0.6	106
Agricultural Yard	8.8	10,631	72	44	10,099	NA	600	0.2	1.1	279
Evaporation 1	208	649	143	36	1,235	7.8	11	3.4	0.4	NA
Evaporation 2	159	570	130	28	654	9	0.14	55	0.5	NA

Table D-2. Selected Concentration of Analytes in Stege Marsh Sediments
URS Corporation Field Investigation

Sampling Location	Analyte											
	Metals (mg/kg dry weight)						Organics (µg/kg dry weight)					
	Arsenic	Copper	Lead	Mercury	Selenium	Zinc	DDTs (total)	HCH alpha	HCH beta	HCH delta	HCH gamma	PCBs total
E-1	496	315	310	10.9	60.7	957	212	57	16	ND	11	160
E-2	749	239	563	5.8	124	863	521	300	66	ND	14	ND
E-3	96.3	169	145	5.3	ND	215	31	ND	ND	ND	ND	140
E-4	20.3	88.7	74.8	0.89	ND	231	28	ND	ND	ND	ND	120
E-5	104	649	69.2	1.9	ND	431	294	ND	ND	ND	ND	ND
E-6	20.6	ND	10	ND	ND	31.6	58	200	46	70	12	ND
E-7	146	34.4	54.7	0.88	ND	150	321	5	2	2	1	ND
E-8	294	600	192	4.5	7.3	1,250	374	ND	ND	ND	ND	ND
E-9	27.3	149	116	1.2	ND	354	147	ND	ND	ND	ND	ND
E-10	1,660	189	78.4	1.6	5.7	348	311	3	9	ND	ND	ND
E-11	177	170	55.6	0.8	ND	457	98	ND	7	ND	ND	ND
E-12	32.1	111	75.1	0.83	ND	286	72	ND	ND	ND	ND	ND
E-13	12.6	942	64.7	1.7	7.2	490	181	38	20	ND	ND	ND
E-15	12.3	116	75.1	3	ND	296	140	ND	ND	ND	ND	ND
E-16	60.1	816	84.1	1.6	4.5	440	273	ND	ND	ND	ND	ND
E-17	65	87.2	157	0.88	ND	270	13	ND	ND	ND	0.8	ND
E-20	810	1,930	210		9.3	5,490	269	ND	ND	4	ND	ND
E-21	651	104	202	2.3	16.3	4,820	332	ND	ND	39	ND	ND

Table D-3. Selected Concentrations in Groundwater near Stege Marsh
Woodward-Clyde Consultants

Well Cluster	Sampling Location	Analyte								
		pH	Sulfate	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
			mg/L							
A	H-38	3.7	4430	109	3.91	0.127	11.6	1370	0.138	84.6
	H-39	6.2	2610	0.568	ND(0.006)	0.012	ND(0.033)	0.468	ND(0.001)	0.043
	H-59	7.3	244	7.68	ND(0.006)	ND(0.011)	ND(0.033)	5.26	0.001	0.023
B	H-40	5.8	3190	2.33	0.085	ND(0.011)	0.039	630	ND(0.001)	0.093
	H-41	7.1	3080	0.849	ND(0.002)	ND(0.011)	ND(0.033)	0.864	ND(0.001)	ND(0.022)
	H-42	7	2960	3.12	0.006	ND(0.011)	ND(0.033)	2.23	ND(0.001)	ND(0.022)
C	H-46	3.6	3310	162	0.053	0.017	0.812	587	0.013	14.7
	H-47	4.5	2240	17.9	0.031	ND(0.011)	0.139	403	0.004	12.3
	H-48	6.8	3580	0.917	ND(0.006)	ND(0.011)	ND(0.033)	0.769	ND(0.001)	0.052
D	H-49	6.2	421	3.39	0.029	ND(0.011)	0.039	21	0.006	0.142
	H-60	6.7	2670	0.687	ND(0.006)	ND(0.011)	ND(0.033)	0.409	ND(0.001)	0.401

Table D-4 Selected Concentrations of Metals in Stege Marsh Sediments
ICF-Kaiser Field Investigation

Sampling Location	Analyte				
	Arsenic	Copper	Lead	Mercury	Zinc
	mg/kg wet weight				
MSM-1	26	97	72	0.69	230
MSM-6	570	300	84	ND (0.44)	550
MSM-8	71	300	63	ND (0.6)	1,400
MSM-9	10	23	8.6	ND (0.25)	21
MSM-10	400	5.7	35	0.65	50
MSM-11	16	ND (1.3)	12	ND (0.24)	ND (2.6)
MSM-12	240	350	120	ND (0.53)	720

Table D-5. Selected Concentrations in Stege Marsh Sediment
RWQCB and Zeneca Split Sample

	RWQCB (dry weight)	ZENECA (wet weight)
Metals (mg/kg)		
Arsenic	570	210
Copper	11,000	11,000
Lead	340	110
Mercury	9.1	1.5
Selenium	20.0	14.0
Zinc	2,100	1,300
Organics (µg/kg)		
Chlordane, total	165	ND (80)
Dieldrin	17	ND (10)
HCH, alpha	50	30
HCH, beta	40	ND (20)
HCH, gamma (Lindane)	14.0	ND (10)
HCH, delta	24	ND (10)
DDT, total	287	110
PCBs, total	335	400
* total HCH		
NA-Not Available		

Table D-6. Selected Concentrations of Analytes in Stege marsh Sediments
BPTCP Field Investigation

Analyte	Sampling Locations			ERM	Ambient Concentrations
	21401	21402	21403		
	06-Oct-97	06-Oct-97	06-Oct-97		
Metals (mg/kg dry weight)					
Arsenic	1,140	61.8	343	70	15.3
Copper	373	624	450	270	68.1
Lead	180	72.2	102	218	43.2
Mercury	5.5	1.1	2.2	0.71	0.43
Selenium	35.7	7.9	3.8	NA	0.64
Zinc	2,500	434	1,020	410	158
Organics (µg/kg dry weight)					
Chlordane, total	14.6	7.1	32.3	NA	1.1
Dieldrin	10.6	5.93	62.6	NA	0.44
Endosulfan Sulfate	7.0	0.9	163	NA	NA
Hexachlorobenzene	19.9	7.5	6.0	NA	0.48
HCH, alpha	292	26.1	ND (0.1)	NA	0.78*
HCH, beta	56.8	9.8	ND (0.5)	NA	
HCH, gamma (Lindane)	8.4	6.3	ND (0.1)	NA	
HCH, delta	99.4	14.4	0.25	NA	
Mirex	ND (0.25)	ND (0.25)	103		NA
trans-Nonachlor	1.8	1.2	1.6	NA	NA
Oxadiazon	ND (1)	ND (1)	114	NA	NA
Toxaphene	ND (5)	ND (5)	15,700	NA	NA
DDT, total	472	304	542	46.1	7
PCBs, total	758	122	2,546	180	21.6
PAH, low molecular weight	1,468	598	583	3,160	434
PAH, high molecular weight	6,734	2,508	2,123	9,600	3,060
PAH, total	8,203	3,106	2,706	44,792	3,390
* total HCH					
NA-Not Available					

Table D-7. Bioassay Results for Sediments from Stege Marsh
BPTCP Field Investigation

SCREENING			
Sampling Location	**Sampling Date**	96 hr.-Sediment-Water Interface Test	10 day-Bulk sediment
		Strongylocentrotus p.	Eohaustorius e.
		Percent normal-development	Percent survival
21401	06-Oct-97	0	0
21402	06-Oct-97	0	0
21403	06-Oct-97	19	0
21404	06-Oct-97	24	54
CONFIRMATION			
Sampling Location	**Sampling Date**	10 day-Bulk sediment	
		Eohaustorius e.	
		Percent survival	
21401	03-Dec-97	1	
21402	03-Dec-97	0	
21404	03-Dec-97	85	

Table D-8. Benthic Community Analysis Results for Sediments from Stege Marsh BPTCP Field Investigation

Sampling Location	Total Individuals	Number of Species	Benthic Index
21401	0	0	0
21402	0	0	0
21404	557	18	0.51

Table D-9 Selected Concentrations of Analytes in Stege Marsh Pacific Eco-Risk Laboratories Field Investigation

Sampling Location	Metals (mg/kg dry weight)					
	Arsenic	Copper	Lead	Mercury	Selenium	Zinc
SM1	33	166	93.4	1.5	ND(1)	549
SM2	77	187	71.3	1.2	ND(1)	582
SM3	60	254	102	1.9	2	721
SM4	91	292	106	2.4	4	1,030
SM5	124	309	111	2	3	1,170
SM6	260	483	232	10.9	25	1,240
SM7	62.1	131	45.4	0.6	3	681
SM8	47	75	15.7	0.3	4	864
SM9	38	109	64.7	1	ND(1)	432
SM10	170	536	152	2.4	6	1,260
SX1	45	723	35.5	0.8	8	2,510
SX2	24	20	3.4	ND(0.2)	ND(1)	201
SX3	214	24	6.1	ND(0.2)	ND(1)	1,330
SX4	56	50	9.4	ND(0.2)	3	1,340
SX5	31	84	8.3	ND(0.2)	4	2,070

Table D-10 Selected Toxicity Results for Sediments from Stege Marsh Pacific Eco-Risk Laboratories Field Investigation

Sampling Location	Sediment Porewater Test (100%)	Bulk Sediment Test	Sediment Water Interface Test
	Mytilus e.	Eohaustorius e.	Atherinops a.
	Percent Normal Development	Percent Survival	Percent Hatchability
SM1	90	0	100
SM2	NR	0	NR
SM3	96.8	0	22
SM4	NR	0	NR
SM5	19.2	0	18
SM6	90.9	0	84
SM7	1	0	76
SM8	0	0	0
SM9	66.8	1.2	98
SM10	0	15	90
SX1	0	0	0
SX2	NR	NR	NR
SX3	NR	NR	NR
SX4	0	0	0
SX5	NR	NR	NR

A. Assessment of areal extent of the THS

Based on the distribution of elevated concentrations of metals, metalloids and organic compounds, three areas of contamination can be seen. The first is near evaporation pond 1 and outfall 2. This area has elevated concentrations of arsenic, mercury, zinc and DDTs. The second area is in the north-west corner of eastern Stege marsh and is characterized by low pH measurements, elevated concentrations of arsenic, copper, zinc and DDTs, aquatic toxicity, and is devoid of benthic organisms. The third area is located in the U.C. Richmond Field Station. This location is characterized by elevated concentrations of arsenic, mercury, selenium, zinc, DDTs and aquatic toxicity, and is devoid of benthic organisms. Further study may show that these areas are continuous rather than discrete. Regardless, the areal extent of the THS is greater than 10 acres. The entire marsh encompasses an area of 23 acres.

B. Assessment of the most likely sources of pollutants

Oxidation of pyrite cinders in the presence of sulfides is the most likely source of the low pH at the site. Leaching of metal at this low pH is a probable source of toxicity. Subsurface transport of metals from upland cinders may also be a source of contaminants to Stege marsh. Effluent discharge from the two evaporation ponds is also a likely source of contaminants to Stege marsh. Contaminants may have also entered Stege marsh via Carlson or Meeker Creeks in urban runoff or from upland industrial facilities. In western Stege marsh munitions manufacturing is a possible source.

C. Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs

RWQCB actions regarding Stege marsh have been to control the sources of contamination through NPDES permitting. NPDES permit No. CA0006157 (Order No. 95-008) requires that wastewater from the evaporation ponds be discharged into the City of Richmond sanitary sewer. Discharge to Stege marsh is only allowed during storm events when the sanitary sewer capacity and on-site storage capacity have been exhausted. A prior NPDES permit requested that the cinders be capped and that an interceptor trench be built to limit discharges from the pyrite cinders.

Other actions by the RWQCB have included a request to Zeneca Agricultural products for sampling and analyses of sediments. In December 1996, the RWQCB requested, under section 13267 of the California Water Code, that Zeneca Agricultural Products perform sediment studies in order to propose a conceptual site model to evaluate potential impacts of contaminants including ecological and human health impacts. The studies by ICF Kaiser and Pacific Eco-Risk Laboratories were in response to this request. However, these studies are just the beginning of studies that will be required to develop a full conceptual site model.

D. Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions

1. Completion of a Sampling and Analysis Plan (SAP) in order to finish delineating vertical and horizontal extent of contamination (in progress);
2. Completion of a Site Investigation to complete goals of SAP including development of a conceptual site model and ecological and human health risk assessments (in progress);
3. Preparation of a Feasibility Study (FS) based on the findings of the Site Investigation (at a minimum the following cleanup options will be considered: natural recovery, in-place containment, dredging with various disposal options, and dredging and capping);
4. Sediment clean up following option(s) selected from the FS and,
5. Follow-up monitoring to ensure that the site has been cleaned up to agreed levels.

An endangered species consultation with all appropriate agencies will be conducted before remediation plans are finalized.

E. Estimate of the total cost to implement the cleanup plan

The uncertainty regarding the horizontal and vertical extent of sediment contamination, the potentially varied nature of the sources of contamination and the cleanup options results in a range of potential clean-up costs. The cost is estimated based on a minimum of 10 acres and a maximum of 23 acres being remediated. The estimated range of costs are $1,500,000 to $10,000,000 depending on the range of clean-up options selected and the areal extent remediated. RWQCB staff costs are estimated at $100,000 to $200,000 over the entire course of the project.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of chemicals at this site. The beneficial use that is impacted is ESTUARINE HABITAT (EST) at a minimum. Due to high concentrations of bioaccumulative compounds, such as selenium, WILDLIFE HABITAT (WILD) and PRESERVATION OF RARE AND ENDANGERED SPECIES (RARE) may also be impacted. Implementation of this plan will minimize or eliminate these impacts on beneficial uses. For a more thorough description of the benefits to restoring beneficial uses see Table 1, Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Stege marsh as well as the cost for RWQCB and other regulatory staff oversight.

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

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Stege marsh as well as the cost for RWQCB and other regulatory staff oversight.

References

Hunt J.W., B.S. Anderson, J. Newman, R.S. Tjeerdema, K. Taberski, C.J. Wilson, M. Stephenson, H.M. Puckett, R. Fairey and J. Oakden. 1998. Sediment Quality and Biological Effects in San Francisco Bay. Final Technical Report. Pp. 118. Appendix A-E.

ICF Kaiser. 1997. Wetlands Area Sampling Program, Zeneca Ag Products, Richmond Facility. November 1997.

ICI Americas Inc. 1987. Assessment of Surface Impoundments at ICI Americas, Richmond, CA for TPCA. November 2, 1987.

ICI Americas Inc. 1990. Solid Waste Assessment Test Proposal. July 23, 1990.

Jonas and Associates. 1990. Sampling and Analysis Report. Richmond Field Station. Report submitted to University of California, Richmond Field Station.

The Mark Group. 1988. Report of Field Investigations Stege Plant. Prepared for ICI Americas. January 22, 1988.

The Mark Group. 1991. Water Quality Solid Waste Assessment Test Report, Cinder Fill Area, ICI Americas Inc., Richmond, California. Prepared for ICI Americas. July 1, 1991.

May, M. 1995. Tidal Marsh Evolution and Breakwater Construction, Richmond, California. Unpublished.

Pacific Eco-Risk Laboratories. 1998. Initial Data Report for the Phase I: Stage 2 Evaluation of Stege Marsh Sediments, Draft. September 30, 1998.

SFBRWQCB. 1997. Chemical Analytical Results for a Stege marsh Sediment.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments. May 1998.

Stauffer Chemical Company. 1987. Proposed Sample and Analysis Plan for NPDES Impoundments per the Toxic Pits Clean-up Act (TPCA). July 16, 1987.

URS Consultants. 1994. CERCLA Site Inspection, Stauffer Chemical Company.

Woodward-Clyde Consultants. 1993. Supplemental Site Subsurface Investigation at Zeneca's Agricultural Facility, Richmond, California. Prepared for Zeneca Agricultural Products. June 23, 1993.

Site E – Point Potrero/Richmond Harbor

Description of Site

The site designated Point Potrero/Richmond Harbor is a 400 foot long intertidal embayment, the Graving Inlet, on the western side of the Shipyard #3 Scrap Area at the Port of Richmond (Figure E-1). Shipyard #3 is currently used as a parking lot, but in the past the site has been used for shipbuilding, ship scrapping, sand blasting and metal recycling. The geographic feature identified with the site is Point Potrero, although the original configuration of the point has been modified by quarrying of a bedrock hillside and filling of intertidal mudflats.

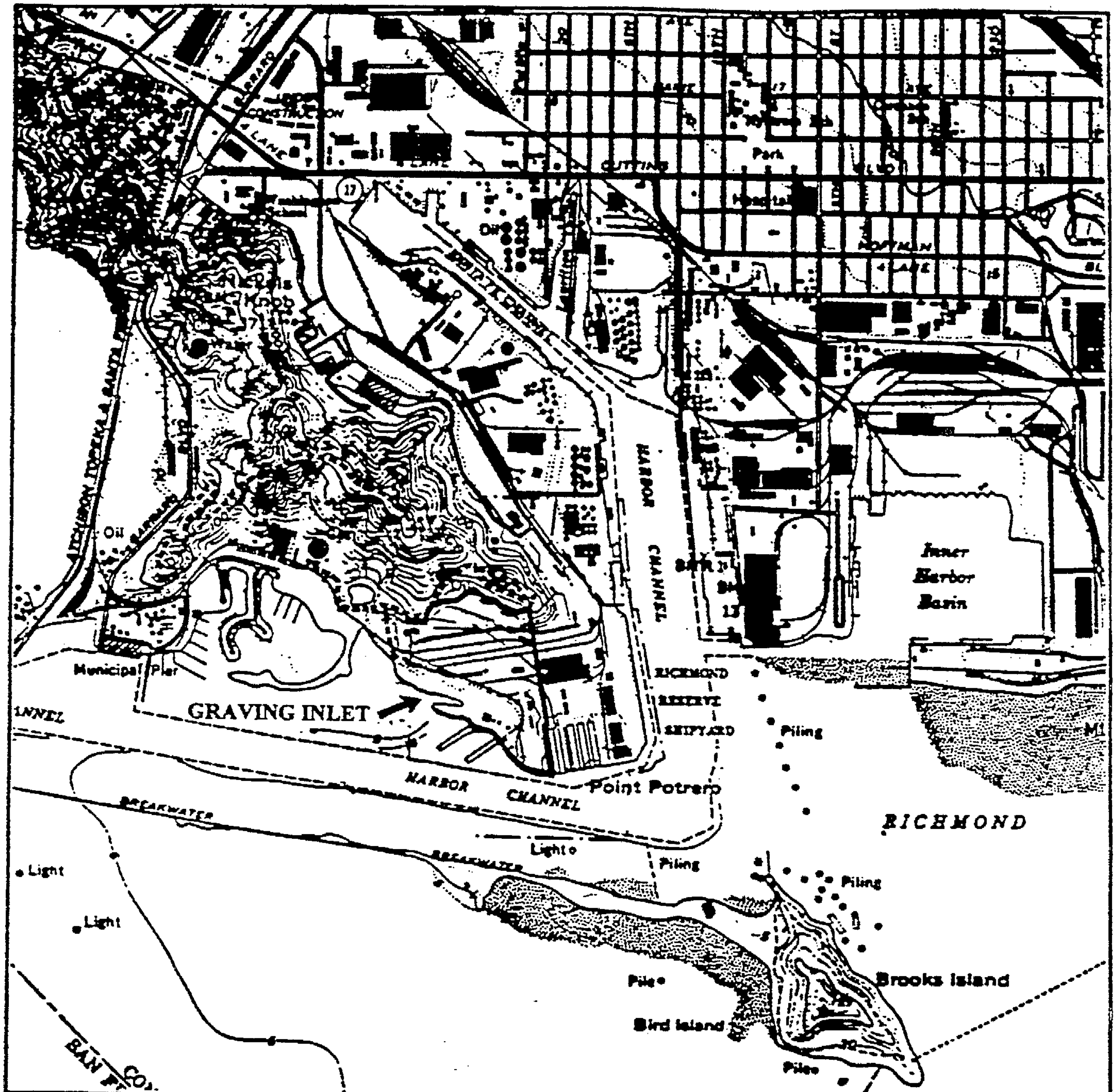
The embayment known as the Graving Inlet (Inlet) was excavated in 1969 to allow ships to be beached in shallow water for final scrapping operations. Site investigations have shown that the sediments in the Inlet have the same levels and types of contaminants found on the adjacent Shipyard #3, including heavy metals, PCBs and PAHs. While the most heavily contaminated sediments are in the intertidal zone and shallow subtidal zone within the inlet, elevated levels of PCBs and metals are also found in the subtidal zone outside of the inlet.

Reason for Listing

Point Potrero has been listed as a candidate toxic hot spot due to the extremely high levels of bioaccumulative contaminants, including the highest levels of PCBs (19.9 mg/kg) and mercury (9.1 mg/kg) found by the BPTCP in over 600 samples collected statewide. These two contaminants are listed in the San Francisco Bay/Delta Fish Advisory as primary chemicals of concern to human health due to fish consumption (OEHHA, 1994; RWQCB, 1995). In addition, there is a site-specific health advisory for the Richmond Harbor Channel area based on PCBs and DDTs that was issued by the Office of Environmental Health Hazard Assessment (OEHHA, 1994) and published by California Department of Fish and Game (1997). Lauritzen Canal, the source of the DDT was cleaned up, under CERCLA, by the summer of 1997.

The levels of contaminants found in the Inlet are shown in Table E-1. Also included are Effects Range Median (ERM) guidelines; NOAA derived values which are the 50th percentile value associated with adverse biological effects for any particular chemical. Levels of PCBs have been measured up to 19.9 ppm and

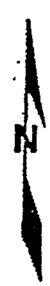
Figure E-1. Point Potrero



Source: USGS 7.5' Richmond and San Quentin Quads, 1980.

0 1/2 1

Scale, in Miles



levels of mercury have been measured up to 7.5 ppm. The table shows that PCBs exceed ERMs by up to 110 times and mercury by over 10 times. Metals such as copper, lead and zinc have been measured at levels exceeding ERMs by 6, 10 and 5 times, respectively. Attempts have been made to associate sediment concentrations with unacceptable concentrations of particular contaminants in fish tissue. The Washington State Dept. of Ecology has proposed a human health based sediment quality criteria for PCBs of 0.012 ppm based on 1% TOC (WA. State Dept. of Ecology, 1997). Concentrations of PCBs at Point Potrero are more than 3 orders of magnitude over this value. Ambient levels of PCBs and mercury in S.F. Bay are, in general, below 0.015 ppm and 0.5 ppm respectively (SFEI, 1993, 1994, 1995, 1996; SFBRWQCB, 1998).

A. <u>Assessment of the areal extent of the THS</u>

Estimated area: At least 1 acre.

The area that has the highest levels of contaminants (Graving Inlet) has a well-characterized boundary and comprises about one acre. This area is surrounded on three sides by land and the open end of the inlet has been defined by five cores with subsamples at 0 to 0.5 feet, 0.5 to 2.5 feet and 2.5 to 4.5 feet. Other areas along the waterfront have elevated levels of metals (including mercury), PCBs and PAHs, but there is conflicting data on the concentrations and extent of contamination. It is possible that contaminants may extend over one or two additional acres.

B. <u>Assessment of the most likely sources of pollutants</u>

The contaminants found in the sediments near Point Potrero are the same as those found on the adjacent upland: metals, PCBs and PAHs. These areas were the site of shipbuilding operations during World War II and later ship scrapping activities. The sediments with the highest chemical concentrations are found in the Graving Inlet.

Industrial activities that have taken place at the site in the past include: shipbuilding, ship scrapping, and metal scrap recycling. Prior to 1920 the site consisted of unimproved marshland and tidal flats at the foot of the Point Potrero hills. During World War II, the U.S. government appropriated much of the waterfront for wartime ship construction. The two finger piers on the west side of the site were constructed between 1942 and 1949. From the end of World War II until 1964 the site was leased to Willamette Iron and Steel for use as a ship repair, construction, scrapping and steel fabrication facility. After 1964 the shipbuilding and steel fabrication ended when Levin Metals took over the site, but scrapping and recycling continued until 1987. In 1969, the Graving Inlet was excavated into the northwest shoreline of the property to allow final dismantling of the keels of scrapped ships. These activities are the most probable source of sediment contamination at the Graving Inlet and around Point Potrero.

Regulatory agencies became involved with the onshore portion of the site in 1984, starting with investigations of leaking and/or unlabeled drums. PCBs, metals and oil and grease were identified in the soils and sandblast waste at the site. Between 1987 and 1988, preliminary remedial actions occurred onshore (removal of drums, sand blast waste and underground storage tanks), the site was graded, storm drains were installed and up to two feet of road base aggregate was added to the site.

C. 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

Regional Board staff, in cooperation with staff of the Department of Toxic Substances Control, have overseen the design and implementation of a Remedial Investigation (Hart Crowser, 1993) and a Feasibility Study (Hart Crowser, 1994) for the onshore area that recommended capping of the upland source of the contaminated sediments. Placement of dredged material on the site was completed in December 1997 and the dredged material will be capped with asphalt when it has completed drying (projected for the summer of 1999).

Regional Board staff have written Waste Discharge Requirements (WDRs) for the onshore portion of the site. The WDRs serve to regulate the placement of dredged material on top of the upland source material to isolate it from human contact and provide a base for an asphalt surface.

Staff approved Supplemental Sediment Characterization in January 1997 and the preliminary results were made available in December 1997. The results provided better documentation of the horizontal and vertical extent of contamination at the mouth of the Graving Inlet. The data indicates that the areas of greatest contamination are limited to the Inlet and a smaller area at the southern extent of the property. Regional Board staff have provided comments on a draft Remedial Action Workplan (Terra Verde, 1998) that described five remedial action alternatives and participated in meetings with the Port of Richmond, Bay Conservation and Development Commission, and Department of Toxic Substances Control.

D. Preliminary assessment of actions required to remedy or restore a THS to an unpolluted condition including recommendations for remedial actions

Actions at this site to date have defined the horizontal and vertical extent of contaminants and shown that beneficial uses of waters of the state are impaired by the levels of contaminants in the Graving Inlet. A draft Remedial Action Workplan (RAP) has been submitted and is being finalized by the Port. Remedial action alternatives described in the RAP include: (1) No action, (2) Sheetpile Bulkhead, Capping and Institutional Controls, (3) Rock Dike Bulkhead, Capping and Institutional Controls, (4) Excavation and Off-Site Disposal, and (5) Excavation and Reuse or Disposal Onsite. Excavation or capping would require restoration of the site or restoration of an offsite location to mitigate for the loss of intertidal habitat.

Alternative 2: Sheetpile Bulkhead, Capping and Institutional Controls, is the alternative preferred by the Port, since it has a relatively low cost and would provide additional flat property that can be used by the Port. While this would provide a financial benefit to the landowner, it would require mitigation for loss of habitat and for filling of the Bay. This mitigation would probably require more than one acre of habitat restoration and/or public access improvements to be acceptable to the San Francisco Bay Regional Water Quality Control Board and the San Francisco Bay Conservation and Development Commission. Any requirement for endangered species consultation will be completed before finalization of the remediation plan.

E. Estimate of the total cost to implement the cleanup plan

Preliminary cost estimates for the remedial action alternatives described in the RAP include: (1) No action ($0), (2) Sheetpile Bulkhead, Capping and Institutional Controls ($792,000),

(3) Rock Dike Bulkhead, Capping and Institutional Controls ($1,344,000), (4) Excavation and Off-Site Disposal ($3,010,000), and (5) Excavation and Reuse or Disposal Onsite ($881,000). Regional Board staff costs are estimated at $30,000 ($10,000/yr for 3 years). There may be additional costs for mitigation of wetlands.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of mercury and PCBs in San Francisco Bay that are accumulating in fish. These concentrations have lead to a human health advisory on consuming fish but probably also impact other higher trophic organisms, that have a much higher consumption rate than humans, as well as possibly the fish themselves. The beneficial uses that are impacted are OCEAN COMMERCIAL AND SPORTFISHING (COMM), MARINE HABITAT (MAR), ESTUARINE HABITAT (EST), NONCONTACT WATER RECREATION (REC 1), WATER CONTACT RECREATION and possibly WILDLIFE HABITAT (WILD). Point Potrero has the highest concentrations of mercury and PCBs in over 600 samples collected statewide in the BPTCP. Implementation of this plan would contribute to lowering concentrations of these chemicals in fish and minimize the impacts on beneficial uses. For a more thorough description of the benefits to restoring beneficial uses see Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Point Potrero, as well as cost for RWQCB staff oversight.

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

The responsible party or parties are accountable for all costs incurred as a result of site investigation and cleanup at Point Potrero, as well as cost for RWQCB staff oversight.

Table E-1. Contaminant Levels in Point Potrero Graving Inlet (all units are mg/kg)

Data Source	Sample Location	Depth	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	PCBs Ar-1254	PAHs
ERM			9.6	370	270	218	0.71	51.6	410	0.180	44.8
Herzog (1986)	D1/2	NR	20	340	1600	2300	10 U	270	400	1.8	NA
Hart Crowser (1992)	SD-1	0-10 cm	4.4	190	870	840	7.5	84	2100	7.2	24
Hart Crowser (1992)	SD-1	11-18 cm	3.4	220	1000	560	6.3	110	1500	4.1	43
Hart Crowser (1997)	SD-1-s	0-15 cm	0.92	45	160	200	2.9	28	450	2.1	>1.0
BPTCP (1997)	21013.0	0-5 cm	NA	NA	NA	NA	4.6	NA	NA	19.9*	NA

ERM = NOAA's Effects Range Median; NA = Not Analyzed; NR = Not Reported; U = Below Detection Limit
< = Less than, data below detection limits counted as one half of the detection limit; * PCBs measured as total congeners

References

California Department of Fish and Game (CDFG). 1997. California Sport Fishing Regulations, Public Health Advisory on Fish Consumption, Richmond Harbor Channel, California

California Office of Environmental Health Hazard Assessment (OEHHA). 1994. Health Advisory on Catching and Eating Fish-Interim Sport Fish Advisory for San Francisco Bay. Sacramento, CA.

California Office of Environmental Health Hazard Assessment (OEHHA). 1994. Public Health Advisory on Fish Consumption , Richmond Harbor Channel, California.

Hart Crowser, Inc. 1993. Final Remedial Investigation Report, Volume I, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.

Hart Crowser, Inc. 1994. Final Feasibility Study Operable Unit 1: Soil and Groundwater, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.

Hart Crowser, Inc. 1995. Final Remedial Action Plan, Port of Richmond, Shipyard No. 3 Scrap Area Site. Richmond, CA.

Hart Crowser, Inc. 1997. Final Work Plan for Supplemental Sediment Characterization, Port of Richmond, Shipyard No. 3 Scrap Area Site, Operable Unit 2 and Operable Unit 3. Richmond, CA.

Herzog, Donald and Associates, Inc. 1989. Final Report, Remedial Investigation/Feasibility Study, Seacliff Marina, Richmond Shipyard No. 3, Richmond.

Hunt J.W., B.S. Anderson, J. Newman, R.S. Tjeerdema, K. Taberski, C.J. Wilson, M. Stephenson, H.M. Puckett, R. Fairey and J. Oakden. 1998. Sediment Quality and Biological Effects in San Francisco Bay. Final Technical Report. Pp. 118. Appendix A-E.

San Francisco Bay Regional Water Quality Control Board, SWRCB, CDFG. 1995. Contaminant Levels in Fish Tissue from San Francisco Bay.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments. May 1998.

San Francisco Estuary Institute (SFEI). 1994. 1993 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

SFEI. 1995. 1994 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

SFEI. 1996. 1995 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

SFEI. 1997. 1996 Annual Report, San Francisco Estuary Regional Monitoring Program for Trace Substances. Richmond, CA.

Terra Verde. 1998. Draft Remedial Action workplan, Operable Units 2 and 3, Port of Richmond, Shipyard No. 3 Scrap Area Site, Richmond, California. April 9, 1998.

Washington State Department of Ecology. 1997. Developing Health Based Sediment Quality Criteria for Cleanup Sites: A Case Study Report. Ecology Publication 97-114.

U.S. Army Corps of Engineers and Port of Richmond. 1996. Final Supplemental Environmental Impact Statement/ Environmental Impact Report, Richmond Harbor Navigation Improvements.

Site F – Mission Creek

Description of site

Mission Creek is a 0.75 mile long arm of the Bay in the eastern side of the San Francisco waterfront (Figure F-1 and F-2). Formerly, the estuary of Mission Creek reached back a couple of miles. It was filled to roughly its present dimension before the turn of the century. Currently, the creek is 100 to 200 feet wide in most sections and narrower at the two bridges at 3rd and 4th Streets. Concrete rip rap and isolated bands of vegetation line Mission Creek's banks.

Ten to fifteen houseboats are docked at the Mission Creek Harbor located between 5th and 6th Streets along the south shore of the creek. Many of the houseboats have year round on-board residents.

The City and County of San Francisco operates seven combined sewer overflow structures in Mission Creek from 3rd Street to the upper end at 7th Street. Light industrial and urban development line the shores of Mission Creek. A new baseball stadium will soon open on the north shore at the mouth of Mission Creek near 2nd Street in China Basin. Currently, demolition debris cover the remainder of the north shore. According to City plans, new retail development will occupy this area in the near future. Along the south shore, there is a golf driving range near 6th Street, warehouse facilities, and a sand and gravel operation near the mouth of the Creek. Finally, Interstate Freeway 280 crosses over Mission Creek between 6th and 7th Streets.

Reason for listing

The upper end of Mission Creek in the vicinity of 6th Street meets the definition of a toxic hot spot due to impacts on aquatic life resulting from contaminated sediment. This is definition number 2 in the SWRCB's <u>Guidance on Development of Toxic Hot Spot Cleanup Plans</u>. Definition number 2 defines a toxic hot spot as exhibiting recurrent toxicity associated with pollutants that is significantly different compared to reference site conditions (see Definition of a Toxic Hot Spot, Volume I). The primary basis

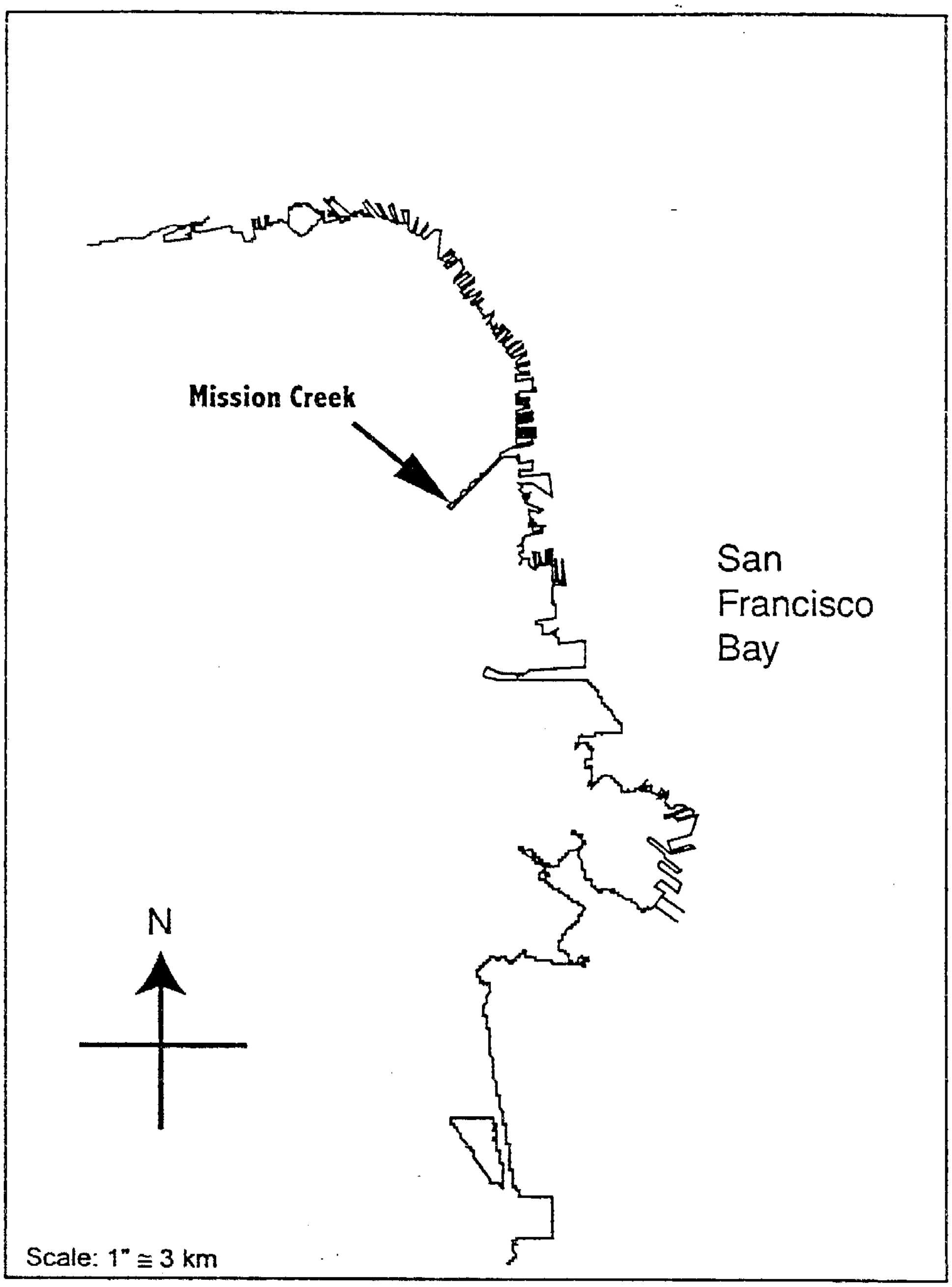


Figure F-1. Mission Creek

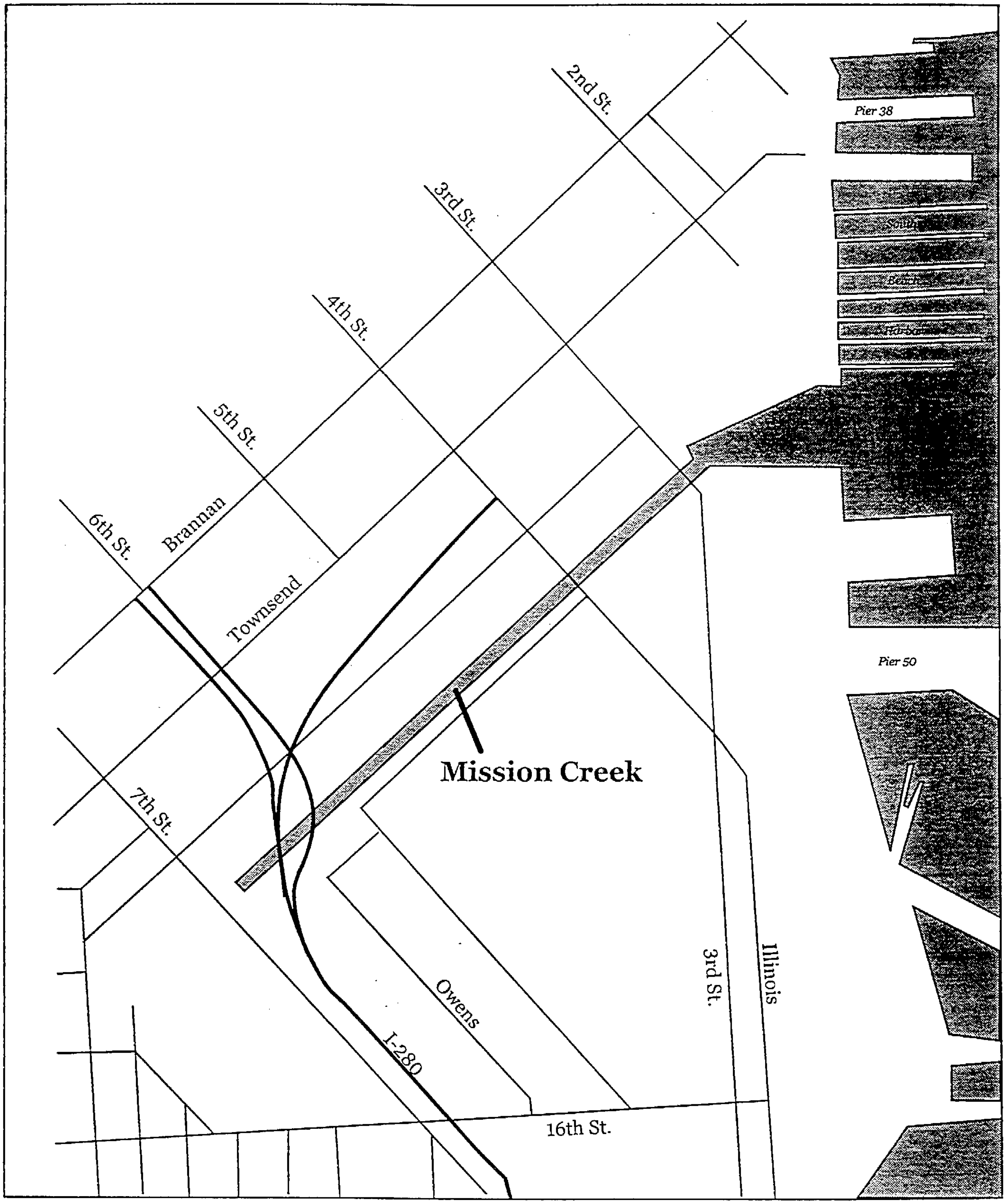


Figure F-2. Mission Creek

for the determination is the BPTCP data. Also, data from a 1979 study the City and County of San Francisco commissioned support the determination. Below is a summary of these data and the specific reason for listing.

According to the State Board Guidance Document, a site is ranked high in aquatic life impact if 1) recurrent toxicity testing, 2) chemical analysis, and 3) benthic community analysis combine to provide a weight-of-evidence determination in the commonly used "sediment quality triad" described by Chapman et al. (1987).

The BPTCP data show that the upper end of Mission Creek has recurrent sediment toxicity, elevated concentrations of chemicals, and an impacted benthic community. The report, Sediment Quality and Biological Effects in San Francisco Bay (Hunt et al., 1998a), contain details of these data. Also, the 1979 study the City and County of San Francisco commissioned to assess the impacts of their wastewater overflows (CH2M Hill, 1979) provides support that there are elevated metals and an impaired benthic community at this site. Below are summaries of each of the three factors.

The BPTCP results show recurrent toxicity to both the amphipod and sea urchin tests at a station located in the upper end of Mission Creek. The BPTCP collected sediment samples from this station (number 21030) during a screening phase in 1995, and two years later during a confirmation phase. The amphipod survival was 5 and 19 percent, in the screening and confirmation phases, respectively. Sea urchin larvae development was zero percent normal in the pore water and 11 percent normal in the sediment-water interface exposure. All of these results were lower than the respective reference envelope limits for that test, less than 90% the appropriate minimum significant difference (MSD), and significantly different than controls.

This toxicity is associated with mean ERM quotients of 0.51 for the screening phase and 3.93 for the confirmation phase. The value of 3.93 is the highest of all the BPTCP stations in the Bay. The chemicals consistently found above the ERM values are chromium, lead, and chlordane. Mercury, copper, silver, zinc, dieldrin, PCBs, phenanthrene, and PAHs were also found above the ERM values during confirmation sampling. In addition, chlorpyrifos and mirex levels were in the top 10% of samples in the statewide BPTCP database.

The 1979 study supports the conclusion that there are elevated metals in the sediments at this site. Data from a station 20 yards upstream of 6th Street show metals in the sediment above the ERM levels for copper, lead, mercury, nickel, silver, and zinc.

The BPTCP benthic community analysis for station 21030 shows a Relative Benthic Index (RBI) of zero. A RBI of less than or equal to 0.3 is an indicator that pollutants or other factors are negatively impacting the benthic community.

The 1979 study found no benthic organisms with the exception of one invertebrate, an oligochaeta, in one out of five sampling events between February and April.

During the reference site study a large composite sediment sample was collected from Mission Creek for a Phase I Toxicity Identification Evaluation (TIE). This sample was toxic to the amphipod *Eohaustorius*. There were high levels of unionized ammonia and hydrogen sulfide in the sample. After the ammonia and hydrogen sulfide were removed toxicity remained. This residual toxicity had to be due to toxicants other than ammonia and sulfide, since those two compounds were reduced to non-toxic levels. However, the residual cause of the toxicity could not be determined (S.R. Hansen & Assoc., 1996).

A. <u>Assessment of areal extent of the toxic hot spot</u>

Our best estimate of the areal extent of the toxic hot spot at this time is approximately 9 acres. This includes the entire width of Mission Creek from its upper end at 7th Street down to the 4th Street bridge. This is a rough estimate based on data from the BPTCP, as discussed below. The precise areal extent is unknown at this time because there are insufficient sampling locations. Additional sampling is necessary to define the actual areal extent, however, it is estimated that it may range from 5 to 12 acres.

The BPTCP collected samples at three stations along Mission Creek: one at the upper end near 6th Street, another near the mouth and a third (added during the confirmation phase) located midway between the two near 4th street. It is data from the upper end station that forms the primary basis for determining that this area is a toxic hot spot.

For the western boundary of the toxic hot spot, we assumed that the upper end station is representative of the sediments upstream to the end at 7th Street. This is a conservative assumption and accurate if the primary source of pollutants is from the combined sewage overflow discharge points located at 6th and 7th Streets. Data from a 1979 study also supports this assumption. The data show elevated metals and impaired benthic community in sediment collected upstream of 6th Street (CH2M Hill, 1979).

We believe the eastern boundary of the toxic hot spot may extend to the 4th Street bridge based on data from the BPTCP midway station (number 21301). The data show that the sediments here are somewhat impacted though not as impacted as at the upper end station. There was toxicity to amphipods with 58% survival, and elevated metals with a mean ERM quotient of 1.0 and three chemicals above the ERM (chlordane, PCBs, and PAH).

B. Assessment of the most likely sources of pollutants

The most likely source of pollutants ~~are the~~ is either historic or legacy sources or storm water either by way of direct discharge to the channel or as discharged during the infrequent combined sewer overflows (CSO) operated by the City and County of San Francisco. Other sources may include deposition from air emissions from vehicles traveling the Interstate 280 overpass and surrounding streets. PAHs are associated with fossil fuel combustion and mercury along with other metals are a contaminant in diesel exhaust. ~~However, compared to the CSO contribution, these are expected to be minor sources.~~ The magnitude of these various sources is still to be determined, however it is probable that all sources have an effect on toxicity at this location.

The City and County of San Francisco operates seven CSO discharge points into Mission Creek. The largest one is located at the upper end near 7th Street (often referred to as the Division Street overflow structure). The City reports that this CSO structure receives approximately 95% of the overflows. Other CSO structures are located along Mission Creek at 6th, 5th, 4th and 3rd Streets. CSO discharges consist of sanitary sewage, industrial wastewaters, and storm water runoff from the City's combined sewer system. Currently, CSO discharges occur when storm water and wastewater flows exceed the treatment capacity of the City's treatment plants. The City is currently permitted to overflow an average of ten times per year to the structures in Mission Creek. Before about 1988, the overflows were untreated and occurred anytime rainfall exceeded 0.02 inches per hour. After 1988, newly constructed storage and consolidation facilities provided treatment of the overflows equivalent to primary treatment standards. Primary treatment involves removal of a significant portion of settleable and floatable solids from the wastewaters.

Although there is sparse data on the quality of the historic overflows to Mission Creek, data from recent discharges and other similar sources support the conclusion that the CSOs are ~~the most likely~~ one of the sources of the pollutants. These data show that most if not all the pollutants exceeding ERMs in the sediment at this site are also present in urban runoff and/or sewage. Additionally, a 1979 study commissioned by San Francisco concluded that the accumulative impact of the CSOs on the sediments was evident (CH2M Hill, 1979). The impact of CSO events on sediment distribution and the relationship of historic versus current discharges is uncertain.

C. Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs

Since 1967, the Regional Board has issued resolutions and orders prescribing requirements on the discharges from the CSO structures. One of the more significant ones is Cease and Desist Order No. 79-119 in 1979 requiring San Francisco to construct overflow consolidation structures to reduce wet weather overflow frequencies to allowable levels. San Francisco completed the consolidation structures for the CSOs into Mission Creek around 1988. These consolidation structures also provided settleable and floatable solids removal treatment for the overflows.

More recently in June 1998, the Regional Board issued a draft Water Code Section 13267 letter requiring San Francisco to define the extent of the sediment contamination, and determine if the CSOs are continuing to cause the contamination or acting to resuspend contaminated sediments already there. Section 13267 is a legal administrative tool with enforcement powers for the Regional Board to require collection of technical information. The Regional Board followed up with three more letters in August and September 1998 and March 1999 to further define and formalize the requirements of the investigation. San Francisco submitted a Sampling and Analysis Plan, and in October 1998 started the investigation. Results of the October sampling have been submitted to Regional Board staff and are being reviewed.

D. Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions

Corrective actions for Mission Creek sediments will require the following phases:

1. Completion of a site investigation that delineates the vertical and horizontal extent of contamination~~, and whether and to what extent the CSOs are continuing to contribute pollutants.~~

2. Complete a source investigation to determine the sources and relative magnitude of contribution of possible sources

~~2.~~3. Preparation of a Feasibility Study based on the findings of the Site Investigation. At a minimum the following cleanup options will be considered, if the CSOs are not contributing pollutants:

a. natural recovery,
b. dredging with disposal and capping, and
c. dredging with disposal of sediments.

If the CSOs ~~are continuing to contribute pollutants,~~ are a significant ongoing source of the identified pollutants the cleanup options will include those listed above plus, at a minimum, the following:
d. evaluation of reduction ~~reduce~~ or ~~eliminate~~ elimination of the number of overflows by changing the operation or the storage and treatment capacity of the current system, and/or
e. implement upstream measures that reduce the volume or intensity of runoff. An example of this would be a program to encourage increasing permeable cover.

~~3.~~4. Implement the remediation option(s) selected from the Feasibility Study.

~~4.~~5. Follow-up monitoring to make sure that the site has been cleaned up and remains clean.

An endangered species consultation with all appropriate agencies will be conducted before remediation plans are finalized.

E. Estimate of the total cost to implement the cleanup plan

We estimate that the cost of performing a full site investigation and feasibility study will be $1 million; the cost of remediation and follow-up monitoring will be $800,000 to $1,800,000 with dredging options; if option (d) is added and significant structural changes are needed the cost would increase to approximately $75 million.

Regional Board staff costs will be $100,000 to $200,000 over the entire course of the project.

In estimating the remediation cost, we used an areal extent of 5 acres as a minimum and 12 acres as a maximum, and contamination to a depth of at least 3 feet below the sediment surface. Furthermore, we used dredging as the preferred option for cleanup, with sediment disposal in an upland facility, either a Class I landfill or a reuse site based on the degree of contamination. Following dredging, we also assume that the area would be backfilled with clean sediment.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of chemicals at this site. The beneficial uses that are impacted are ESTUARINE HABITAT (EST), WATER CONTACT RECREATION (REC 1) AND NONCONTACT WATER RECREATION (REC 2). Implementation of this plan will minimize or eliminate these impacts on beneficial uses. For a more thorough description of the benefits to restoring beneficial uses see Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs for the site cleanup. Costs for Regional Board and other regulatory staff oversight are recoverable from the responsible party after the Regional Board issues a Cleanup and Abatement Order to that party.

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

In the next two years, we estimate the expenditure will be $1,100,000. This includes the completion of the site investigation and feasibility study with Regional Board staff oversight.

Currently, the City and County of San Francisco is funding the site investigation. The plan is for the Regional Board to issue a Cleanup and Abatement Order to the responsible party or parties subsequent to completion of the site investigation, at which point, staff oversight costs and the feasibility study will be recoverable from that party.

References

Chapman, P.M., Dexter, R.N., and Long, E.R. 1987. Synoptic Measures of Sediment Contamination, Toxicity and Infaunal Community Composition. The Sediment Quality Triad in San Francisco Bay. Marine Ecology Progress Series 37:75-96.

CH2M Hill. 1979. Bayside Overflows. Report for City and County of San Francisco.

Hunt, J.W., Anderson, B.S., Phillips, B.M., Newman, J., Tjeerdema, R.S., Taberski, K.M., Wilson, C.J., Stephenson, M., Puckett, H.M., Fairey, R., and Oakden, J. 1998a. Sediment Quality and Biological Effects in San Francisco Bay. Prepared for Ca. State Water Resources Control Board. pp. 188 + appendices A-E.

SFBRWQCB. 1996. Fact Sheet. Prepared by staff of the California Regional Water Quality Control Board, San Francisco Bay Region for Amendment of Waste Discharge Requirements for Order No. 94-149 for City and County of San Francisco, Southeast Water Pollution Control Plant.

S.R. Hansen & Assoc. 1996. Development and Application of Estuarine Sediment Toxicity Identification Evaluations. Prepared for San Jose State Foundation. pp. 79 Appendix A&B.

Site G -- Islais Creek

Description of site

Islais Creek is a one mile long channel of the Bay running east-west on the San Francisco waterfront near the foot of Potrero Hill and Caesar Chavez Street (Figure G-1 and G-2). Formerly, the estuary of Islais Creek reached back a couple of miles as far as Bayshore Boulevard, and was fed by a creek that ran down what is now Alamany Boulevard. Before the turn of the century, the area was filled to roughly its present size.

A bridge at Third Street forms a narrow 100-foot wide constriction that physically divides the channel into two segments. The eastern segment is approximately 400 to 500 feet wide; the western, 250 to 300 feet wide.

The City and County of San Francisco operates four wet weather overflow structures that discharge into the western segment. San Francisco also operates a sewage treatment plant effluent outfall that discharges into the western segment at Quint Street.

The banks of Islais Creek are covered with concrete rip-rap with narrow bands of vegetation in small isolated areas. Long stretches of creek bank in the eastern segment are under pier structures. Old pier pilings dot the southern shore of the western segment.

Light industrial and urban development surround Islais Creek. On the shores of the eastern segment are a sand and gravel facility, grain terminal, oil and grease rendering facility, warehouse, and container cargo terminal. Auto dismantlers and auto parts dealers, scrap metal recyclers, and warehouses make up the bulk of the current activities surrounding the western segment. Interstate 280 passes over the western end of Islais Creek.

Reason for listing

The western segment of Islais Creek meets the definition of a toxic hot spot due to impacts on aquatic life resulting from contaminated sediment. This is definition number 2 in the

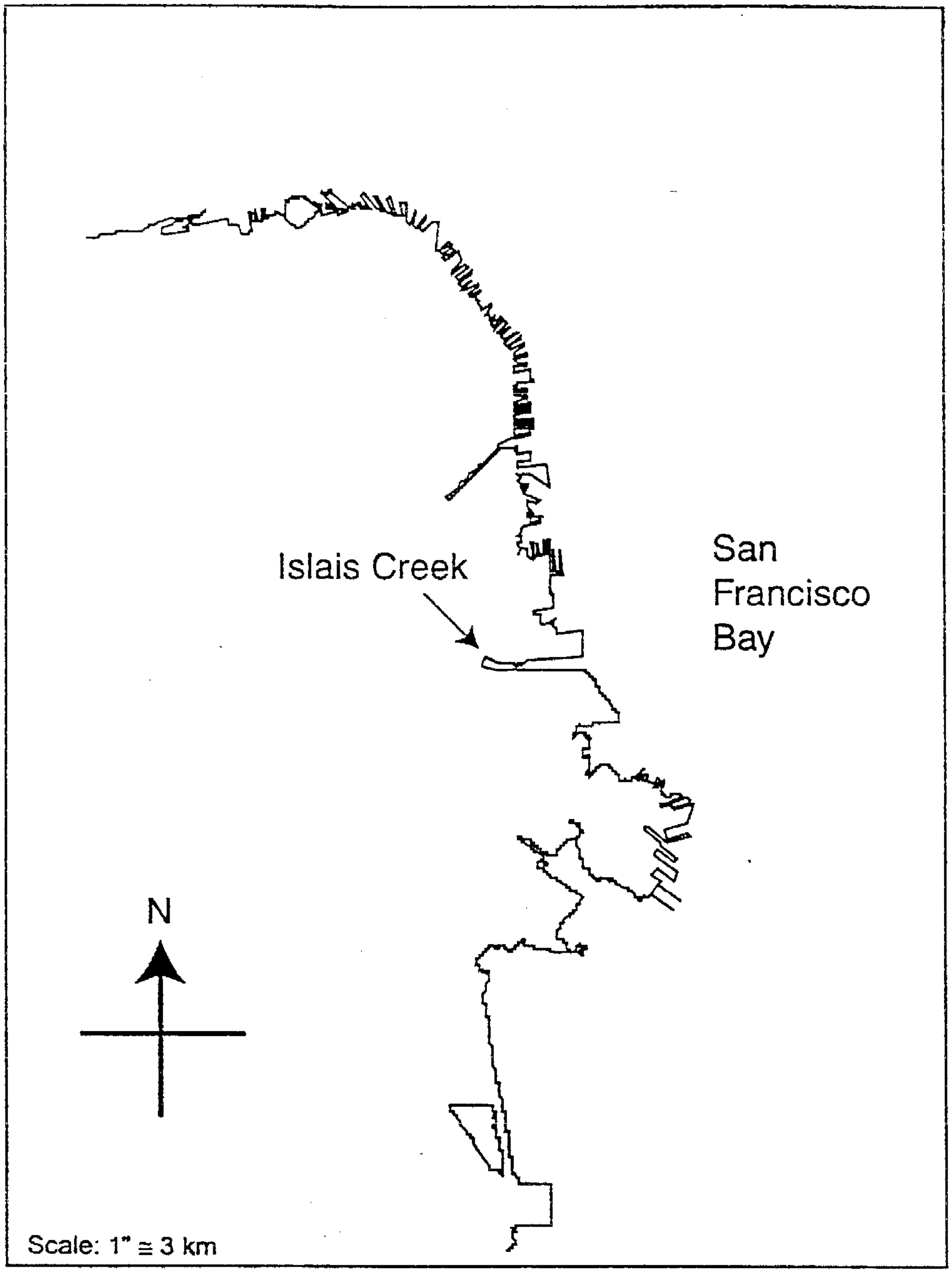


Figure G - 1. Islais Creek

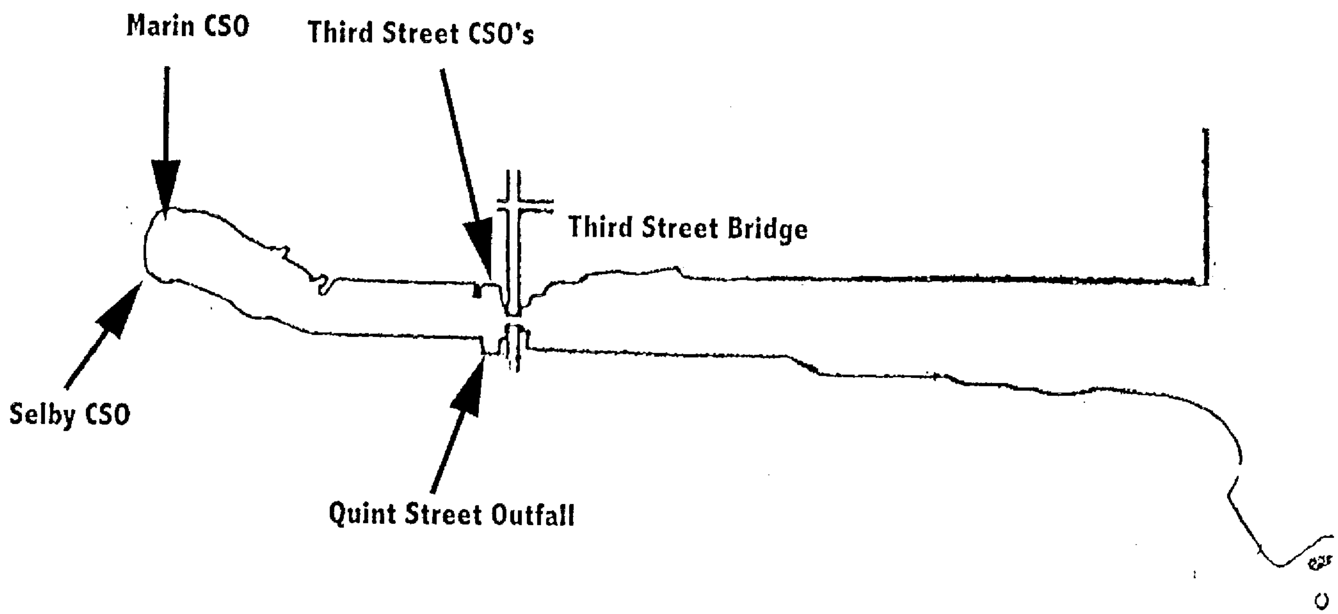


Figure G-2. Islais Creek, Location Detail

SWRCB's Guidance on Development of Toxic Hot Spot Cleanup Plans. Definition number 2 defines a toxic hot spot as exhibiting recurrent toxicity associated with pollutants that is significantly different compared to reference site conditions (see Part I Specific Definition of a Toxic Hot Spot). The primary basis for our determination is the BPTCP data. Data from various other studies also support our determination. Below is a summary of these data and the specific reasons for listing.

According to the State Board Guidance Document, a site has a high ranking in aquatic life impact if (1) recurrent toxicity testing, (2) chemical analysis, and (3) benthic community analysis combine to provide a weight-of-evidence determination in the commonly used "sediment quality triad" described by Chapman et al. (1987). The BPTCP data show that the western segment of Islais Creek has sediment toxicity, elevated concentrations of chemicals, and an impacted benthic community. The report Sediment Quality and Biological Effects in San Francisco Bay (Hunt et al., 1998a) contain these data. The BPTCP report Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay (Hunt et al., 1998b) contain additional details. Also, a research study in 1987 and a study MEC conducted for San Francisco provide supporting data for our determination that this site is a toxic hot spot. Below are summaries of the data related to each of the three factors.

Recurrent Toxicity

The BPTCP results show recurrent toxicity to both the amphipod and sea urchin tests at a station located in the western segment of Islais Creek. The BPTCP collected sediment samples from this station (number 20011) during the reference site study in 1995 (which served as the screening for this site), and two years later during a confirmation phase.

The amphipod survival was 57% and 0%, in the screening and confirmation phase, respectively. The sea urchin larvae development was 0% normal in the pore water and sediment-water interface during the screening phase. In the confirmation phase, there was only 8% normal development. All of these results were lower than the respective reference envelope limits for that test, less than 90% of the appropriate minimum significant difference (MSD), and significantly different than controls.

During the reference site study, a large composite sediment sample was collected for a Phase I Toxicity Identification Evaluation (TIE). The results of the Phase I Characterization procedures indicated that the sediments from Islais Creek were toxic to the urchin *Strongylocentrotus p.* and contained 20 TUs (toxic units). Sediments were high in unionized ammonia and hydrogen sulfide. When the ammonia and hydrogen sulfide were removed there were still 10 TUs remaining. The residual toxicity had to be due to toxicants other than ammonia and hydrogen sulfide since those two compounds were reduced to non-toxic levels. The cause of the remaining toxicity was not identified but may have been due to polar organics (S.R. Hansen & Assoc., 1996).

Data from a research study in 1987 supports the finding of toxicity in sediments in the western segment of Islais Creek. This study found toxicity to amphipods and mussel larvae (Chapman et al., 1987).

A study MEC conducted for the City and County of San Francisco in 1996 shows toxicity to amphipods compared to controls in four out of fifteen samples in the western segment (MEC, 1996). Although this study did not find toxicity at all locations in the western segment, the results still support recurrent toxicity and may suggest sediment quality is dynamic in this segment.

Elevated Chemicals

The toxicity described above is associated with a mean ERM quotient of 1.18 for the confirmation phase. This quotient is calculated from the concentrations of a list of metals and organic compounds divided by an average of sediment quality guideline values (ERMs) for those compounds. Sediments with a quotient of greater than 0.5 are considered to have elevated chemical concentrations. The chemicals found above the ERM values are chlordane, dieldrin, PCBs, and low molecular weight PAHs. In addition, endosulfan sulfate was in the top 10% of samples in the statewide BPTCP database.

Data from a 1979 study by CH2M Hill and another research study in 1987 support the conclusion that there are elevated PCBs in the sediments in the western segment. The 1979 study found a mean of 500 ug/kg total Aroclor (CH2M Hill, 1979); the 1987 study found total PCBs at 255 ug/kg (Chapman et al., 1987). Furthermore, the 1987 study found sediments with elevated low and high molecular weight PAHs (Chapman et al., 1987).

These studies also found metals in the western segment sediments above ERM values (Chapman et al., 1987; CH2MHill, 1979). The metals include lead, mercury, and silver. Sediment monitoring in the western segment of Islais Creek by the City and County of San Francisco from 1990 to 1993 show levels of mercury exceeding the ERM in every year except 1990. The ERM value for lead was also exceeded in 1991 (CCSF, 1990-1993).

Impacted Benthic Community

The BPTCP benthic community analysis of the western segment of Islais Creek shows a Relative Benthic Index (RBI) of 0.22. A RBI of less than or equal to 0.3 is an indicator that pollutants or other factors are negatively impacting the benthic community.

The 1979 study found few to no benthic organisms in five sampling events between February and April in the western segment of Islais Creek. There were a total of only eleven species, six of which the report's authors noted as being unusual because they were freshwater organisms or fly larvae common at sewage treatment plants.

A 1987 research study concluded that this area of Islais Creek was the most depauperate compared to other sites in the study, in terms of taxa richness and total abundance (Chapman et al., 1987).

A. <u>Assessment of areal extent of the toxic hot spot</u>

At this time, our best estimate of the areal extent of the hot spot is approximately 11 acres, comprising the entire width of Islais Creek from its upper end at Selby Street down to Third Street. This is a rough estimate based on data from the BPTCP, as discussed below. The precise areal extent is unknown at this time because there are insufficient sampling locations. Additional investigation is necessary to determine the actual areal extent which may range from 5 to 35 acres.

The BPTCP collected samples at three stations along Islais Creek: one at the upper end near Selby Street, and the other two down stream about 200 feet west (mid-gradient) and 400 feet east (lower end) of the Third Street Bridge. The last two were added during the confirmation phase. It is data from the upper end station that forms the primary basis for determining that that area is a toxic hot spot. Therefore, the western boundary for the toxic hot spot is the upper end of Islais Creek at Selby Street.

The eastern boundary of the toxic hot spot extends out to the Third Street Bridge and probably farther east towards the Bay. The BPTCP data show that the sediments at the mid-gradient station are impacted though not as highly impacted as at the upper end station. The sediment at this station was toxic to sea urchin larvae with 47% normal development, had elevated chemicals with an ERM quotient of 0.6, and had a Relative Benthic Index (RBI) of 0.25.

Support for the statement that the toxic hot spot extends farther east of the Third Street Bridge comes from the last BPTCP station and other studies. These other studies show that the quality of sediments in the eastern segment of Islais Creek has high variability either spatially or temporally. These studies include one by the National Oceanic and Atmospheric Administration in 1992 (Long et al., 1992), another by the Lawrence Berkeley National Laboratory in 1995 (Anderson et al., 1995), and two others by Advanced Biological Testing in 1998 (ABT, 1998a and 1998b).

In 1997, the sediments at the BPTCP lower end station appear impacted. The sediment was toxic to amphipods with 49% survival, and had elevated chemicals with an ERM quotient of 0.62. However, the benthos was less impacted than the other two BPTCP stations with a RBI of 0.43.

A 1992 study collected sediments from Islais Creek at stations further east of the BPTCP stations. These data show mercury, PAHs, and PCBs at concentrations above ERM levels (Long et al., 1992). There was also observed cytogenetic effects on mussel and sea urchin larvae exposed to sediments at these stations compared to controls (Long et al. 1992). The 1995 study also found sediment in this vicinity to be toxic to sea urchins and mussels compared to a reference site (Anderson et al., 1995).

Studies conducted in 1998 for the Port of San Francisco sampled sediments midway along the north shore of the eastern segment of Islais Creek (ABT 1998a and 1998b). The purpose of the studies was to characterize the sediments for maintenance dredging. The data did not show elevated concentrations of chemicals although several samples were toxic to mussel larvae and one sample was toxic to amphipods.

B. Assessment of the most likely sources of pollutants

The most likely source of pollutants ~~are~~ is some combination of storm water and urban runoff either entering the channel directly or through the combined sewer overflows (CSO) operated by the City and County of San Francisco. Another ~~likely~~ possible source is San Francisco's treatment plant discharge outfall at Quint Street. Because of recent improvements in treatment ~~the quality~~ of the discharges from ~~these sources~~ the CSOs and the Quint Street outfall in the past two years, historic discharges from these sources are probably more of a factor than current discharges. Other sources may also contribute and the actual magnitude of contribution of sources is still to be determined. Additional description of all these sources and potential sources are below.

CSOs

The City and County of San Francisco operates four CSO discharge points into Islais Creek. Two are at the upper end near Selby Street (referred to as the Selby Street and Marin Street overflow structures). The other two CSO structures are at Third Street.

CSO discharges consist of sanitary sewage, industrial wastewaters, and storm water runoff from the City's combined sewer system. CSO discharges occur when storm water and wastewater flows exceed the treatment capacity of the City's treatment plants. The City is currently permitted to overflow an average of four times per year to the structures in Islais Creek. Newly constructed storage and consolidation facilities provide treatment of the overflows equivalent to primary treatment standards. Primary treatment involves removal of a significant portion of settleable and floatable solids from the wastewaters. However, prior to the completion of these consolidation facilities in 1996, the overflows were untreated and occurred anytime rainfall exceeded 0.02 inches per hour.

Although there is sparse data on the quality of the historic overflows to Islais Creek, data from recent discharges and other similar discharges support the conclusion that the CSOs are ~~the most likely~~ one of the sources of the pollutants. Most if not all the pollutants exceeding ERMs in the sediment at this site are or were pollutants in urban runoff and/or sewage. Additionally, a 1979 study commissioned by San Francisco concluded that the accumulative impact of the CSOs on the sediments was evident (CH2M Hill, 1979).

Quint Street Outfall

This outfall is at the south shore of Islais Creek at Quint Street just west of the Third Street Bridge. San Francisco uses this outfall when wastewater flows from the Southeast Wastewater Treatment Plant exceed the capacity of the main deep water discharge outfall to the Bay. The capacity of the deep water outfall is 100 million gallons per day.

After completing a re-piping project and increasing the secondary treatment capacity of the plant in 1997, San Francisco discharges only secondary treated wastewater to the outfall. Prior to 1997, the Quint Street outfall received a blend of primary and secondary treated wastewaters from the treatment plant.

Secondary treatment is a higher level of treatment than primary. Primary treatment relies on physical separation and removal of settleable and floatable solids. Secondary involves using biological treatment technologies which can remove dissolved pollutants. Secondary treatment standards require removal of at least 80% of the suspended solids and oxygen consuming matter from the sewage.

As is the case for the CSO, most if not all the pollutants exceeding the ERMs in the sediment at this site are or were pollutants in treated sewage. Therefore, the discharges from the Quint Street Outfall are or were a likely source of pollutants.

Other Potential Sources

Other sources of pollutants to Islais Creek may include sheet runoff or any past discharges from auto dismantlers and metal recycling facilities bordering Islais Creek. Deposition from air emissions from vehicles traveling the Interstate 280 overpass and surrounding streets may also contribute. PAHs are associated with fossil fuel combustion. Mercury and other metals are contaminants in diesel exhaust. ~~However, compared to the CSO and Quint Street outfall contributions, these are estimated to be minor sources.~~

C. Summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at existing THS and to prevent the creation of new THSs

Since 1967, the Regional Board has issued numerous resolutions and orders prescribing requirements on the discharges from the CSO structures. One of the more significant ones is Cease and Desist Order No. 79-119 in 1979 requiring San Francisco to construct overflow consolidation structures to reduce wet weather overflow frequencies to allowable levels throughout the city. For Islais Creek, San Francisco completed the consolidation structures in 1996. These consolidation structures also provided settleable and floatable solids removal treatment for the overflows.

Order No. 79-119 also required the City to develop alternatives to address the discharge from the Quint Street outfall. The outcome of this order was improvement in the quality of the discharge to the outfall. Starting in 1997, the Quint Street outfall received only secondary treated wastewater. San Francisco accomplished this by a major re-piping project and increasing the secondary treatment capacity of their Southeast Treatment Plant.

More recently in June 1998, the Regional Board issued a draft Water Code Section 13267 letter requiring San Francisco to define the extent of the sediment contamination, and determine if the CSOs and Quint Street outfall are continuing to cause the contamination or may act to resuspend contaminated sediments already there. Section 13267 is a legal administrative tool with enforcement powers for the Regional Board to require collection of technical information. The Regional Board followed up with three more letters in August and September 1998 and March 1999 to further define and formalize the requirements of the investigation.
San Francisco submitted a Sampling and Analysis Plan, and in October 1998 started the investigation. The results of the October 1998 investigation have been submitted and are being reviewed by RWQCB staff.

D. Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions

Corrective actions for Islais Creek sediments will require the following phases:

1. Completion of a Site Investigation that delineates the vertical and horizontal extent of contamination~~, and whether and to what extent the CSOs and Quint Street outfall are continuing to contribute pollutants~~.

2. Complete a source investigation to determine the sources and relative magnitude of contribution of possible sources

~~2.~~3. Preparation of a Feasibility Study based on the findings of the Site Investigation. At a minimum the following cleanup options will be considered, if the CSOs and Quint Street outfall are not contributing pollutants:
a. natural recovery,
b. partial dredging with disposal and capping, and
c. dredging with disposal of sediments.

If the CSOs and Quint Street outfall are ~~continuing to contribute pollutants~~ identified as a significant ongoing source of the chemicals of concern, the cleanup options will include those listed above plus at a minimum the following:

d. evaluation of reduction ~~reduce~~ or ~~eliminate~~ elimination of the number of overflows by changing the operation or increasing the storage and treatment capacity of the current system, and/or
e. implement upstream measures that reduce the volume or intensity of runoff. An example of this would be a program to encourage increasing permeable cover.

~~3.~~4. Implement the remediation option(s) selected from the Feasibility Study.

~~4.~~5. Follow-up monitoring to make sure that the site has been cleaned up and remains clean.

An endangered species consultation with all appropriate agencies will be conducted before remediation plans are finalized.

E. Estimate of the total cost to implement the cleanup plan

We estimate that the cost of performing a full site investigation and feasibility study will be $1 million; the cost of remediation and follow-up monitoring will be

$800,000 to $5,200,000 with dredging options; if option (d) is added and significant structural changes are needed the costs would increase to approximately $75 million. Regional Board staff costs will be $100,000 to $200,000 over the entire course of the project.

In estimating the remediation cost, we used an areal extent of 5 acres as a minimum and 35 acres as a maximum, and contamination to a depth of at least 3 feet below the sediment surface. Furthermore, we used dredging as the preferred option for cleanup, with sediment disposal in an upland facility, either a Class I landfill or a reuse site based on the degree of contamination. Following dredging, we also assume that the area would be backfilled with clean sediment.

Although there are costs to implementing this plan there are also benefits. Currently, beneficial uses are being impacted by high concentrations of chemicals at this site. The beneficial use that is impacted is ESTUARINE HABITAT(EST) and NONCONTACT WATER RECREATION (REC 2). Implementation of this plan will minimize or eliminate these impacts on beneficial uses. For a more thorough description of the benefits to restoring beneficial uses in Table 1 in Volume I.

F. Estimate of recoverable costs from potential dischargers

The responsible party or parties are accountable for all costs for the site cleanup. Costs for Regional Board and other regulatory staff oversight are recoverable from the responsible party after the Regional Board issues a Cleanup and Abatement Order to that party.

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

In the next two years, we estimate the expenditure will be $1,100,000. This includes the completion of the site investigation and feasibility study with Regional Board staff oversight.

Currently, the City and County of San Francisco is funding the site investigation. The plan is for the Regional Board to issue a Cleanup and Abatement Order to the responsible party or parties subsequent to completion of the site investigation, at which point staff oversight costs and the feasibility study will be recoverable from that party.

References

Advanced Biological Testing Inc. 1998a. Results of Chemical, Physical, and Bioassay Testing of Sediments for Maintenance Dredging at Pier 80A, San Francisco, California. Prepared for the Port of San Francisco.Advanced Biological Testing Inc. 1998b. Results of Chemical, Physical, and Bioassay Testing of Sediments for Maintenance Dredging at Pier 80B, San Francisco, California. Prepared for the Port of San Francisco.

Anderson, S.L., Knezovich, J.P., Jelinski, J., and Steichen, D.J. 1995. The Utility of Using Pore-Water Toxicity Testing to develop Site-Specific Marine Sediment Quality Objectives for Metals. Final Report. LBL-37615 UC-000. Lawrence Berkeley National Laboratory, University of California, Berkeley, California.

Chapman, P.M., Dexter, R.N., and Long, E.R. 1987. Synoptic Measures of Sediment Contamination, Toxicity and Infaunal Community Composition. The Sediment Quality Triad in San Francisco Bay. Marine Ecology Progress Series 37:75-96.

City and County of San Francisco, Department of Public Works, Bureau of Water Pollution Control. 1990-1993. Tabulated data on Southeast and Islais Creek Sediment submitted by Jim Salerno to the California Regional Water Quality Control Board, San Francisco Bay Region.

CH2M Hill. 1979. Bayside Overflows. Report for City and County of San Francisco.

Hunt, J.W., Anderson, B.S., Phillips, B.M., Newman, J., Tjeerdema, R.S., Taberski, K.M., Wilson, C.J., Stephenson, M., Puckett, H.M., Fairey, R., and Oakden, J. 1998a.

Sediment Quality and Biological Effects in San Francisco Bay. pp. 118 + Appendices A-E.

Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, M. Stephenson, M. Puckett, R. Fairey, R. Smith, K. Taberski. 1998b. Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 133 + Appendices A-D.

Long, E.R. and Markel. 1992. An Evaluation of the Extent and Magnitude of Biological Effects Associated with Chemical Contaminants in San Francisco Bay, California. NOAA Technical Memorandum NOS ORCA 64. National Oceanic and Atmospheric Administration.

MEC Analytical Systems Inc. 1996. Sampling and Analysis of Sediment at Islais Creek, San Francisco, CA. Report prepared for the City and County of San Francisco, Department of Public Works, Water Quality Planning.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 1996. Fact Sheet. Prepared by staff of the California Regional Water Quality Control Board, San Francisco Bay Region for Amendment of Waste Discharge Requirements for Order No. 94-149 for City and County of San Francisco, Southeast Water Pollution Control Plant.

SFBRWQCB. Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments. May 1998.

S.R. Hansen & Assoc. 1996. Development and Application of Estuarine Sediment Toxicity Identification Evaluations. Prepared for San Jose State Foundation. pp. 79 + Appendices A&B.

Future Needs

This document is primarily oriented to the cleanup of specific sites that have contaminated sediments. However, the goals of the Bay Protection and Toxic Cleanup Program are not only to clean up toxic hot spots but also to prevent them from occurring. U.S. EPA and the State Board are strongly encouraging the development of watershed management plans to protect watersheds. However, to develop watershed management plans there must be watershed monitoring and assessment in order to identify and prioritize current or potential problems. Watershed monitoring is also important for the calculation of Total Maximum Daily Loads (TMDLs) and the development of implementation plans, which are required when water bodies are listed as impaired under section 303(d) of the Clean Water Act. Currently, approximately 500 water bodies in the state are 303(d) listed yet the resources needed to calculate TMDLs and develop meaningful implementation plans are almost totally lacking.

Stormwater runoff is currently the major source of mass loading of contaminants that accumulate in the food chain and pesticides that cause acute toxicity to aquatic organisms. In the past several years, the RMP and the Bay Area Stormwater Management Agencies Association (BASMAA) have been conducting some monitoring of runoff from urban creeks. Through this monitoring Coyote Creek has been identified as a source of PCBs and chlorinated pesticides to the estuary. In other urban creeks, high levels of toxicity have been identified during runoff events. Toxicity Identification Evaluations (TIEs) have shown that in most of the samples tested toxicity was due to the pesticides diazinon and/or chlorpyrifos. A recent RMP workgroup on PCBs that is using a model to conduct a preliminary calculation of loadings has determined that there are probably significant ongoing sources of PCBs to the estuary. Identification of the sources and an evaluation of the loadings of these contaminants are necessary to develop TMDLs and implementation plans, as well as watershed management plans to protect the beneficial uses of the estuary. Remediation might take the form of cleanup, the implementation of best management practices or pollution prevention. Yet, to solve watershed problems and plan for their prevention, a solid program of watershed monitoring and assessment is needed. At this time, the funding for the monitoring and assessment of watersheds is extremely inadequate and needs to be substantially increased if TMDLs and watershed management plans are to be meaningful.

Sites of Concern

There are additional sites of concern in the San Francisco Bay Region that don't technically qualify as candidate toxic hot spots under the definition used in this program. Most of these sites are military bases slated for closure or redevelopment properties. Many of these sites are undergoing large scale investigations, including environmental risk assessments. Lauritzen Canal, which was previously listed as a potential toxic hot spot in 1993, went through a $2 million investigation under CERCLA and was cleaned up by the summer of 1997.

At military bases sediment pollution is evaluated in the larger context of determining the risk to human and ecological receptors. Ecological risk assessments are generally rigorous and are required under CERCLA, the primary regulatory authority driving environmental investigations at military bases. Jurisdictions other than the Regional Board, including the U.S. EPA, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the Ca. Department of Fish and Game and the Ca. Department of Toxic Substances Control also participate in designing and determining the scope of the characterization. Although efforts were made at these sites to follow methods and protocols being used by the BPTCP, and in the beginning of the program were visited by the BPTCP, the study designs and the scale of the investigations were distinctly different.

Some military facilities were identified for investigation due to suspected use or disposal practices, or elevated levels of contaminants identified upland. Therefore, full characterization of these sites was conducted. Study designs at these sites were driven by various programmatic requirements. Characterization included defining the nature and extent of chemical contaminants, conducting synoptic toxicity tests and determining the risk to vertebrate species in proximity to the sites by conducting ecological risk assessments. The fact that samples were taken at deeper depths toxicity tests were not recurrent and benthic community analyses were not conducted made data collected at these sites difficult to compare to BPTCP criteria. In addition, the limited number of surficial sediment samples that the BPTCP took at these sites exhibited no toxicity and relatively low levels of chemicals of concern. Subsequent studies at some military bases have identified toxicity in areas not sampled by the BPTCP and elevated levels of chemical contaminants at deeper depths that may potentially be a risk to human and/or environmental health. However, since the cost of investigating one of these sites dwarfed the entire BPTCP budget, the BPTCP decided to concentrate on sites that were not already undergoing extensive investigations.

Limited funding and the desire to avoid regulatory overlap at sites already in the process of remedial investigations focused the BPTCP on performing sediment screening at 127 locations in the Bay. For the aquatic life definition, candidate toxic hot spots are those with recurrent toxicity and associated high chemistry. To be a "high priority" site they must have another biological measurement such as impacted benthic communities, high bioaccumulation or TIEs that associate the contaminants at the site with toxicity. For the human health definition, "high priority" candidate toxic hot spots are sites which have a human health advisory on consuming aquatic non-migratory species and which have high levels of the chemicals of concern established in the advisory. High priority sites will be required to conduct a site investigation, develop a feasibility study and remediate, as appropriate. Environmental risk assessments may also be conducted.

Several of the sites that were sampled by the BPTCP contained high levels of compounds, such as PAHs, that are known to cause chronic effects but do not cause acute effects, unless at very high concentrations, in the toxicity tests being used for screening. These sites should be resampled in the future when tests are developed that are more sensitive to the chronic effects of these compounds. These sites are also listed in the following table.

Sites of Concern (These sites do not qualify as Candidate Toxic Hot Spots)

Water body Name	Segment Name	Site Identification	Pollutants Present	Status/Comments	Report reference
San Francisco Bay	South Bay	Hunters Point Shipyard /Yosemite Creek & South Basin	PCBs, PAHs, DDT, chlordane, dieldrin, endrin, TBT, metals	Offshore Feasibility Study submitted in April 1998; studies in Yosemite Creek ongoing	6, 8, 15, 16, 23, 28, 30
San Francisco Bay	South Bay	Alameda Naval Air Station	Cr, Hg, PAHs, DDT, PCBs, TBT	Field work and analysis ongoing	11, 16, 19, 22, 35
San Francisco Bay	Central Bay	Treasure Island Naval Station	fuels, Ag, As, Cu, Hg, Pb, Zn	Offshore Remedial Investigation report submitted in June 1998	1, 3, 10, 16, 17, 18, 30, 36
Napa River	Mare Island Straits	Mare Island Naval Shipyard	As, Ag, Cr, Cu, Hg, Zn, TBT, PAHs, PCBs, dieldrin, endrin toxaphene	Risk characterization in progress	12, 16, 30, 37
Suisun Bay	Suisun Bay	Concord Naval Weapons Station	As, Cd, Cu, Pb, Zn	Most contaminated area cleaned up, rest undergoing investigation	14, 16, 21, 24, 25, 38, 39, 40
San Francisco Bay	South Bay	Moffett Naval Air Station	Hg, Pb, Zn, PCBs, DDT, chlordane, PAHs	Finalizing Feasibility Study for cleanup at Eastern Diked Marsh and channels. Developing ecological monitoring program.	9, 13, 16, 20, 26, 27

Sites of Concern (These sites do not qualify as Candidate Toxic Hot Spots)

Water body Name	Segment Name	Site Identification	Pollutants present	Status/Comments	Report reference
San Francisco Bay	San Pablo Bay	Hamilton Army Airfield	Cr, Hg, Pb, PAHs, PCBs, DDT, petroleum	Currently validating ecological risk assessment	7, 16, 33, 34, 41
San Francisco Bay	South Bay	Shearwater/ U.S. Steel	Pb, PCBs	Regional Board approved remediation plan , Bay Area Conservation and Development Commission (BCDC) denied approval	16, 29, 30, 31, 32
San Francisco Bay	South Bay	Warmwater Cove	PAHs	No toxicity in screening despite high levels of PAHs	4, 16, 30
San Francisco Bay	Central Bay	Gashouse Cove	PAHs	Finished report on study to characterize aerial extent of contamination	2, 16, 30
San Francisco Bay	Richardson Bay	Waldo Point	PCBs, PAHs	EIR released	5, 16, 30

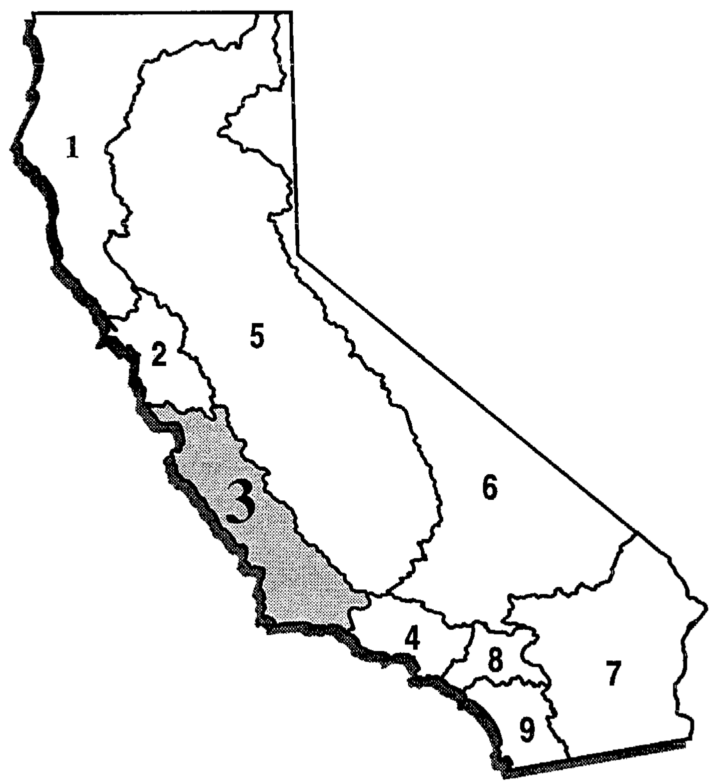
Reference list

1. Anderson, S. L., J. P. Knezovich, J. Jelinski, and D. J. Steichen. 1995. The Utility of Using Pore-Water Toxicity Testing to develop Site-Specific Marine Sediment Quality Objectives for Metals. Report LBL-37615 UC-000, Lawrence Berkeley National Laboratory, University of California, Berkeley, CA.
2. Advanced Biological Testing (ABT). 1997. Results of Investigation of Sediments from Gashouse Cove in San Francisco Marina, San Francisco, CA.
3. Aqua Terra Technologies (ATT). 1991. Environmental Sampling and Analysis Plan for Naval Station, Treasure Island, Hunters Point, San Francisco, CA.
4. Dames & Moore. 1992. Data Report, Offshore Sediment Sampling, Army Street Site, San Francisco, California for Union Pacific Realty Co., Job No. 16515-015-043 GN-O-111.006 , Project #96231.
5. EDAW. 1997. Draft Environmental Impact Report for Waldo Point Harbor, Marin County.
6. EMCON Associates. 1987. Confirmation Study Verification Step, Hunters Point Naval Shipyard. Volumes 1-IV. San Francisco, CA.
7. Engineering-Science, Inc. (ESI). 1993. Final Environmental Investigation Report, Hamilton Army Airfield, California. Prepared for the U.S. Army.
8. Environmental Science Associates (ESA). 1987. Final Environmental Impact Statement: Homeporting Battleship Battle Group/Cruiser Destroyer Group, Volumes 1,2 and 3. San Francisco, CA.
9. ESA. 1988. Dredge Sediment Evaluation, Naval Air Station, Moffett Field, Sunnyvale, CA.
10. Hunt, J.W., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, M. Stephenson, M, Puckett, R. Fairey, R. Smith, K. Taberski. 1998. Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 132. Appendix A-D.
11. Harding Lawson Associates (HLA). 1988. Sediment Evaluation Alameda Naval Air Station, Piers 2 and 3, Alameda, CA. Concord, CA. Santina and Thompson, Inc.
12. IT Corp. 1992. Distribution and Environmental Fate of Metals and Organotin in Mare Island Strait near Building 900. Prepared for the Department of the Navy, San Bruno, CA.
13. Larry Walker and Associates & Kinnetic Laboratories. 1991. Summary Data Report: Toxicity Testing of Sediment Collected in the Vicinity of the Sunnyvale Water Pollution Control Plant (1989-1990). Prepared for the City of Sunnyvale.

14. Lee, C.R., L.J. O'Neil, D.L. Brandon, R.G. Rhett, J.G. Skogerboe, A.S. Portzer, and R.A. Price. 1988. Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord, California. Subtitle Appendix 2.5 - 1986/87 Data, Miscellaneous Paper EL-86-3 (Draft Final Report), US Army Engineer Waterways Experiment Station, Vicksburg, MS.
15. O'Connor T. P. and B. Beliaeff. 1994. Recent Trends in Coastal Environmental Quality: Results from the Mussel Watch Project. National Status and Trends Program. Marine Environmental Quality. NOAA, NOS, ORCA, Coastal Monitoring and Bioeffects Division, Silver Spring, MD.
16. Office of Environmental Health Hazard Assessment (OEHHA). 1994. Health Advisory on Catching and Eating Fish-Interim Sport Fish Advisory for San Francisco Bay. Sacramento, CA.
17. PRC EMI Inc. 1993. Draft Phase I Remedial Investigation Report for Naval Station Treasure Island, California. Prepared for the Department of the Navy, San Bruno, CA.
18. PRC EMI Inc. 1993. Naval Station Treasure Island, California, Draft Ecological Risk Assessment Report. Prepared for the Department of the Navy, San Bruno, CA.
19. PRC EMI Inc. 1994. Draft Naval Air Station Alameda Draft Ecological Assessment. Prepared for the Department of the Navy, San Bruno, CA.
20. PRC EMI Inc. 1996. Final Station-Wide Remedial Investigation Report, Moffett Federal Airfield, California. Prepared for the Department of the Navy, San Bruno, CA.
21. PRC EMI Inc. 1996. After Remediation (Year 1) Monitoring Remedial Action Report, Litigation Area, Naval Weapons Station Concord, California. Prepared for the Department of the Navy, San Bruno, CA.
22. PRC EMI, Inc. 1996. Naval Air Station Alameda, California. Operable Unit 4 Ecological Risk Assessment Revision 2 Draft. Prepared for the Department of the Navy, San Bruno, CA.
23. PRC EMI, Inc. 1996. Phase 1B Ecological Risk Assessment Draft Report Hunters Point Shipyard, San Francisco, CA.
24. PRC EMI Inc. 1997a. After Remediation (Year 2) Monitoring Remedial Action Report, Litigation Area, Naval Weapons Station Concord, California. Prepared for the Department of the Navy, San Bruno, CA.
25. PRC EMI Inc. 1997b. Qualitative Ecological Assessment Report, Litigation Area, Naval Weapons Station Concord, California. Prepared for the Department of the Navy, San Bruno, CA.
26. PRC EMI Inc. and Montgomery Watson. 1995. Final Phase I Site-Wide Ecological Assessment Report, Moffett Federal Airfield, California. Prepared for the Department of the Navy, San Bruno, CA.
27. PRC EMI Inc. and Montgomery Watson. 1997. Final Phase II Site-Wide Ecological Assessment Report, Moffett Federal Airfield, California. Prepared for the Department of the Navy, San Bruno, CA.

28. Parcel F Feasibility Study Draft Report, Hunters Point Shipyard, San Francisco, CA. 1998. Prepared by Tetra Tech EM Inc., and Levine-Fricke-Recon Inc.
29. San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 1996. Order No. 96-102. Adoption of Site Cleanup Requirements for USX Corporation and Bay West Cove LLC for the Property :Located at Shearwater Site, Oyster Point Blvd., South San Francisco, CA.
30. Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, K. Taberski, C. Wilson, M. Stephenson, H. Puckett, R. Fairey, J. Oakden. 1998. Sediment quality and biological effects in San Francisco Bay. For Ca. State Water Resources Control Board. pp. 188 + appendices A-E.
31. Treadwell and Rollo. 1995. Draft Workplan for Onshore Investigative, Bay West Cove, South San Francisco, California. Prepared for Bay West Cove LLC, San Francisco, CA.
32. Treadwell and Rollo. 1997. Workplan for Offshore Remediation and Wetland Mitigation, Bay West Cove, South San Francisco, California. Prepared for Bay West Cove LLC, San Francisco, CA.
33. United States Army Corps of Engineers (USACE). Supplement to the Final Environmental Investigation Report, Hamilton Army Airfield, California. Prepared for the U.S. Army.
34. Woodward-Clyde, Inc. 1996. Draft Additional Environmental Investigation Report, BRAC Property, Hamilton Army Airfield, California.
35. Chemical Data Summary Report for Offshore Sediment and Wetland Areas at Alameda Point, Alameda, CA. 1998. Prepared by Tetra Tech Em Inc. for EFA West, San Bruno, CA.
36. Remedial Investigation, Offshore Sediments Operable Unit, Naval Station Treasure Island, San Francisco, CA. 1998. Prepared by Tetra Tech EM Inc.
37. Draft Offshore Areas Ecological Risk Assessment, Mare Island, Vallejo, CA. 1998. Prepared by Tetra Tech EM Inc.
38. After Remediation (Year 1) Monitoring Report, Litigation Area Sites, Concord Naval Weapons Station. 1996. Prepared by Tetra Tech EM Inc.
39. After Remediation (Year 2) Monitoring Report, Litigation Area Sites, Concord Naval Weapons Station. 1997. Prepared by Tetra Tech EM Inc.
40. After Remediation (Year 3) Monitoring Report, Litigation Area Sites, Concord Naval Weapons Station. 1998. Prepared by Tetra Tech EM Inc.
41. Draft Comprehensive Remedial Investigation Report, BRAC property, Hamilton Army Airfield, Novato, CA. 1998. Prepared by IT Corporation for the Department of the Army, United States Army Corps of Engineers.

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION



REGIONAL TOXIC HOT SPOT CLEANUP PLAN

Region Description

The Central Coast Regional Board has jurisdiction over a 300-mile long by 40-mile wide section of the State's central coast. Its geographic area encompasses all of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties as well as the southern one-third of Santa Clara County, and small portions of San Mateo, Kern, and Ventura Counties. Included in the region are urban areas such as the Monterey Peninsula and the Santa Barbara coastal plain; prime agricultural lands as the Salinas, Santa Maria, and Lompoc Valleys; National Forest lands, extremely wet areas like the Santa Cruz mountains; and arid areas like the Carrizo Plain.

Historically, the economic and cultural activities in the basin have been agrarian. Livestock grazing persists, but it has been combined with hay cultivation in the valleys. Irrigation, with pumped local ground water, is very significant in intermountain valleys throughout the basin. Mild winters result in long growing seasons and continuous cultivation of many vegetable crops in parts of the basin.

Candidate Toxic Hot Spot List

These waterbodies warrant consideration as Toxic Hot Spots because they meet criteria for Candidate status described earlier in this report. Specific site information provides supporting documentation for the designation of the water body. "Pollutants present at each site" includes information from the Bay Protection and Toxic Cleanup Program, State Mussel Watch Program, Toxic Substances Monitoring Program, RWQCB sampling activities, and others. Chemicals which exceeded ERMs or PEL for sediment; EPA Screening Levels, NAS or FDA Action levels for tissue; or Basin Plan or Ocean Plan water quality violations are indicated in bold print.

Water body name	Segment Name		Reason for Listing	Pollutants present at the site	Report reference
Moss Landing Harbor & Tributaries	Moss Landing Harbor	Sandholdt Bridge - Station #30007.0	Aquatic Life Concerns - Sediment Chemistry, Sediment Toxicity (multiple visits), bioaccumulation	**Dieldrin, Chlordane, Total DDT, Toxaphene, PCBs,** Endosulfan, Chlorpyrifos, Dacthal, Aldrin, HCH, Nonachlor, Diazinon, Endosulfan, Endrin, Ethion, Ethylparathion, gamma-chlordene, heptachlor epoxide, hexachlorobenzene, methoxychlor, chlorbenside	1, 3, 5, 6
	Moss Landing Harbor	Moss Landing Yacht Harbor - Station #30004.0, Moss Landing South Harbor - Station #30005.0	Aquatic Life Concerns - Sediment Toxicity (single visit), Sediment Chemistry, bioaccumulation	**Tributyltin, Dieldrin, PCBs, Total DDT, Toxaphene, Nickel,** Dacthal, Endosulfan, Endrin, Heptachlor epoxide	1, 3, 5

Water body name	Segment Name		Reason for Listing	Pollutants present at the site	Report reference
Moss Landing Harbor & Tributaries Moss Landing Harbor & Tributaries	Elkhorn Slough	Andrews Pond - Station #31003.0, Egret's Landing - Station # 31001.0, Potrero Rd - Station #30028.0	Aquatic Life Concerns - Sediment Toxicity (multiple visits except Potrero Rd.), Sediment Chemistry, bioaccumulation (multiple exceedances of NAS and/or FDA guidelines)	**Dieldrin, Nickel, Endosulfan, Endosulfan sulfate, Chemical Group A,** Chromium, Dacthal, Heptachlor epoxide, PCBs, Toxaphene, Endrin, Hexachlorocyclohexane (HCH)	1, 2, 5, 6
	Bennett Slough	Bennett Slough - Station #30023.0	Aquatic Life Concerns - Sediment Toxicity (multiple visits), Sediment Chemistry	**Dieldrin, Nickel, Chromium**	1
	Tembladero Slough	Upper Tembladero (Alisal) – downstream of Salinas City - Station #36004.0, Tembladero - Station #36002.0	Aquatic Life Concerns, Human Health Concerns - Sediment Toxicity associated with Sediment Chemistry (single visit), bioaccumulation (multiple exceedances of NAS and/or FDA guidelines)	**Chlordane, Dieldrin, Total DDT, Toxaphene, PCBs, Lindane, PAH, Endosulfan, Endosulfan sulfate, Chemical Group A,** Aldrin, Chlorpyrifos, Dacthal, Endrin, Heptachlor epoxide, Hexachlorobenzene, Oxadiazon	1, 2, 6
	Old Salinas River	Old Salinas River Channel - Station #36007.0	Aquatic Life Concerns - Sediment Toxicity associated with Sediment Chemistry (single visit), bioaccumulation	**Dieldrin, Total DDT, Toxaphene, PCBs,** gamma HCH, Aldrin, Chlorpyrifos, Dacthal, Endrin, Heptachlor epoxide, Hexachlorobenzene, Methoxychlor, oxydiazinon, Endosulfan	1, 5, 6

Water body name	Segment Name		Reason for Listing	Pollutants present at the site	Report reference
	Espinosa Slough	Espinosa Slough - Station #36005.0	Aquatic Life Concerns, Human Health Concerns - Sediment Toxicity associated with Sediment Chemistry (single visit), bioaccumulation (multiple exceedances of NAS and/or FDA guidelines)	**Dieldrin, DDT, Toxaphene, PCBs, Chlordane, Endosulfan, Endosulfan sulfate, Endrin, Heptachlor Epoxide, Chemical Group A**	1, 2
	Moro Cojo Slough	Moro Coho Slough - Station #30019.0	Aquatic Life Concerns - Sediment Toxicity associated with Sediment Chemistry (single visit), bioaccumulation	**Nickel, Dieldrin, Total DDT, Toxaphene, PCBs,** Dacthal, Endosulfan, Heptachlor epoxide	1, 5
	Salinas Reclamation Canal	Salinas Reclamation Canal – State Mussel Watch Sites #408.8, 408.9, 409.0	Human Health and Aquatic Life Concerns - bioaccumulation (multiple exceedances of NAS and/or FDA guidelines)	**Chlordane, Total DDT, PCBs, Dieldrin, Chemical Group A, Endrin, Toxaphene, Endosulfan, Endosulfan sulfate, Heptachlor Epoxide,** Diazinon, Aldrin, Dacthal, Hexachlorobenzene, Methoxychlor, Chlorpyrifos, alpha-Chlordene, gamma HCH, gamma-Chlordene, nonachlor	2, 5, 6

Water body name	Segment Name		Reason for Listing	Pollutants present at the site	Report reference
	Blanco Drain	State Mussel Watch Sites #407.4, 407.5, 407.8	Human Health and Aquatic Life Concerns - Bioaccumulation (multiple exceedances of NAS and FDA guidelines)	**Chlordane, Total DDT, Dieldrin, PCBs, Toxaphene, Chemical Group A, Endrin**, nonachlor, Aldrin, Hexachlorobenzene, Chlorpyrifos, Dacthal, Alpha-chlordene, gamma-chlordene	3, 4, 5, 6
Moss Landing Harbor & Tributaries	Salinas River Lagoon	State Mussel Watch Sites #405.6, 405.7, 405.8	Human Health and Aquatic Life Concerns - Bioaccumulation (multiple exceedances of NAS and FDA guidelines)	**Total DDT, Dieldrin, PCBs, Toxaphene**, Chlorpyrifos, Hexachlorobenzene, Aldrin, Dacthal, methoxychlor, Endrin, Endosulfan sulfate, Alpha-chlordene, Chlorbenzide, gamma HCH, Heptachlor epoxide	1, 5
Canada de la Huerta	Shell Hercules Gas Plant, Santa Barbara County	Multiple Sites	Aquatic Life Concerns - Sediment and water toxicity, sediment chemistry, bioaccumulation Water Quality Concerns – violation of Basin Plan and Ocean Plan standards	**PCBs**	8, 9, 10, 11, 12

References

1. State Water Resources Control Board, Central Coast Regional Water Quality Control Board California Department of Fish and Game, Moss Landing Marine Laboratories, University of California Santa Cruz. 1998. Chemical and Biological Measures of Sediment Quality in the Central Coast Region.

2. Rasmussen, D. and H. Blethrow. 1991. Toxic Substances Monitoring Program 1988-89 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 91-1WQ

3. Rasmussen, D. 1992. Toxic Substances Monitoring Program 1990 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 92-1WQ.

4. Rasmussen, D. 1993. Toxic Substances Monitoring Program 1991 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 93-1WQ.

5. Rasmussen, D. 1995a. State Mussel Watch Program 1987-1993 Data Report (94-1WQ). State Water Resources Control Board, California Environmental Protection Agency.

6. Rasmussen, D. 1996. State Mussel Watch Program 1993-1995 Data Report (96-2WQ). November. State Water Resources Control Board, California Environmental Protection Agency.

7. Hunt, J. W., B.A. Anderson, B. M. Phillips, R.S. Tjeerdema, H. M. Puckett, and V. deVlaming. In press. Patterns of aquatic toxicity in an agriculturally dominated coastal watershed in California. Agriculture, Ecosystems and Environment.

8. Regional Water Quality Control Board Central Coast Region. October 1997. Post-Remediation Monitoring

Report, Canada de la Huerta, Gaviota, Santa Barbara County.

9. Dames & Moore Consultants. January 15, 1998 "September 1997 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

10. Dames & Moore Consultants. March 12, 1998. December 1997 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

11. Dames & Moore Consultants. July 1, 1998. March 1998 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

12. Dames & Moore Consultants. October 5, 1998. June 1998 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

Ranking Matrix

A water body was ranked as a high priority candidate toxic hot spot if data collected to evaluate any of the first three categories (Human Health Impacts, Aquatic Life Impacts, or Water Quality Objectives) suggested that a "high" was merited. Information on aerial extent, and natural remediation potential are also included in the ranking matrix, when available, to help describe the problem. "No Action" indicates that no data is available for consideration (see Section IV).

Water body Name	Human Health Impacts	Aquatic Life Impacts	Water Quality Objectives	Areal Extent	Remediation Potential	Overall Ranking
Moss Landing Harbor & Tributaries	Moderate	High	No Action	>10 acres	Moderate	High
Canada de la Huerta	Moderate	High	High	>10 acres	High	High

High Priority Candidate Toxic Hot Spot Characterization

Moss Landing and Tributaries

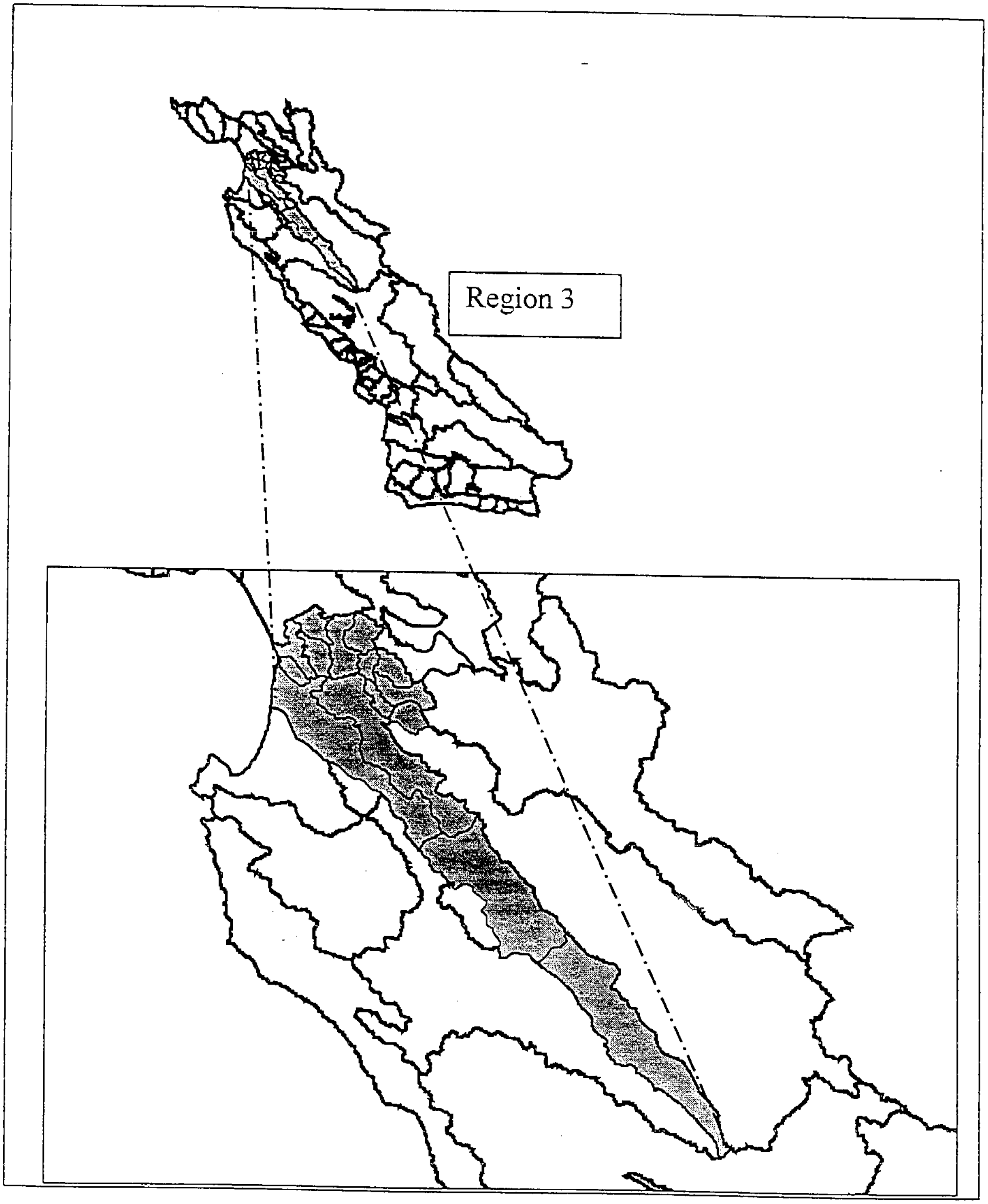
Moss Landing Harbor and associated drainages appear to meet the Bay Protection and Toxic Cleanup Program's criteria for a "high priority toxic hot spot". Moss Landing and the surrounding vicinity has special importance for both the State and Nation. Because of the unique nature of the marine environment within the area, the National Oceanographic and Atmospheric Administration (NOAA) established the Monterey Bay National Marine Sanctuary in 1992. Elkhorn Slough is a NOAA National Estuarine Research Reserve. These designations reflect the high resource values found within the area. Figure 1 shows the location of the Moss Landing area and associated subwatersheds of interest within Region 3.

Because of a "high" ranking for impacts to aquatic life due to sediment toxicity with confirming chemistry and tissue bioaccumulation, the areal extent of the problem, and the sensitive nature of the area, "high priority toxic hot spot" status is warranted for the Moss Landing area. The area was given a moderate ranking for Human Health because of pesticide levels in tissue repeatedly exceeding federal standards. It was not give a "high" ranking for Human Health because health advisories have not been issued recently.

Sediments from Moss Landing Harbor have been shown for a number of years to contain high levels of pesticides, in some cases at levels which cause concern for human and aquatic life. Concentrations of a number of pesticides in fish and shellfish tissue have exceeded National Academy of Sciences (NAS) Guidelines, USEPA Screening Values, and Food and Drug Administration (FDA) Action Levels.

In addition to pesticides, PCBs have also been identified as a concern in the Harbor and its watershed; they have been detected in shellfish tissue by the State Mussel Watch Program at elevated concentrations for many years.

Figure 1. Moss Landing Harbor and subwatershed areas of interest



High levels of tributyltin exceeding EPA Screening Values have been detected in mussel tissue at several locations in the Harbor. The Harbor's watershed supports substantial agricultural and urban activities, which are sources of pesticides and other chemicals. Several chemicals detected by the program have been banned for many years (Figure 2). Although chemical types and usages have changed, banned chemicals, particularly chlorinated hydrocarbons, are still mobilized through eroding sediments. Actions to alleviate this problem consist of proper disposal of dredged materials, source control management measures for the chemicals of concern, and management of erosion of associated sediment.

Aldrin	No longer in use
Chlordane	No longer in use
DDT (Total DDT)	No longer in use
Dieldrin	No longer in use
Endrin	No longer in use
Heptachlor	No longer in use
Toxaphene	No longer in use
PCBs	No longer in use
Tributlytin	No longer in use
Chlorpyrifos	Currently in use
Dacthal	Currently in use
Diazinon	Currently in use
Endosulfan	Restricted

Figure 2. Use Status of Some of the Chemicals Found in Moss Landing Harbor and its Watershed.

Moss Landing was given a moderate "remediation potential" ranking according to BPTCP guidelines, since improvements may or may not occur over time without intervention. Although concentrations of persistent chemicals which have been banned will eventually decrease without action in aquatic systems, the time involved in significant reductions in the Harbor would have to be measured in decades. Reducing land erosion and implementing Best Management Practices in urban, agricultural and harbor areas will remediate the problem more rapidly and provide other benefits for both the land and Harbor. Both chemical concentrations and the volumes of sediment which must be dredged from the Harbor will be reduced, improving aquatic habitat and reducing problems with dredge spoil disposal. Implementation of appropriate erosion control practices will serve to restore and protect the status of beneficial uses including navigation, aquatic life, and human health.

A. Assessment of areal extent. (Greater than 10 acres)

Moss Landing Harbor receives drainage water from Elkhorn Slough watershed, Moro Cojo Slough watershed, Tembladero Slough watershed, the Old Salinas River, and the Salinas River. Figure 3 shows the location of these water bodies. Elevated levels of chemicals were found associated with all of these water bodies.

The watershed areas include only the lower portions of the Salinas watershed. Some Salinas River water drains to the Old Salinas River and then to Moss Landing Harbor. A slide gate near the mouth of the Salinas River permits approximately 250 cubic feet per second to pass to the Old Salinas River (Gilchrist, et al., 1997). Other watercourses such as the Blanco Drain and the Salinas Reclamation Canal also drain either directly or indirectly to Moss Landing Harbor. The size of water bodies of immediate concern and their associated watershed subareas are indicated in Figure 4.

Figure 3. Location of various waterbodies of interest.

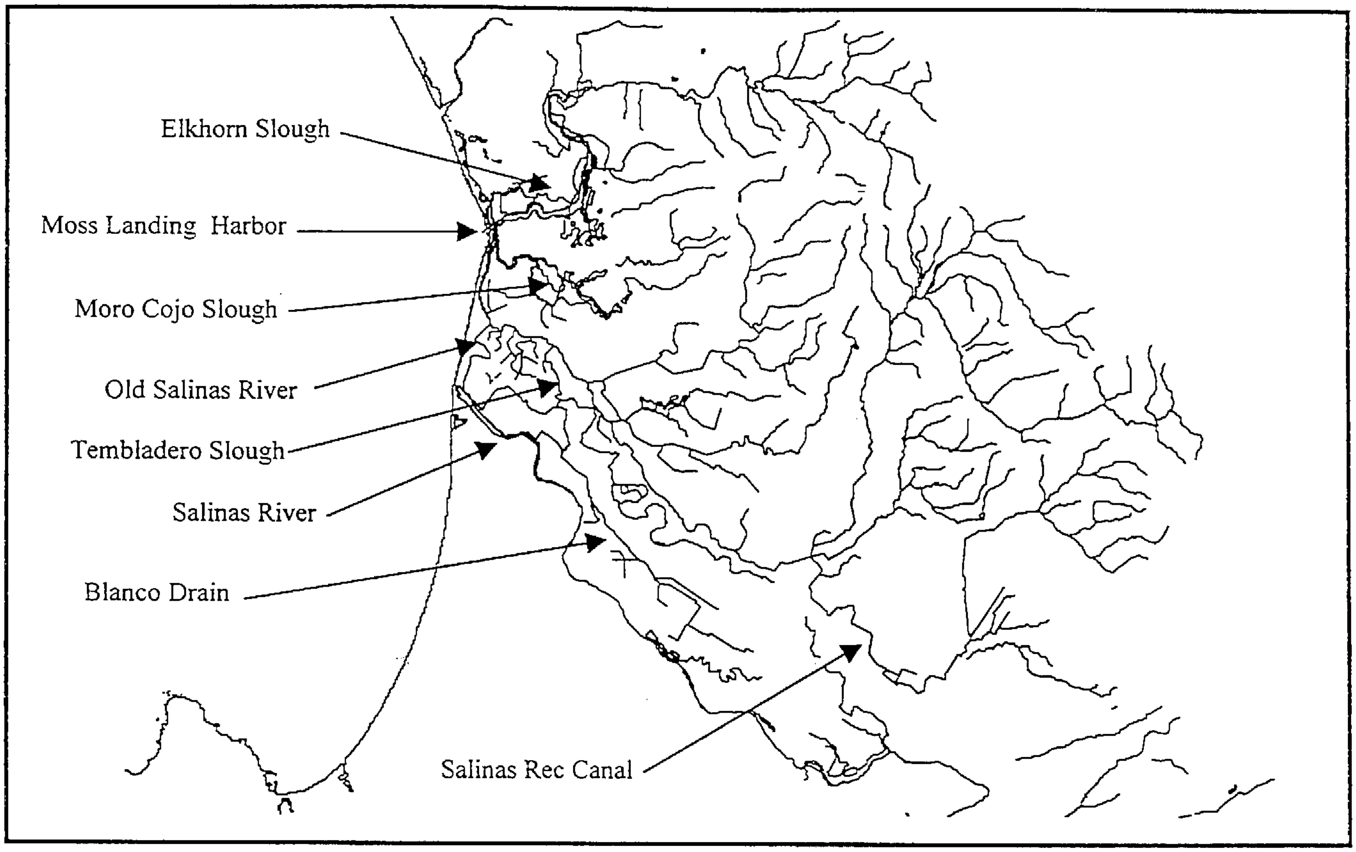


Figure 4. Size of various water bodies of concern, and acreage of associated watersheds.

Water Body		**Size**
Moss Landing Harbor		160 acres
Old Salinas River Estuary		55 acres
Moro Cojo Slough		345 acres
Elkhorn Slough		2500 acres
Tembladero Slough		150 acres
Lower Salinas River		20 miles

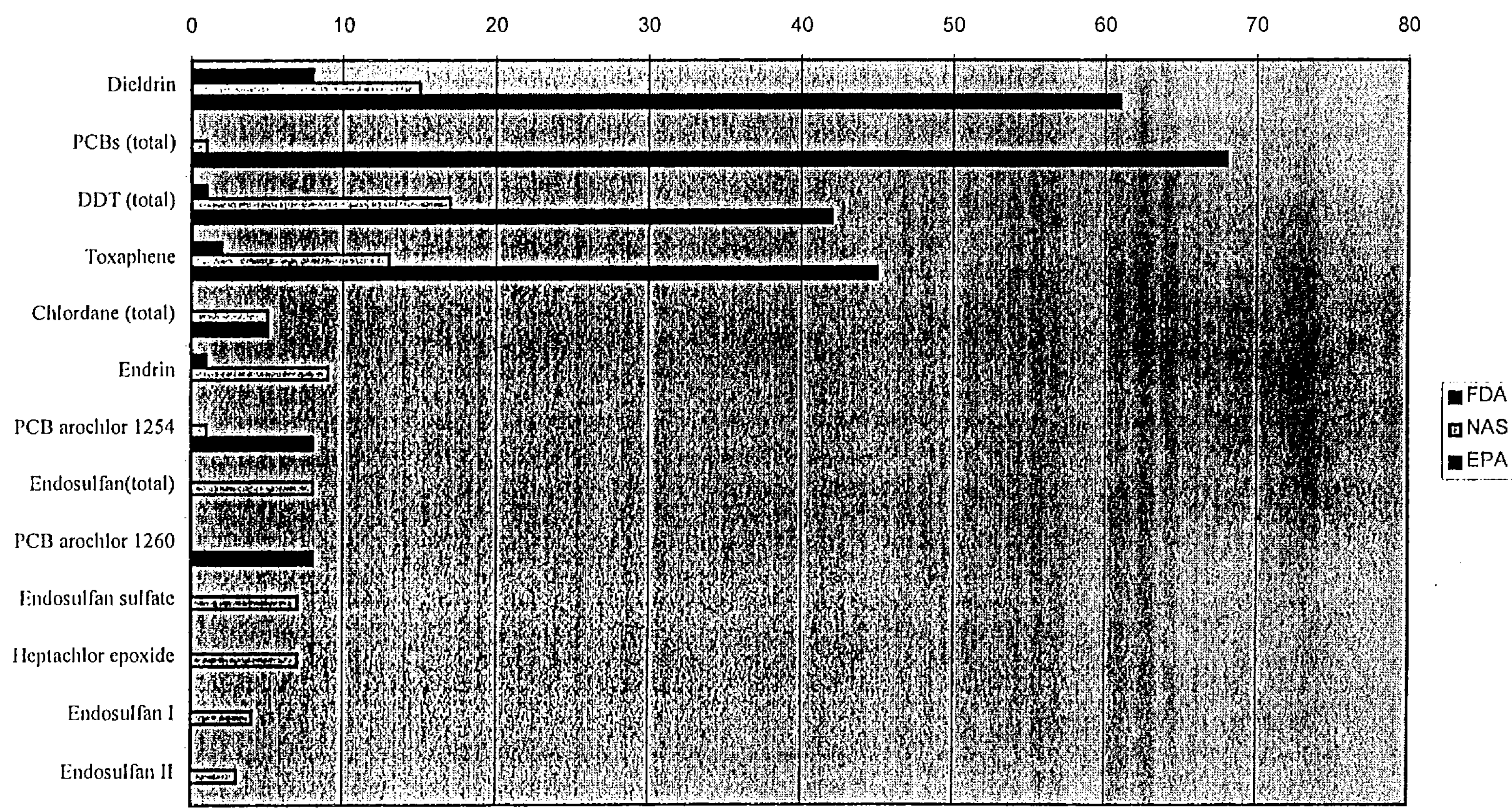
Hydrologic Subarea	**Subarea #**	**Acreage**
Bolsa Nueva	#306.00	50,339
Lower Salinas Valley	#309.10	77,204
Chualar	#309.20	60,053

B. Assessment of most likely sources of pollutants.

The majority of chemicals found at excessive concentrations in the Harbor and its tributaries are pesticides, and most have already been banned. Figure 5 shows a summary of chemical exceedances of various guideline values for State Mussel Watch and Toxic Substances Monitoring Program data collected within the Moss Landing watershed in the past ten years in fish and shellfish data (Rasmussen, 1991, 1992, 1993, 1995a, 1995b, 1995c, 1996, 1997).

Tissue data (Rasmussen, 1995, 1996, 1997) shows that total DDT values in the southern Harbor increased dramatically after the end of the drought of the mid and late 1980's. Other pesticides follow a similar trend (Figure 6). Nesting failure of the Caspian Tern (a bird species of special interest) in Elkhorn Slough in the heavy rain year of 1995 was attributed to high tissue levels of DDT resulting from storm-driven sediments (Parkin, 1998). High flow events carry large amounts of chemical-laden sediments into sensitive aquatic habitats and the Moss Landing Harbor. Soil erosion from numerous sources is a major transport mechanism for a variety of chemicals impacting the Harbor (Kleinfelder, 1993).

Figure 5. Number of exceedences of EPA Screening Levels, FDA Action Levels, and/or NAS levels for protection of Human Health and Wildlife for various chemicals in the Moss Landing Watershed (compiled from the State Mussel Watch and Toxic Substances Monitoring Program (1988 – 1996), and Bay Protection and Toxic Cleanup Program (1998).



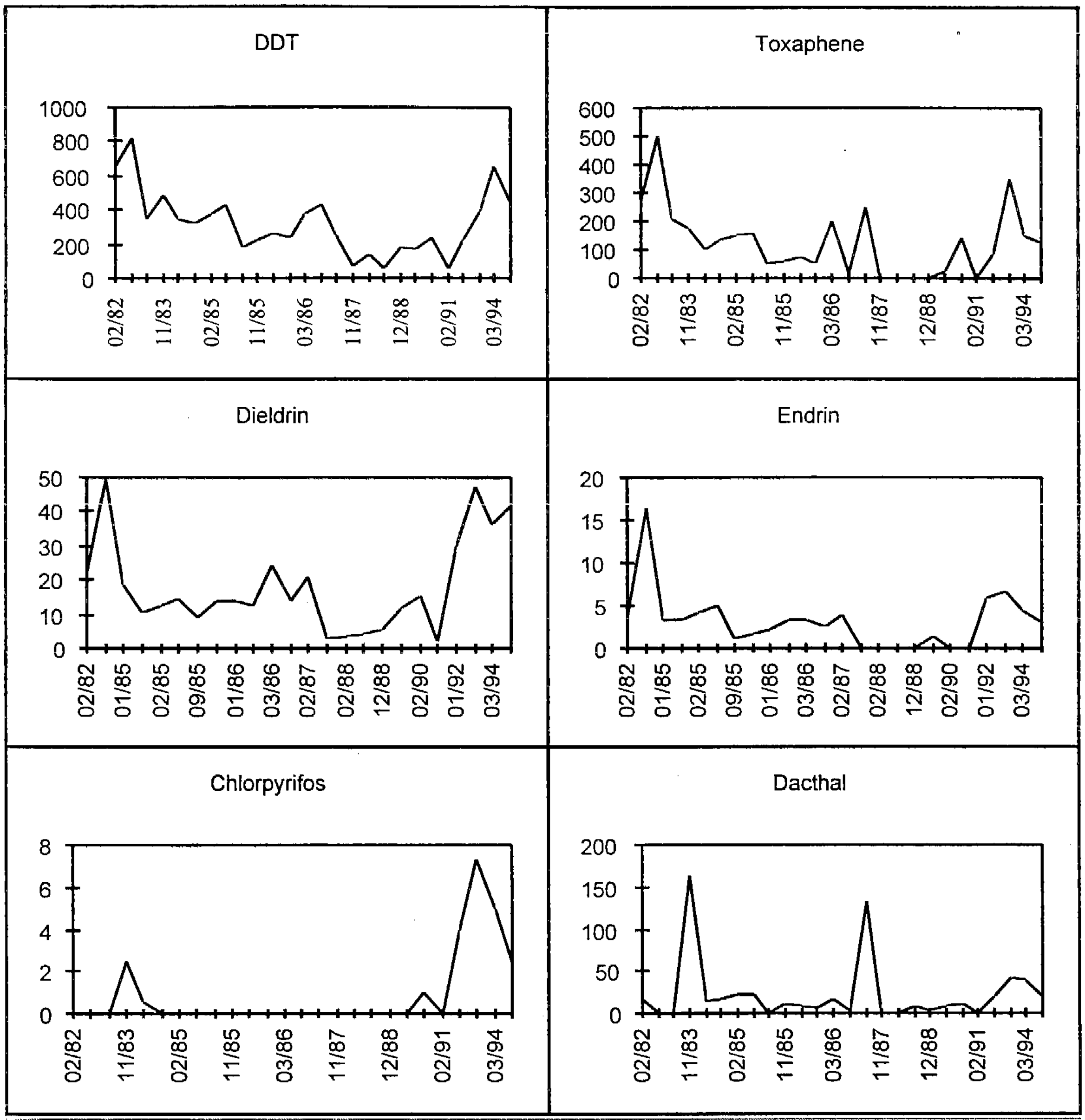


Figure 6. Tissue levels of six pesticides in mussels at Sandholdt Bridge, 1982 - 1995. Measured in parts per billion, wet weight (of these, only Chlorpyrifos and Dacthal are still in use).

Agricultural Activities - Past and present storage and use of agricultural biocides is a primary source of chemicals found in Moss Landing Harbor. Fine sediment in runoff from agricultural land is the primary transport mechanism for many chemicals (Kleinfelder, 1993; NRCS, 1994; AMBAG, 1997). Erosion from farm land is a concern for private landowners and the public alike. Though most of the chemicals of concern are no longer applied to agricultural land, they are still present in soils. Banned chemicals found in soils tested on agricultural land in the Elkhorn Slough watershed include DDT and its breakdown products, Dieldrin, Endrin, Chlordane and Heptachlor Epoxide (Kleinfelder, 1993, RWQCB, raw data 1998). Though PCBs were used extensively in industrial applications, prior to 1974 they were also components of pesticide products and may originate from agricultural as well as industrial sources (U.S. EPA Envirofacts, 1998). Several currently applied chemicals have been detected at various sites in the watershed, including Chlorpyrifos, Diazinon, Dimethoate and Endosulfan (Ganapathy, et al., draft). Amounts of a few of the pesticides applied during 1994-95 in the Salinas watershed are shown in Figure 7.

Methomyl	63,149 lbs.	(Aug 94-July 95)
Diazinon	62,000 lbs.	(Aug 94–July 95)
Chlorpyrifos	52,095 lbs.	(Aug 94-July 95)
Malathion	42,519 lbs.	(Aug 94-July 95)
Dimethoate	33,024 lbs.	(Aug 94–July 95)
Carbofuran	19,982 lbs.	(Aug 94-July 95)
Endosulfan	2,953 lbs.	(Aug 94-July 95)

Figure 7. Examples of annual application rates of some pesticides in the Salinas Watershed (from Ganapathy, et al., draft).

River and Stream Maintenance Activities

Local agency personnel indicate DDT was used for mosquito control in the sloughs draining to Moss Landing in past years (Stillwell, pers. comm., 1997). This must have introduced large amounts of DDT and its breakdown products directly into the river and estuarine systems.

River systems in the area have been treated for riparian plant control for a number of years in order to increase water supply and channel capacity (Anderson-Nichols & Co., 1985). Vegetation removal, which increases flow velocities and consequent sediment transport, may exacerbate erosion and transport of chemicals of concern.

Urban Activities

Large amounts of certain pesticides are used in the urban environment. These have included chlordane and dieldrin for treatment of termites and other wood boring insects, and diazinon and other chemicals for household and garden use.

PCBs were widely used in industrial applications prior to 1974, when their use was confined to transformers and capacitors. They have not been used in any application since 1979. Because of their diverse past use and extreme persistence, they are still present at many sites throughout the watershed.

Polyaromatic Hydrocarbons (PAHs) are petroleum related chemicals. These are common pollutants in urban runoff, from improperly handled waste oil, street and parking lot runoff, and other sources.

Sampling conducted in Tembladero Slough for BPTCP found highest levels of dieldrin below the City of Salinas, exceeding Effects Range Median (ERM) values by six-fold. Concentrations of this chemical generally decreased with distance below the City. Other concentrations for nearly all measured pesticides and PAHs were higher here than anywhere else measured in the drainage. Both sediment and water toxicity were found at this site. (SWRCB et al., 1998). Because agricultural activity occurs above the City of Salinas and no sampling site was placed upstream of the City, it is not possible to discriminate between agricultural and urban sources at this time. However, the decrease in concentrations in downstream agricultural areas indicate that urban sources may be significant contributors and should be the subject of further study.

Harbor Activities

Tributyltin has been documented over the years at several sites in Moss Landing Harbor. This chemical was the active ingredient in antifouling paint for boat bottoms. Its use has been banned for many years, but it is persistent in the environment. Other chemicals associated with Harbor activities include PAHs, copper, zinc, and other metals.

C. A summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at Moss Landing Harbor and to prevent the creation of new THSs.

The Regional Board has long been involved in activities to address water quality issues in the Moss Landing area. The following are some of the Regional Board activities which either directly or indirectly address pollution at Moss Landing Harbor and its tributaries:

Issuance and enforcement of Discharge Permits and CWA 401 Certifications 303(d) listings of water quality limited water bodies Watershed Management Initiative activities

Issuance of Discharge Permits and CWA 401 Certifications

Existing RWQCB Waste Discharge Requirements for the Moss Landing Harbor District, U.S. Army of Corps of Engineers, National Refractories, and Pacific Gas and Electric Co. (now Duke Energy), contain prohibitions and limitations on the quality of effluent discharges to the ocean. These limitations are for the protection of beneficial uses. RWQCB staff also review Army Corps permitted activity, pursuant to the Clean Water Act Section 401 Water Quality Certification Program.

Harbor Dredging Activities

The Moss Landing Harbor has suffered from severe sedimentation for a number of years; this has been exacerbated by high flows during the winter of 1997/98 which have made the Harbor nearly unusable for many vessels and landlocked some at their moorings. The Harbor District requested an increase of up to 150,000 cubic yards for 1998 and 1999 to address the current sedimentation problems.

Recent results of sediment sampling and analysis (Harding, Lawson, & Assoc., July 7, 1998 Draft) indicate that sediment quality in Moss Landing Harbor varies with depth and location, with some sediments showing significant toxicity and high chemical concentrations, and others suitable for unconfined aquatic disposal.

Suitable dredge material has been used for beach replenishment, or is disposed offshore at one of two areas. The disposal areas are located within the Monterey Bay National Marine Sanctuary and authorization to dispose of material at these sites is allowed under a grandfather clause. Dredging activities have occurred since the early 1950's, but there have been no focused studies of unconfined aquatic disposal of inner harbor material, and ultimate impacts are unknown.

Because of the long history of monitoring data indicating elevated levels of pesticides in inner harbor sediments, several regulatory agencies, including the U.S. Environmental Protection Agency and the Monterey Bay National Marine Sanctuary, expressed concerns in recent years regarding the suitability of the material for unconfined aquatic disposal. Dredging of inner harbor fine grain sediments has been limited during the past five years as a result of these concerns. Dredged materials which do not meet certain quality standards must be disposed of using sites located on land. The cost of upland disposal is considerably more expensive than unconfined aquatic disposal (Jim Stillwell, pers. comm., 1997).

The Regional Board has worked with other regulatory agencies in an effort to develop a sediment sampling and disposal suitability plan for the Monterey area. The basis of Board approval is a determination of beneficial use protection. The Board is currently involved in a dialog with the U.S. EPA, U.S. Army Corps of Engineers, California Dept. of Fish and Game, the California Coastal Commission, and Monterey Bay National Marine Sanctuary, regarding sampling and disposal of dredge spoils in the Moss Landing area. Moss Landing Harbor District has recently obtained several million dollars in Federal Emergency Management Act funding for dredging the Harbor, securing an upland disposal site, and possibly conducting a ecological risk assessment on contaminated sediments in the Harbor.

303(d) Listings of Water Quality Limited Water Bodies

Currently, the Regional Board has listed Moss Landing Harbor, Elkhorn Slough, Espinosa Slough, Moro Cojo Slough, Old Salinas River Estuary, Salinas River Lagoon, Salinas River Reclamation Canal, and Tembladero Slough on the 303(d) list of water quality limited water bodies. All of these water bodies are listed for pesticides and other problems. A Total Maximum Daily Load analysis for pesticides, which assesses sources and allocates loadings appropriately, must be developed for all of these waters. Once developed, management activities will be prioritized to best address various sources. The Regional Board will coordinate development of Total Maximum Daily Loads for pesticides with interested and responsible landowners, organizations and agencies. Coordination will occur through meetings, workshops, preparation and review of written documentation and implementation of existing memorandums of understanding or management agency agreements. For example, in the case of currently registered pesticides, the Regional Board will coordinate with DPR through the State Water Resources Control Board's Management Agency Agreement.

Watershed Management Initiative

In order to more effectively utilize limited resources, the Regional Board is implementing the Watershed Management Initiative (WMI), the purpose of which is to direct State and federal funds to the highest priority activities needed to protect water quality. The WMI is attempting to achieve water quality goals in all of California's watersheds by supporting development of local solutions to problems with full participation of all affected parties (this constitutes a "watershed management approach").

One objective of the Regional Board's WMI effort is to integrate and coordinate permitting, enforcement, implementation of the Coastal Zone Act Reauthorization Amendments, basin planning, monitoring and assessment, total maximum daily load (TMDL) analysis, groundwater protection and nonpoint source (NPS) pollution control activities within watersheds.

As part of the WMI effort, the Regional Board has identified several target watersheds in the region, based on severity of water quality impacts. The Salinas River Watershed is currently the Region's top priority watershed.

Salinas River Watershed Strategy

In 1996, the Central Coast Regional Board established the Salinas River Watershed Team to develop a pilot watershed management approach to address water resource issues in the Salinas River watershed. The Team has outlined a two-year Salinas River Watershed Team Strategy (1996) to develop a Watershed Management Action Plan, which is scheduled to be completed by December 1998. The Team's goal is to promote integrated/coordinated water resource protection, enhancement, and restoration in the Salinas River Watershed. The general steps to accomplish this goal include the following:

1. Implement Existing Regulatory Responsibilities within the Watershed
2. Implement Watershed Activities
3. Characterize the Watershed
4. Identify and Evaluate Water Resource Issues/Areas
5. Develop a Watershed Management Action Plan
6. Implement the Plan
7. Evaluate Progress

Staff is currently implementing watershed activities by facilitating grant funding, supporting and participating in activities of the Water Quality Protection Program of the Monterey Bay National Marine Sanctuary, coordinating with the Central Coast Regional Monitoring Program, participating and supporting education and outreach efforts, and coordinating with other agencies on permit streamlining and resource protection activities. The Regional Board has committed staff time and resources towards watershed management in the Salinas River watershed. The Regional Board has also given the Salinas River Watershed priority for receipt of grant funding under Sections 205(j) and 319(h) of the Clean Water Act.

Nonpoint Source Program

The Regional Water Quality Control Board has been implementing its nonpoint source program in the tributaries to Moss Landing for a number of years and is continuing to do so as part of its WMI effort. The Regional Board's nonpoint source program incorporates a tiered strategy for obtaining control of nonpoint source pollution. Consistent with the 1988 State Board Nonpoint Source Management Plan, Region 3 advocates three approaches for addressing nonpoint source management in the tributaries to Moss Landing Harbor (from the Central Coast Basin Plan, 1996).

1. Voluntary implementation of Best Management Practices

   Property owners or managers may volunteer to implement Best Management Practices.

2. Regulatory Encouragement of Best Management Practices

   Although the California Porter-Cologne Water Quality Control Act constrains Regional Boards from specifying the manner of compliance with water quality standards, there are two ways in which Regional Boards can use their regulatory authorities to encourage implementation of Best Management Practices.

First, the Regional Board may encourage Best Management Practices by waiving adoption of waste discharge requirements on condition that dischargers utilize Best Management Practices. Alternatively, the Regional Board may encourage the use of Best Management Practices indirectly by entering into management agreements with other agencies which have the authority to enforce the use of Best Management Practices.

3. Adoption of Effluent Limitations

The Regional Board can adopt and enforce requirements on the nature of any proposed or existing waste discharge, including discharges from nonpoint sources. Although the Regional Board is constrained from specifying the manner of compliance with waste discharge limitations, in appropriate cases, limitations may be set at a level which, in practice, requires the implementation of Best Management Practices.

In general, the Regional Board's approach to addressing sediment and its associated pollutants follows this three tiered approach. The voluntary approach is predominantly utilized, with resources committed to planning, educational outreach, technical assistance, cost-sharing and BMP implementation.

Urban Runoff Management

Regional Board has been reviewing phases of the application for an NPDES Municipal Storm Water Permit from the City of Salinas. The city of Salinas is developing and implementing management practices and will be conducting monitoring of urban discharges as part of that permit.

Regional Board staff participated in development of The Model Urban Runoff Guide with the Cities of Monterey and Santa Cruz and the Monterey Bay National Marine Sanctuary. This project was funded under a 319(h) grant.

Implementation of strategies contained in the MBNMS Action Plan for Implementing Solutions to Urban Runoff (1996) are currently in progress. Seven strategies are identified in this plan:

Public Education and Outreach
Technical Training
Regional Urban Runoff Management
Structural and Nonstructural Controls
Sedimentation and Erosion
Storm Drain Inspection
CEQA Additions

Clean Water Act Section 319(h) and 205(j) Grants

A number of projects have been undertaken in the affected area using Clean Water Act (CWA) funding, provided by the United States Environmental Protection Agency and administered by the State and Regional Boards. Some of these projects are described in more detail below.

The Elkhorn Slough Agricultural Watershed Demonstration Program was developed by the State Coastal Conservancy and the Elkhorn Slough Foundation. This project included implementation of a series of BMP's on agricultural lands in Elkhorn Slough watershed, including filter strips, sediment basins, farm road revegetation and realignment, and riparian corridor restoration. The project also included developing a characterization of agricultural activities in the watershed in cooperation with U.C. Santa Cruz, the Elkhorn Slough Foundation and the Nature Conservancy, developing a demonstration project and associated agricultural/environmental education outreach program, and coordinating with activities of various agencies.

A 205(j) grant was obtained by the Association of Monterey Bay Area Governments (AMBAG) to develop the "Northern Salinas Valley Watershed Restoration Plan". The Watershed Restoration Plan discusses pesticide pollution entering Moss Landing Harbor through its southern tributaries, including the Salinas River, Tembladero Slough, and Moro Cojo Slough, and recommends Best Management Practices to help alleviate this problem. The program emphasizes the use of "wet corridors" as a means of reducing sediment delivery to waterways. A number of Best Management Practices have been implemented associated with this plan. Several wet corridors have been installed by the Watershed Institute (California State University at Monterey Bay). Several other project sites for wet corridors have been identified in need of funding.

The Moro Cojo Slough Management and Enhancement Plan, prepared for the State Coastal Conservancy and Monterey County, was funded by a number of agencies, including the State Board. This document examines several alternative plans for management of the lower slough and recommends Best Management Practices for implementation in the entire watershed. As part of plan implementation, two hundred acres in the lower slough have recently been acquired through Coastal Conservancy funds for restoration as wetland and floodplain.

The Elkhorn Slough Uplands Water Quality Management Plan, developed for AMBAG, examined the effectiveness of Best Management Practices at reducing pesticide runoff from strawberry fields on study sites in the Elkhorn Slough watershed, and makes recommendations for Land Use Policies and implementation of Best Management Practices.

The Model Urban Runoff Program, developed under a 319(h) contract, is a pilot project by the cities of Monterey and Santa Cruz which has produced a user's guide for small municipalities to help them develop effective storm water management programs.

There are currently five new 319(h) contracts awarded in the Salinas River Watershed. These projects will demonstrate the use of restored wetlands as filters for pollutants and as ground water recharge areas; reduce nitrate loading to ground water through demonstrating and promoting agricultural best management practices; promote citizen monitoring in the watersheds of the Monterey Bay National Marine Sanctuary; reduce erosion and sedimentation on the east side of the Salinas Valley; and develop an expedited permitting process to encourage implementation of agricultural best management practices for reduction of erosion and sedimentation.

Coordination with Existing Resource Protection Efforts

A number of other programs have been initiated in the past decade to address erosion and pesticide problems impacting Moss Landing Harbor and its watershed. The Regional Board has been involved in funding or providing technical support for many of these programs. Numerous land management plans have been developed for the various watersheds and tributaries within the Moss Landing watershed, and extensive effort has been dedicated to education, outreach, and technical assistance to agricultural landowners and operators.

The Water Quality Protection Program for the Monterey Bay National Marine Sanctuary (WQPP) is a cooperative effort of many agencies and entities working in the watersheds of the

Sanctuary to protect the water quality of the Sanctuary. The Regional Board is a signatory of a Memorandum of Agreement between agencies which deals with water quality activities within the Sanctuary and its watersheds. The Regional Board participates in a number of programs related to Sanctuary efforts, including the WQPP. Regional Board staff are members of the WQPP Water Quality Council. Staff attend meetings and have worked with other Council members in developing and reviewing strategies to address problems facing the Sanctuary.

The WQPP has developed Action Plans to address water quality needs related to Urban Runoff and Boating and Marinas within the Sanctuary. These documents contain information pertinent to problems identified at Moss Landing Harbor. Full implementation of these plans will help address problems related to tributyltin, PCBs, PAHs, and other pollutants found in the Harbor and downstream of the City of Salinas.

The WQPP is currently involved in work with the agricultural community to develop an Agricultural Action Plan to better protect water quality. A number of meetings have been held with the agricultural community to acquire its input during the plan development process. The Regional Board has been an active participant in these meetings. The Action Plan focuses on a variety of ways to encourage the adoption of management measures to reduce sedimentation, pesticide and nitrate runoff through improvements in technical training, education, demonstration projects, economic incentives, regulatory coordination, etc.

The plan will be linked with the State Farm Bureau Federation's new Nonpoint Source Initiative which proposes that Farm Bureaus take a leadership role in establishing landowner committees and active projects to address nonpoint pollution. Six county Farm Bureaus on the Central Coast have developed an intercounty agreement to work together as an agricultural implementation arm of the WQPP, and to establish Farm Bureau-led pilot projects which will evaluate and implement management measures and track success over time. The local and state Farm Bureaus will work with the various WQPP members, particularly with the Regional Board as a key player, to ensure that their nonpoint efforts can help meet the water quality goals of a variety of agencies and sustain the agricultural economy.

<u>The Natural Resources Conservation Service (NRCS) and Monterey County Resource Conservation District</u> have been involved in technical assistance and bilingual educational outreach to the growers in the Elkhorn and Moro Cojo Slough watersheds,

through the Elkhorn Slough Watershed Project (1994). This project focuses particularly on outreach to ethnic minority farmers and strawberry growers. Its goal is to produce a fifty percent reduction in erosion, sediment, and sediment-borne pesticides. It strives to reconcile some of the socio-economic factors hindering adoption of BMPs, including high land rental and production costs, leasing arrangements and unfamiliarity with technical services and opportunities. Funding has been provided to this program through the SWRCB Cleanup and Abatement Fund.

The U.S. Army Corps of Engineers has issued a regional, watershed permit to the NRCS and the Resource Conservation District for activities in and around streams associated with restoration efforts in the Elkhorn Slough area. This is a pilot permit streamlining effort to encourage landowners to implement management practices which protect water quality. Landowners working with the NRCS on approved management practices and meeting specific design conditions can be included in a regional watershed permit held by NRCS and the Resource Conservation District rather than applying for individual permits or agency approvals.

The Farm Services Agency and the Natural Resources Conservation Service of the U.S. Department of Agriculture have designated Elkhorn Slough and the Old Stage Road area on the East Side of the Salinas Valley as priority areas for cost sharing under the Environmental Quality Incentive Program (EQIP). Decisions on priority areas and other aspects of the EQIP program are made by local work groups, whose members include landowners, and staff from NRCS, resource conservation districts, Regional Boards, county planning departments and UC Cooperative Extension.

The State Coastal Conservancy and the County of Monterey funded the Elkhorn Slough Wetlands Management Plan (1989). This document describes problems in Elkhorn Slough resulting from erosion, pesticides, bacteria and sea water intrusion, describes enhancement plans for five major wetlands in the Slough, plans for public access, and proposed implementation for management problem areas. It includes a lengthy discussion of pesticide use in Elkhorn Slough and the Salinas River area.

Monterey County Water Resources Agency and the Salinas River Lagoon Task Force, with funding provided by a number of agencies, developed the Salinas River Lagoon Management and Enhancement Plan (MCWRA, 1997). This document describes natural resources of the area, as well as some land management issues of concern associated with this lagoon. The document encourages the participation of Task Force members in the WQPP planning process, and recommends that an Interagency/Property Owners Management Committee be formed to ensure implementation of the Management Plan. Funds have recently been obtained to begin implementation of portions of this plan related to bank revegetation.

Monterey County Water Resources Agency has also developed a *Nitrate Management Program* as part of the *Salinas Valley Water Project* (formerly the Basin Management Plan). This long-term program will address reduction of the transport of toxic pollutants, specifically nitrate, through implementation of "on-farm management" outreach and education programs, as recommended by the Salinas Valley Nitrate Technical Advisory Committee in October 1997. Additionally, the Water Conservation Section of the Agency has promoted and fostered water conservation and fertilizer management programs since the early 1990s. These efforts have been focused on reducing the transport of toxic pollutants, specifically nitrate to ground water. Simultaneously, they have resulted in reducing the transport of toxic pollutants to surface waters as well.

D. Preliminary Assessment of Actions required to remedy or restore Moss Landing Harbor to an unpolluted condition

Actions necessary to restore Moss Landing Harbor to an unpolluted condition include both removal of contaminated sediments through dredging and control of the sources of pollutants in the watersheds tributary to the harbor.

As discussed previously, the pollutants of concern in Moss Landing Harbor and its tributaries include sediment, pesticides, tributyltin and several metals. Sources include urban runoff, runoff from agricultural fields and activities associated with boating and marinas.

Listed below are recommended actions, followed by a more detailed description of each item:

Dredging and appropriate disposal of sediments
Control of Harbor Pollutants: Implementation of the Marinas and Boating Action Plan developed by WQPP
Control of Urban Runoff:
Implementation of the Urban Runoff Action Plan developed by WQPP

Implementation of an approved storm water management plan for the City of Salinas
Use of the Model Urban Runoff Guide by small municipalities
Implementation of management practices to reduce nonpoint source pollution from agriculture

Dredging

It is not the intent of this cleanup plan to originate new requirements or actions associated with the dredging of the Harbor. The problems associated with dredging projects are well known and are the topic of continuing interagency discourse. The gravity of the problems facing the Moss Landing Harbor caused the United State Congress to seek funding specifically for this purpose. In addition, several million dollars in Federal Emergency Management Act money have been acquired by the Harbor District to address dredging issues.

Sediment originating in upland watershed areas will continue to be deposited in the harbor and disrupt navigation. This material will continue to present a dredging and disposal problem, as long as it contains pesticides and other pollutants. An upland site for drying and processing dredge spoils has been established in the North Harbor area, but upland disposal is significantly more expensive and labor intensive than offshore disposal. The sedimentation itself, and the financial burden of dredge spoil disposal, create adverse impacts to the Harbor District, marine research community, fishing industry and other harbor interests. The best long term solution is source control of sediment within the watershed.

The current dredging activities are expected to deal with much of the excess sediment in the Harbor area itself. However, dredging will provide only a partial solution to an ongoing problem of sediment and pollutants entering the harbor from the watershed. This plan focuses cleanup efforts at the sources of sediment and associated pollutants.

Control of Harbor Pollutants

A number of activities are generated at harbors as a result of boat maintenance and other activities. Tributyltin, one of the chemicals of major concern, has long since been banned. However, other problem chemicals, including PAHs, copper, zinc, and other metals, can still create pollution problems in poorly flushed Harbor areas.

Implementation of the Boating and Marinas Action Plan Developed by the WQPP will contribute to reduction of pollutants resulting from harbor activities. Seven strategies are identified in this plan:

Public Education and Outreach
Technical Training
Bilge Waste Disposal and Waste Oil Recovery
Hazardous and Toxic Materials Management
Topside and Haul-out Vessel Maintenance
Underwater Hull Maintenance
Harbor Pollution Reduction Progress Review

A position has recently been created to address the various water quality issues in the Harbors and Marinas of the Sanctuary.

Control of Urban Runoff

Urban runoff from the city of Salinas is a probable source of some of the contamination in the Moss Landing Harbor watershed. The city of Salinas is in the process of obtaining an NPDES Municipal Storm Water Permit through the RWQCB, and will implement management practices and conduct monitoring of urban discharges as part of that permit.

Other smaller cities will soon be required to develop municipal storm water programs as well. The Model Urban Runoff Guide developed by the Cities of Monterey and Santa Cruz and the Monterey Bay National Marine Sanctuary under a 319(h) grant will be promoted for use by small municipalities throughout the area.

Continued and increased implementation of strategies contained in the MBNMS Action Plan for Implementing Solutions to Urban Runoff (1996) will also reduce urban pollution discharges. Seven strategies are identified in this plan:

Public Education and Outreach
Technical Training
Regional Urban Runoff Management
Structural and Nonstructural Controls
Sedimentation and Erosion
Storm Drain Inspection
CEQA Additions

The State Water Resources Control Board's management agency agreement with the Department of Pesticide Regulation (DPR) provides another mechanism for developing strategies for reducing problems associated with runoff of pesticides into urban waters. The Regional Board will coordinate with DPR in developing and implementing such strategies.

Implementation of Management Practices to Reduce Nonpoint Source Pollution from Agriculture

There are currently many activities taking place within upland areas which can potentially reduce the movement of sediments containing pesticides from agricultural lands. In order to ensure increased implementation of management practices, the following actions are recommended:

Implement the Regional Board's Watershed Management Initiative. To further the restoration process in the tributaries to Moss Landing Harbor the Regional Board will continue with implementation of the Salinas River Watershed Team Strategy and development of a watershed management action plan for the Salinas River Watershed. The scope of this effort should be expanded to include all tributaries to Moss Landing Harbor. This expansion will not be feasible without the addition of another staff person. Funding for this person is included in the estimates of cleanup costs in Section E of this Cleanup Plan.

Increase support for education and outreach. Many activities and planning efforts are already underway by other agencies in the tributaries to Moss Landing Harbor, and have been described in this report. The Regional Board supports many of these activities through funding, technical support, or other means. It is important that implementation activities be continued and whenever possible, accelerated. The importance of education and outreach can not be overemphasized. Providing and facilitating funding for these efforts is a priority action of this cleanup plan.

Develop and promote a variety of tools to control agricultural nonpoint source pollution. Agricultural nonpoint source pollution is diffuse by nature and is generated from a variety of crop types and land use configurations. Landowner attitudes towards government involvement in private property management vary considerably. It is important that a number of tools be available for implementing solutions and that a wide variety of approaches be applied by various agencies. These may include development of land management plans, cost sharing programs, educational programs, technical support programs, demonstration projects, land easement acquisition programs, purchase of critical areas for floodplain restoration and wetland buffer development, and so on. The Regional Board will work with state and local Farm Bureaus and the WQPP to develop effective strategies.

Coordinate implementation of existing land management plans. A number of agencies and landowners have developed land management plans and are already actively involved in erosion control activities in the tributaries to Moss Landing. Many of these documents list Best Management Practices and make recommendations for site specific implementation projects. To ensure that the numerous management plans developed for this area are implemented in a coordinated and effective fashion, it is recommended that an agency and landowner task force or other coordinating body be designated to assume a lead role in prioritizing and implementing actions.

Build on existing plans and programs. Work with the Natural Resources Conservation Service and other agricultural extension agencies to develop resource management plans which address both economic and environmental concerns.

Increase effective use of land use policies and local ordinances. Local agencies can utilize land use policies and ordinances to provide incentives for retirement of marginal or highly erodible agricultural lands which are sources of sediment and pollutants, such as those on steep slopes. Local agencies should utilize erosion control policies and ordinances to discourage activities which create excessive soil erosion. Local agencies, however, are often underfunded. Investigation of means of increasing the ability of local agencies to effectively enforce ordinances would be of benefit.

Increase technical assistance and outreach to landowners. Most private landowners are concerned with soil loss and pesticide use, for both environmental and economic reasons. Excessive or inappropriate use of pesticides can increase operating costs. Excessive soil erosion can increase land maintenance costs and result in irreversible impacts to land productivity. It has been estimated that strawberry farmers in the Elkhorn Slough watershed lose $1.7 million per year as a result of soil erosion (NRCS, 1994). Many landowners are familiar with Integrated Pest Management and basic erosion control practices and have worked with the Natural Resources Conservation Service and other technical agencies on land management issues. However, many farmers are uncomfortable or unfamiliar with the use of government assistance, and are unsure how to obtain such assistance (NRCS, 1994). This effort could be facilitated through development of short courses for row crops and vineyards, similar to the Ranch Water Quality Planning courses being offered statewide the University of California Cooperative Extension.

Support joint efforts of the California Farm Bureau Federation's Nonpoint Source Initiative and the Water Quality Protection Program. The California Farm Bureau Federation has developed a statewide nonpoint source initiative to address water quality concerns. The initiative is based on a voluntary watershed planning process to be developed by landowners and coordinated through local farm bureaus. Farm bureaus in three watersheds tributary to Monterey Bay National Marine Sanctuary, including the Salinas River Watershed, will be working with the Water Quality Protection Program of the Sanctuary to develop pilot projects. Work with the WQPP and the Farm Bureau to ensure that the action plans developed for protection of water quality in the Sanctuary reflect agricultural needs and issues as well as regulatory requirements.

Encourage broad implementation of management practices to solve multiple problems. Many practices exist which can reduce the delivery of pesticides to waterways. It is not the intent of this document to present a comprehensive list of practices that should be implemented. Many sources of guidance are available which address this issue. Also, these practices must be selected and tailored to the specific conditions at each site, combining the expertise of the grower/rancher and technical outreach by agencies as necessary. Some of the major approaches which can be utilized by the agricultural community are summarized below:

- Maintain a vegetative buffer area between creek drainages and agricultural activities. Wider buffer areas should be utilized adjacent to larger creeks.

- Revegetate drainageways with grass or suitable wetland vegetation.

- If levees are utilized, set them back from creek channels to provide a flood plain within the area of channelized flow.

- Restore channelized areas wherever possible to a more natural flood plain condition.

- Seek funding for riparian enhancement and easement development to offset financial losses from land conversion immediately adjacent to creek areas.

- Utilize cover crops and grassed field roads during winter months to reduce soil erosion and pesticide runoff during rain events.

- Utilize low till and no till farming practices wherever feasible.

- Monitor land for evidence of soil loss; implement control measures as needed.

- Use sediment basins and other detention or retention devices to help capture sediment before it leaves the property.

- Reduce overall use of pesticides; utilize integrated pest management practices.

- Time application of pesticides to minimize runoff.

- Avoid overspraying and spraying when wind can transport chemicals.

- Make use of cost sharing programs and available technical assistance to address erosion control problems and pesticide application issues.

- Wherever possible, retire steeply sloped farmland to grazing or other, less erosive uses.

- Utilize irrigation/runoff management such as underground outlets and irrigation tailwater return systems.

10. Coordinate with the Department of Pesticide Regulation. The State Water Resources Control Board's management agency agreement with DPR establishes a unified and cooperative program to protect water quality related to the use of pesticides. The State Water Resources Control Board and DPR have produced the California Pesticide Management Plan which provides for outreach programs, compliance with water quality standards, ground and surface water protection programs, self-regulatory and

regulatory compliance, and interagency communication. The Regional Board will coordinate with DPR and implementation efforts of the California Pesticide Management Plan.

Summary

A large number of planning and implementation activities have been undertaken in the tributaries to the Moss Landing Harbor to specifically address erosion control and chemical management issues. Some of these have been done at a "demonstration" scale on public lands, but other projects have been on private lands working with the cooperation of local landowners. All of these plans identify erosion and pesticide movement as a major problem, and all recommend various land treatments to help ameliorate the problem. These activities are an extremely important component of watershed restoration. The implementation of these plans should be continued, in order to achieve the long-term improvements which are needed in the watershed. Increased effort should be aimed at coordinating and implementing recommendations of existing plans, including those of the Regional Board's Watershed Management Initiative and Salinas River Watershed Strategy, and the Water Quality Protection Program of the Monterey Bay National Marine Sanctuary.

Environmental Benefits

The actions described above will result in reduction of total sediment and smaller percentages of polluted sediment. These environmental benefits will impact a wide variety of beneficial uses throughout the watershed. Benefits of the plan in terms of Beneficial Uses designated in the Region 3 Basin Plan for Moss Landing Harbor, adjacent waters, and tributaries, include the following:

- Navigation
- Reduction of impairments to navigation resulting from siltation in the Harbor area.
- Reduction of complications and cost of dredging the harbor.
  Shellfish Harvesting
- Reduction of elevated levels of pollutants found in shellfish.
  Commercial and Sport Fishing
- Reduction of elevated levels of pollutants found in finfish and the benthic invertebrates which serve as food for a number of species.
- Aquaculture
- Reduction of elevated levels of pollutants found in shellfish.

Wildlife Habitat

- Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in fish and shellfish.

Warm Freshwater Habitat

- Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in fish and shellfish.

Cold Freshwater Habitat

- Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in fish and shellfish.

Estuarine Habitat

- Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in fish and shellfish.
- Preservation of Biological Habitats of Special Significance
- Reduction of elevated levels of pollutants found in the food chain in special habitats:
- Elkhorn Slough National Estuarine Research Reserve
- Monterey Bay National Marine Sanctuary
- Salinas River Wildlife Refuge

Rare, Threatened, and Endangered Species

- Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in birds, fish and shellfish.

Industrial Service Supply

- Reduction of sediment and turbidity in power plant cooling water intake, resulting in increased plant efficiency.

E. An estimate of the total costs to implement the cleanup plan Cost estimates for implementation of this Cleanup Plan are partitioned into four general categories:

1) Regional Board Program Coordination costs
2) Harbor implementation costs
3) Urban implementation costs
4) Agricultural implementation costs

1. Regional Board Program costs

The Watershed Management Initiative Chapter (1997) for Region 3 states "Although the state has had a Nonpoint Source (NPS) Program for many years, funding has been extremely limited and inadequate to address NPS problems in the Region, and in the Salinas River watershed in particular, which has relatively few point source discharges." In the WMI, for FY 99/00, a staffing deficit of 1.6 Personnel Years (PYs) has been identified related to implementation of the Watershed Management Action Plan, Nonpoint Source activities, and this Cleanup Plan in the Salinas and Elkhorn watersheds. Because only a portion of the Salinas

Watershed is considered in this cleanup plan, 1.0 PY is recommended for funding to implement this cleanup effort.

In addition to an allocation for this PY, an allocation has been made to cover other expenses expected to be incurred by the Regional Board in connection with its administration of the plan and in connection with water and habitat monitoring in support of the implementation of this plan. First year expenses include provisions for a monitoring program and equipment to aid in selection of implementation sites and for collecting baseline data to be used during subsequent years in the performance evaluation phase of monitoring the BMP installations.

2. Harbor implementation costs

Cost estimates for this aspect of the Cleanup Plan were developed using Action Plan III, Marinas and Boating, Water Quality Protection Program for Monterey Bay National Marine Sanctuary, May 1996. This plan dealt with the entire Sanctuary area and involved a broad range of agency and private sector stakeholder involvement in its development. Cost estimates included in the document were prorated to provide estimates for use in this Cleanup Plan in Moss Landing Harbor only.

Strategy	First Year		Second Year	
	Low Estimate	High Estimate	Low Estimate	High Estimate
Public Education and Outreach	5,000	6,667	10,000	15,000
Technical Training	4,000	5,000	6,667	11,667
Bilge Waste Disposal and Waste Oil Recovery	5,000	8,333	18,333	21,667
Hazardous and Toxic Materials Management	1,667	3,000	11,667	16,667
Topside and Haulout Maintenance	1,667	1,667	13,333	16,333
Underwater Hull Maintenance	1,667	3,000	4,000	6,333
Harbor Pollution Reduction Review	1,667	1,667	3,333	6,667
Overall Harbor Costs	20,667	29,334	67,333	94,333

3. Urban implementation costs

Cost estimates for this aspect of the Cleanup Plan were developed using Action Plan I, Implementing Solutions to Urban Runoff, Water Quality Protection Program for Monterey Bay National Marine Sanctuary, May 1996. This plan dealt primarily with the coastal urban areas of the Sanctuary and involved a broad range of agency and private sector stakeholder involvement in its development. Cost estimates included in the document were used as guidelines to provide estimates for use in this Cleanup Plan.

Strategy	First Year		Second Year	
	Low Estimate	High Estimate	Low Estimate	High Estimate
Education and Outreach	22,500	22,500	10,000	10,000
Technical Training	10,500	10,500	6,500	6,500
Regional Urban Runoff Mgmt Program	134,000	134,000	75,500	85,500
Structural/Non-Structural Controls	30,000	40,000	30,500	67,500
Sedimentation / Erosion	7,500	12,500	15,000	32,500
Stormdrain Inspection	17,500	20,000	27,500	35,000
CEQA additions	3,500	4,500	3,500	3,500
Overall Urban Costs	225,500	244,000	168,500	240,500

4. Agricultural implementation costs

The overall area of the Moss Landing watershed used for this cost estimate is approximately 210,000 acres. The cost estimates were derived by evaluating several local land improvement plans and prorating costs contained in those plans to the area under consideration in this plan. Some elements of these plans are already being implemented, and recalculations based on these activities will reduce overall clean up cost estimates.

Primary source documents evaluated to provide a basis for the estimates contained in this document are:

1. Elkhorn Slough Uplands Water Quality Management Plan (Kleinfelder, 1993)

   This plan estimates that implementation of Best Management Practices in the area will cost between $1,000 and $1,500 per acre of land treated.

2. Elkhorn Slough Watershed Project (SCS, 1994)

   This plan includes the Elkhorn Slough and Moro Cojo Slough watersheds. It estimates implementation costs at about $650 per acre. It proposes to reduce erosion and the resulting transport of sediment and sediment borne pesticides by 50%. The plan encompasses a 44,900 acre portion of the Moss Landing watershed, of which approximately 10,000 acres are agricultural land and 5,450 acres are proposed for treatment. The plan emphasizes agricultural land treatment measures, and gives special attention to strawberry growing operations in the area.

   In addition to providing remediation for some of the problems in Moss Landing, this plan estimates that its implementation would reduce the cost of erosion damage on strawberry lands by an average of $1,100,000 per year, public road cleanup costs by $64,000 per year and traffic delay costs by $9,000 per year.

3. Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters (USEPA, Jan 1993).

   While this guidance document is general in nature, it provides cost estimates for a wide variety of land treatment measures and offers a framework for comparison of the cost benefit ratios for various management measures.

   For the purposes of this Cleanup Plan, the acreage of irrigated agricultural land being considered for treatment was roughly estimated at 100,000 acres, using Association of Monterey Bay Area Governments(AMBAG) Geographic Information System data layers which employed satellite imagery as a basis for land cover classification. Only a portion of this total acreage is targeted for implementation efforts.

Documented cost estimates for the types of treatment deemed suitable and feasible range from $650/acre (NRCS 1994) to $1,500/acre (Kleinfelder 1993). Though Kleinfelder cites a higher treatment cost per acre than NRCS, the variability appears to be based on the topography and actual cropping practices in their respective study areas. Further inquiry into cost estimates indicates that because of the flatter overall topography of the Tembladero and lower Salinas area the costs will actually be lower. NRCS indicates that estimates of $500/acre are reasonable (D. Mountjoy, pers. comm. 1997). The use of a focused, results-oriented implementation management approach, which gives high priority to projects at sites which produce maximum benefits, will have a significant impact on overall costs.

The cost estimates below are based on implementation of Best Management Practices on 10 to 15% of the estimated 100,000 acres of agricultural land addressed by this Cleanup Plan.

Overall Agricultural Implementation Cost Estimate

Strategy	First Year		Second Year	
	Low Estimate	High Estimate	Low Estimate	High Estimate
Education and Outreach	75,000	100,000	40,000	50,000
Technical Training	50,000	75,000	40,000	40,000
Sedimentation / Erosion Control Projects	100,000	500,000	1,300,000	1,400,000
Land Use Practice BMP Assistance	100,000	300,000	100,000	100,000
Overall Agricultural Costs	325,000	975,000	1,480,000	1,590,000

F. <u>An estimate of recoverable costs from potential dischargers</u>

Harbor

Moss Landing Harbor District currently bears the financial burden of dredging sediment from the Harbor. Providing funding for regular maintenance dredging of the harbor will continue to be the responsibility of the harbor department.

Federal funding for the large dredging project required by recent extreme sedimentation has been appropriated through the Federal Emergency Management Act (FEMA).

Urban

Urban stormwater control activities by municipalities in the area are currently underway and the cost of administering and implementing these activities is being borne by municipalities, the State, and Federal government. The majority of funding for the urban stormwater component of this plan will be borne by the cities as part of their implementation of stormwater management plans.

Agricultural

Implementation of management measures to control erosion is most frequently carried out by a combination of public and private sector funds. A variety of cost sharing programs exist which will be employed as a part of the overall funding strategy. These cost sharing programs generally require a project proponent share of 25% to 50% of the overall project cost. Many of the needed management measures produce continuing economic benefits to landowners and land users in general. Accordingly, a portion of the land treatment cost is expected to be absorbed by individuals and organizations which receive direct benefit from the land treatment measures.

The cleanup plan implementation program will incorporate inducements for private and public sector investment, and will include a spectrum of grants, fees, tax incentives, and public-private partnerships. In the case of management measures which produce a predictable return on investment, State Revolving Funds may be considered as temporary financing to encourage private and public sector investment by amortizing implementation costs. Other mechanisms, such as conservation banking and mitigation banking, can combine many small sources of funding into an asset pool capable of supporting larger scale projects.

Currently, there is no plan to issue waste discharge requirements or otherwise regulate agricultural land uses in the tributaries to Moss Landing Harbor. Consequently, no directly recoverable costs are anticipated from agricultural land owners. However, if voluntary compliance continues to be inadequate to address pollution problem in the Harbor, regulatory action may be considered at some point, particularly for individual landowners whose actions are shown to cause significant impact. The RWQCB has existing authority to initiate such action, under the Porter Cologne Act Water Quality Control Act.

G. <u>A five-year expenditure schedule identifying funds to implement the plans that are not recoverable from potential dischargers</u>

Expenditures in the first year of the program will be largely committed to identifying and prioritizing specific implementation measures and target sites. First year expenses would include the addition of one full time position for Region 3 staff, and staff time expenditures by several other agencies. The Region 3 staff position would be dedicated to "land treatment implementation management". The individual would initially be charged with the creation of a prioritized candidate project list for focused remediation of the Moss Landing sedimentation and pesticide problems. This list would include financing and performance monitoring options for each project. This effort will require and result in an increase in coordination and assistance with existing projects and programs.

Second year funding, as well as funding for following years will emphasize implementation activities and monitoring for success.

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	5 YEAR TOTALS
Harbor	25,001	80,833	80,833	80,833	80,833	348,334
Urban	234,750	204,500	204,500	204,500	204,500	1,052,750
Agricultural	650,000	1,535,000	1,535,000	1,535,000	1,535,000	6,790,000
Program Management	185,000	185,000	185,000	185,000	185,000	925,000
Monitoring	198,000	110,000	110,000	110,000	150,000	678,000
Total Program	**1,292,751**	**2,115,333**	**2,115,333**	**2,115,333**	**2,155,333**	**9,794,084**

Canada de la Huerta – Shell/Hercules Site

The Shell Western/Hercules Gas Plant site (now owned by Aera Energy LLC (Aera)) is located adjacent to Canada de la Huerta, approximately 18 miles west of Goleta in Santa Barbara County. In 1986 soils at the site were discovered to contain PCBs and other chemicals, as a result of operation and maintenance of the plant, and storage of a heat transfer fluid onsite.

In 1988, a remedial investigation was initiated, as a result of a Consent Agreement between Shell Western and the Department of Toxic Substances Control. As a result of that investigation, soil containing PCBs in concentrations exceeding 50 parts per million (ppm) was excavated from the site and removed to a landfill for disposal. A Human Risk Assessment comprised a large part of the analysis associated with the Remedial Action Plan. The analysis only considered individuals in direct contact with the site. Cleanup at 50 ppm was deemed appropriate to protect Human Health given a "Reasonable Maximum Exposed " individual. This corresponds to the Toxic Substances Control Act Protection Level for PCBs, but is considerably less protective than other suggested protection levels as published in the National Sediment Quality Survey (U.S. EPA, 1997).

Data collected as part of the post-remediation monitoring program in 1997- 98 indicate that PCB levels at the site still violate EPA, Ocean Plan, and Basin Plan standards in both surface and ground water by orders of magnitude (Figures 8 and 9). Toxicity has been documented in both water and sediment. Sediment PCB levels from post-remediation sampling have ranged at some sites between 3,000 and 20,000 ppb (wet weight). These values are orders of magnitude higher than numerous protective levels referenced in the 1997 U.S. EPA document which are intended to provide protection for various beneficial uses. A number of different species still show elevated tissue levels of PCBs, with many exceedances of EPA Screening levels (10 ppb), FDA Action Levels (2,000 ppb), and/or NAS Guidelines for protection of wildlife (500 ppb). Worm tissue collected at the site is particularly high in PCBs. Tissue from marine species, including mussels and shore crabs, are also elevated above EPA Screening levels and Maximum Tissue Residual Levels. Average values of mussels collected at the marine sites in 1997 and 1998 are compared to averages from Regions 1 and 3 State Mussel Watch data in Figure 10. Data are averaged over both regions and in the nonurbanized areas only, for comparison purposes. A summary of data collected, a map of sampling locations during the first year of monitoring, and a timeline of important events are shown in Appendix A.

Figure 8. Shell Hercules Post Remediation, PCBs in Groundwater

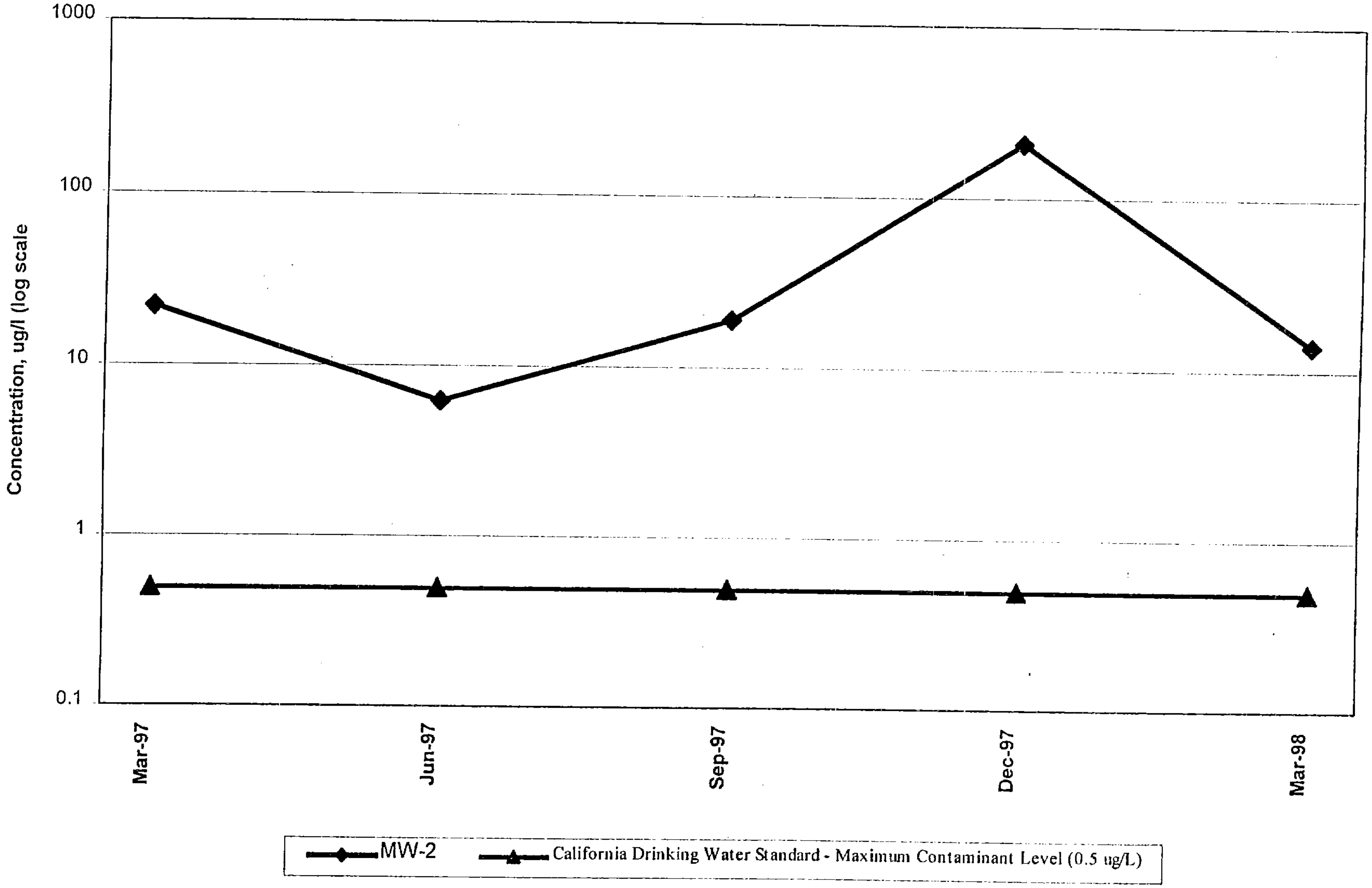


Figure 9. Shell Hercules Post Remediation, PCBs in Surface Water

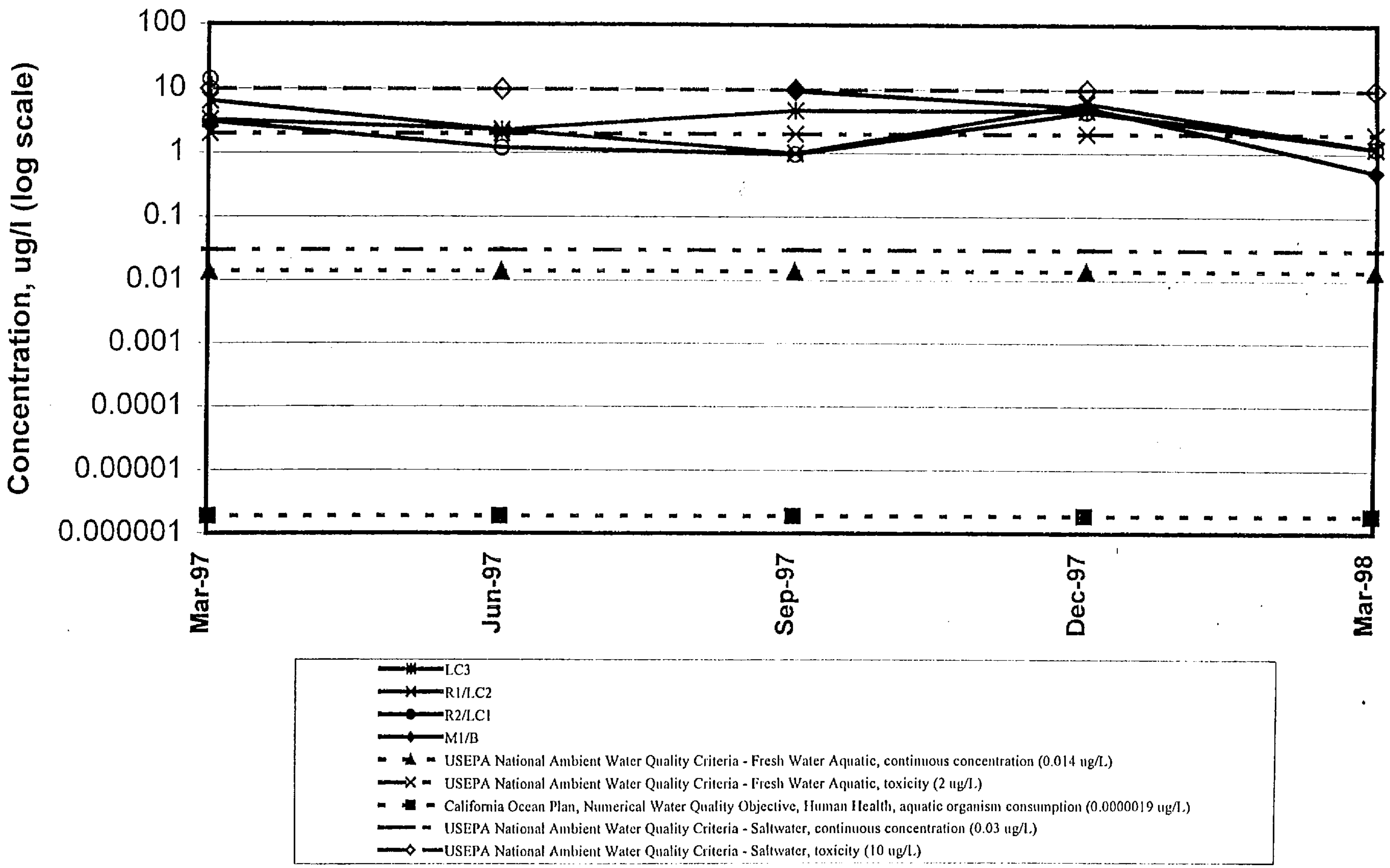
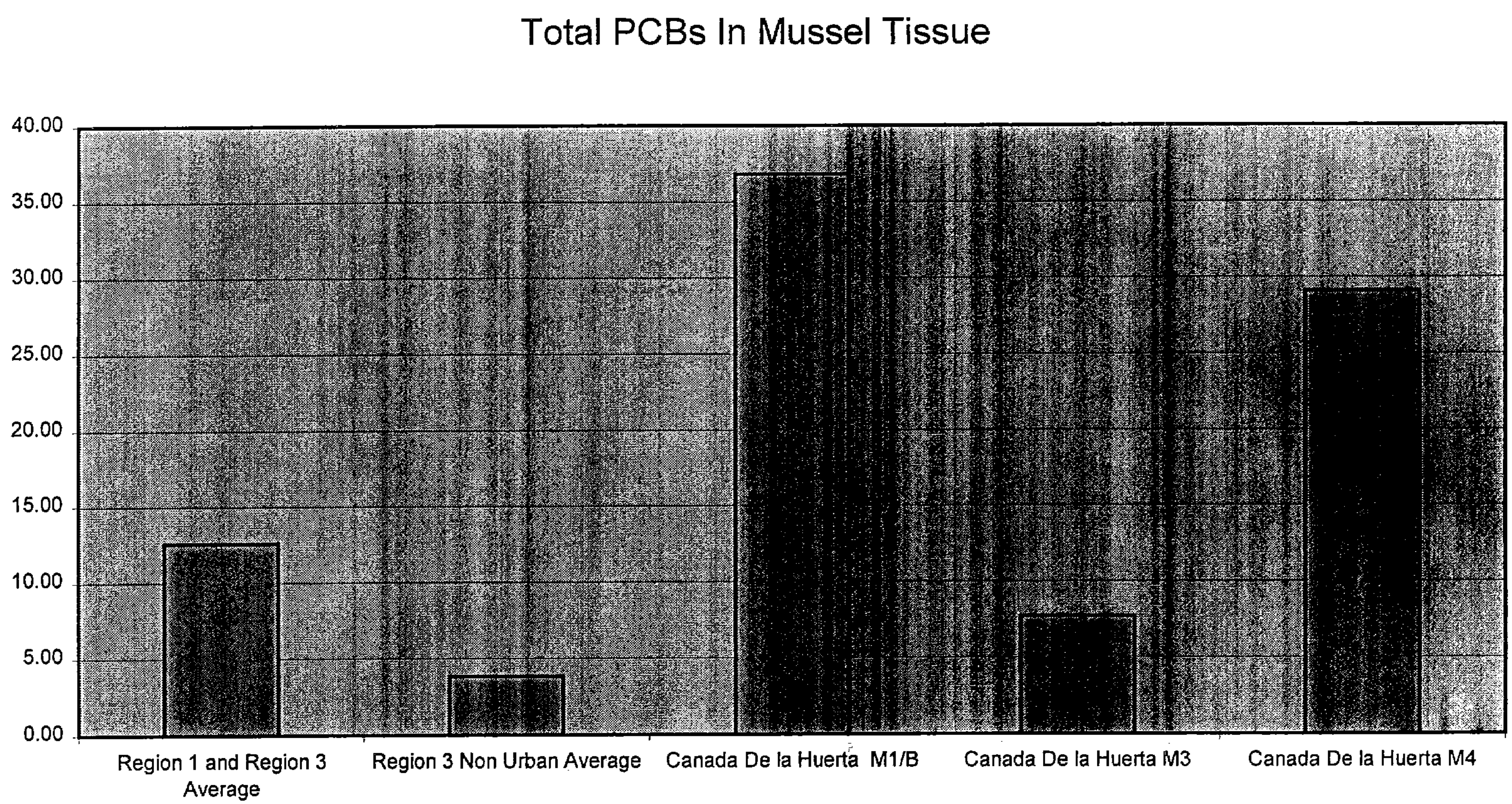


Figure 10. Average concentrations of total PCB (ppb, wet weight) from State Mussel Watch data (1988 – 1996) for the North Coast and Central Coast Regions. Data from non-urbanized areas has excluded major harbors, urban areas, and areas with known pollution problems. This data is representative of relatively undeveloped open coast in California.



It was assumed at the onset of post-remediation monitoring that the site could take a year or more to stabilize following treatment. The first year of monitoring data indicates both water quality violations and tissue bioaccumulation concerns. In spite of prior remediation efforts, the site appears to qualify at this time as a high priority toxic hot spot based on Bay Protection and Toxic Cleanup Program guidelines; we recommend that it be included as a "known toxic hot spot".

A. Assessment of areal extent (Greater than 10 acres)

The Shell Hercules Gas Plant site is approximately 25 miles west of the City of Santa Barbara. The plant was constructed in 1963 and operated until 1988. It processed natural gas from offshore wells for pipeline transport. The site is located in a canyon (known as Canada de la Huerta) that is approximately 3600 feet in length (from the headwaters of the canyon to the ocean) and approximately 1200 feet wide (from ridge to ridge). This canyon can be divided into four zones described as follows:

Sea Cliff - This zone is approximately 400 feet in length and includes the canyon's point of discharge from a three-foot diameter culvert to the sea wall and into the ocean. The culvert inlet is located on the north side of Highway 101 and runs beneath the highway and the Union-Pacific Railroad right-of-way.

Lower Canyon – This zone is approximately 700 feet in length and includes a riparian area with a perennial surface water flow fed by groundwater seepage.

Fill Pad – This zone is approximately 600 feet in length and was the former location of Shell Western E&P Inc.'s gas plant. Shell constructed a terraced fill pad, involving three levels, through this zone. The Fill Pad was constructed from soils excavated at the head of this canyon. A four-foot diameter culvert is located beneath and along the full length of this zone. The culvert's inlet is located in a sediment retention basin, described below, and terminates at the head of the Lower Canyon.

Upper Canyon – This zone is approximately 1500 feet in length and includes riparian areas along an ephemeral stream. There is a sediment retention basin at the south end of this zone. As indicated, the head of the Upper Canyon was the borrow site for constructing the Fill Pad.

Aera (formerly Shell) owns 56 acres of this canyon (a portion of the Lower Canyon, the Fill Pad and Upper Canyon). Four acres of Aera's property was used as the gas plant site area (essentially the Fill Pad zone). Kennedy/Jenks (1994) described the pollution prior to the 1997 remediation efforts as follows:

"PCB-impacted soils have been detected in localized areas throughout the Site. The plant site area was determined to be the most impacted by small leaks and spills over time. Impacted soils in the upper canyon area (immediately north of the Plant Site) resulted from discarding of drums containing residual oils with PCBs and subsequent erosion and deposition of impacted soils down the canyon during storm events. Impacted soils in the lower canyon area (immediately south of the Plant Site) resulted from erosion of impacted soils in the upper canyon and the plant site area. In addition, PCBs were detected in the Seacliff area, where the canyon meets the coastline. It is likely that PCBs were transported to the Seacliff area in stormwater runoff from the Site."

The Kennedy/Jenks report indicated that approximately 13 acres of the 51-acre site had detectable levels of PCBs in studies from the late 1980's. Though the site was excavated and capped as a result of the remediation effort in Winter 1997, data still indicates toxicity, contamination of surface and ground water, and bioaccumulation in a number of resident organisms.

It is unclear to what extent the remediation effort has reduced the areal extent of contamination at the site, but it is likely that the areas remediated are still a source of contamination (e.g., soils were taken from a sediment retention basin onsite to fill the excavated area in the lower canyon). At least ten acres may still require additional remediation in order to fully protect beneficial uses. We are proposing amending the Post-Remediation Monitoring Program to address this issue.

B. Assessment of most likely sources of pollutants

The Shell Western E & P Inc. Hercules Gas Plant used a heat transfer fluid, Therminol oil, as part of the treatment process while in operation from 1963 to 1989. This fluid contained Polychlorinated biphenyls (PCB). PCBs were released to site soils, ground waters and surface waters from Shell's various practices at this site. In addition to PCBs, activities at the plant caused releases to the environment of benzene, toluene, xylenes, ethylbenzene, total petroleum hydrocarbons and polynuclear aromatic hydrocarbons, along with many other chemicals and some metals.

Some contamination, though probably minimal, may possibly also originate from Highway 101 and railroad right-of-way stormwater runoff, which discharges to the seawall culvert onsite.

C. A summary of actions that have been initiated by the Regional Board to reduce the accumulation of pollutants at the Shell Hercules site and to prevent the creation of new THSs

During the Fall of 1996 and Winter of 1997, the site was excavated and capped, per a remedial action plan (RAP) approved by the Department of Toxic Substances Control (DTSC). The excavation was based on removing PCB contaminated soils to 50 ppm, to a depth of five feet and a site average concentration of 10-ppm. This Regional Board and other local and state agencies, prior to RAP approval, advised DTSC that water quality and the environment were not adequately assessed by the plan. Further, Regional Board staff indicated that the 50-ppm standard would not sufficiently protect water quality or the environment. DTSC disagreed with the other agencies and the Regional Board and approved the RAP on June 15, 1994. The time period between June of 1994 and the summer of 1997 was spent negotiating with DTSC and Aera over the inclusion and details of a post-remediation monitoring program.

It was agreed that the post-remediation monitoring plan would continue for a minimum of five years. Data collected from the first year of monitoring are shown in Appendix A. Also in this appendix is a time-line of events, along with a rainfall record. A few post-remediation monitoring results are described as follows:

Mean PCB-Arochlors and Benzene concentrations have been found at 100 times and 1300 times drinking water and ground water standards, respectively.
PCB-Arochlors concentrations in surface waters are 300 times higher than USEPA's guidelines for protecting fresh water aquatic organisms.
Total PCB-congeners, at 23 parts per million (ppm), in the Lower Canyon sediments, exceed the 10-ppm remediation cleanup criteria described above.
Some invertebrate marine organisms are bioaccumulating PCBs at 11,000 times the USEPA's guideline for protection of saltwater organisms and 30 times the USEPA's recommended toxicity limit.
Laboratory bioaccumulation studies using worm tissue show toxic levels of total PCBs at 43 ppm.
Laboratory toxicity tests show PCBs are at toxic levels for water and sediment dwelling organisms located in the lower riparian area.

D. Preliminary Assessment of Actions required to remedy or restore Canada de la Huerta to an unpolluted condition

The following actions are planned for this site. The success of implementing these actions depends on the cooperation of Aera, the Department of Toxic Substances Control, Department of Fish and Game, Santa Barbara County Planning and Protection Services, and this Regional Board.

Continue the post-remediation monitoring program for minimum of five years after remediation (one year has already past). Aera has taken the position time is needed to allow the site to stabilize, and that once stable, there will be a significant reduction in releases of constituents of concern to the environment. The above agencies have generally agreed with this position provided there is a substantial reduction in concentrations for constituents of concern within a very short period of one or two years.
Within this five-year monitoring period, particularly during the period of site stabilization, the implemented remedial action plan's effectiveness at protecting water quality and the environment will be evaluated.

If it is determined that water quality or the environment are not being protected, the monitoring program will be modified to assess the source of the contamination and the RAP will be amended to eliminate the source of contamination.

An ecological risk assessment may be appropriate to determine to what extent this site is impacting the environment.

Deed restriction on groundwater use should remain in place on the property until monitoring data demonstrate beneficial uses are being protected.

Environmental Benefits

A number of environmental benefits will result from action taken to fully remediate the Shell Hercules site. Benefits of cleanup, in terms of existing and foreseeable Beneficial Uses designated in the Region 3 Basin Plan, include the following:

Commercial and Sport Fishing

Reduction of elevated levels of pollutants found in finfish and the benthic invertebrates which serve as food for a number of species.

Aquaculture

Reduction of elevated levels of pollutants found in shellfish.

Wildlife Habitat

Reduction of elevated levels of pollutants found in the food chain evidenced by bioaccumulation in various species.

Cold/Warm Freshwater Habitat

Reduction of elevated levels of pollutants found in the food chain evidenced by bioaccumulation in various species.

Rare, Threatened, and Endangered Species

Reduction of elevated levels of pollutants found in the food chain and evidenced by bioaccumulation in various species which may serve as prey for rare, threatened or endangered species.

E. An estimate of the total costs to implement the cleanup plan

At this time the amount of excavation and/or groundwater extraction needed to fully protect beneficial uses is unknown. Assuming additional excavation is required to remedy the contamination problem once the site has stabilized, estimates of cost can be estimated from past remediation efforts.

The Remedial Action Plan for the first cleanup effort estimated that 6,600 cubic yards of material would need to be excavated and disposed of properly. The plan determined that offsite disposal would be the most cost effective alternative. The total preliminary estimate for offsite disposal was $2,945,200. This estimate included clearing and grubbing, excavating, transportation, disposal, filling, grading and revegetating the site. Assuming that as much material must be removed and disposed of as was in the initial project, the total cost would probably be similar to the cost of the initial remediation effort. Obviously, this estimate will be highly dependent on the outcome of monitoring efforts directed at determining the areal extent and specific nature of the remaining problems.

Costs may be approximated as follows:

Monitoring ($30,000/yr for 10 years)	$300,000
Additional Site Assessment	$250,000
Amended Remedial Action Plan	$50,000
Implement Remediation Alternative	$2,000,000
Total	**$2,600,000**

An estimate of recoverable costs from potential dischargers

The Remediation Action Plan provides a non-binding preliminary allocation of financial responsibility. The document states that Shell Western E & P, Inc. (Aera) is allocated 100 percent financial responsibility for cleanup of this site.

G. A two-year expenditure schedule identifying funds to implement the plans that are not recoverable from potential dischargers

This schedule assumes that continued monitoring shows insufficient improvement in water, sediment and biological measures.

Year 1 – Continued Monitoring and Assessment $30,000
Regional Board staff time(160 hrs @ $70/hr) $11,200

Year 2 – Continued Monitoring and Assessment $30,000
Detailed assessment and RAP revision to address $250,000 cleanup needs Regional Board staff time (160 hrs @ $70/hr) $11,200

Estimated costs for first two years $332,400

All funds to be recovered from discharger.

References

ABA Consultants, 1989. Elkhorn Slough Wetland Management Plan. Prepared for the California State Coastal Conservancy and the Monterey County Planning Department.

Action Plan 1: Implementing Solutions to Urban Runoff. 1996. Water Quality Protection Program for the Monterey Bay National Marine Sanctuary.

Action Plan III: Marinas and Boating. 1996. Water Quality Protection Program for the Monterey Bay National Marine Sanctuary.

AMBAG, 1997. Northern Salinas Valley Watershed Restoration Plan: Final Report of AMBAG's Water Quality Planning Project entitled Nonpoint Source Pollution in Coastal Harbors & Sloughs of the Monterey Bay Region: Problem Assessment and Best Management Practices.

Anderson-Nichols & Co., 1985. Salinas River Study Phase 3 Report: Phreatophyte Water Use.

Boggs, Melissa. California Department of Fish and Game. Telephone conversation on July 31, 1998.

Central Coast Basin Plan, 1996. Central Coast Regional Water Quality Control Board.

Central Coast Regional Water Quality Control Board, Region 3. Watershed Management Initiative Chapter. May, 1998. Prepared for the U.S Environmental Protection Agency.

Coastlinks: News from the Water Quality Protection Program for the Monterey Bay National Marine Sanctuary. Winter, 1997.

Cotter, P. and L. Strnad. 1997. Compilation of Monitoring Data for the Elkhorn Slough Watershed and the Lower Salinas River Drainage Area. California Coastal Commission.

Dames & Moore Consultants. January 15, 1998 "September 1997 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

Dames & Moore Consultants. March 12, 1998. December 1997 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

Dames & Moore Consultants. July 1, 1998. March 1998 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

Dames & Moore Consultants. October 5, 1998. June 1998 Quarterly Sampling, Hercules Gas Plant Site, Area Energy LLC. Prepared for Area Energy LLC.

EDAW, Inc. 1998. Draft Environmental Impact Report: Salinas River Vegetation Management Program. State Clearinghouse No. 98021039.

Ganapathy, C., C. Nordmark, K. Bennett, A. Bradley, H. Feng, J. Hernandez, J. White, in draft. Temporal Distribution of Insecticide Residues in Four California Rivers. Environmental Hazards Assessment Program, Environmental Monitoring and Pest Management Branch, California Dept. of Pesticide Regulation, Sacramento.

Habitat Restoration Group, 1996. Moro Cojo Slough Management and Enhancement Plan. Prepared for the Monterey County Planning and Building Inspection Department and the State Coastal Conservancy.

Harding Lawson & Associates (1997). Amphipod toxicity and sediment chemistry testing for the Moss Landing Harbor District.

Hunt, J. W., B.A. Anderson, B. M. Phillips, R.S. Tjeerdema, H. M. Puckett, and V. deVlaming. In press. Patterns of aquatic toxicity in an agriculturally dominated coastal watershed in California. Agriculture, Ecosystems and Environment.

Kennedy/Jenks Consultants. April 1994. Final Remedial Action Plan, Hercules Gas Plant Site, Santa Barbara

County, California. Prepared for Shell Western E&P Inc. K/J 920042.00.

Kleinfelder, 1993. Uplands Water Quality Management Plan for Elkhorn Slough. Prepared for the Association of Monterey Bay Area Governments.

Model Urban Runoff Program – A How-To Guide For Developing Urban Runoff Programs for Small Municipalities. April, 1998 Draft. MBNMS, Calif. Coastal Commission, RWQCB, City of Monterey, City of Santa Cruz, AMBAG.

National Academy of Sciences. 1973. Water Quality Criteria, 1972.

Oakden, J.M. and J.S. Oliver (1988). Pesticide Persistence in Fields and Drainages of the Central Monterey Bay Area. Prepared for the Regional Water Quality Control Board.

Parkin, J. L. 1998. Ecology of Breeding Caspian Terns (*Sterna caspia*) in Elkhorn Slough, California. Thesis presented to the Faculty of Moss Landing Marine Laboratories, San Jose State University.

Rasmussen, D. and H. Blethrow. 1991. Toxic Substances Monitoring Program 1988-89 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 91-1WQ

Rasmussen, D. 1992. Toxic Substances Monitoring Program 1990 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 92-1WQ.

Rasmussen, D. 1993. Toxic Substances Monitoring Program 1991 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 93-1WQ.

Rasmussen, D. 1995a. State Mussel Watch Program 1987-1993 Data Report (94-1WQ). State Water Resources Control Board, California Environmental Protection Agency.

Rasmussen, D. 1995b. Toxic Substances Monitoring Program 1993-94 Data Report. State Water Resources Control Board, California Environmental Protection Agency. 95-1WQ.

Rasmussen, D. 1996. State Mussel Watch Program 1993-1995 Data Report (96-2WQ). November. State Water Resources Control Board, California Environmental Protection Agency.

Rasmussen, D. 1997. Toxic Substances Monitoring Program 1994-95 Data Report. State Water Resources Control Board, California Environmental Protection Agency.

Regional Water Quality Control Board, Central Coast Region. January 1997. Pre-Remediation Monitoring Report, Canada de la Huerta, Gaviota, Santa Barbara County.

Regional Water Quality Control Board Central Coast Region. October 1997. Post-Remediation Monitoring Report, Canada de la Huerta, Gaviota, Santa Barbara County.

Regional Water Quality Control Board, Central Coast Region. November 6, 1998. Position Paper, Shell Hercules Gas Plant, Canada de la Huerta, Santa Barbara County.

Salinas River Watershed Team Strategy, 1996. Central Coast Regional Water Quality Control Board.

Salinas River Lagoon Management and Enhancement Plan (March, 1997). Prepared by John Gilchrist & Assoc., the Habitat Restoration Group, Philip Williams and Associates, Wetlands Research Associates, and the staff of the Monterey County Water Resources Agency for the Salinas River Lagoon Task Force.

State Water Resources Control Board. 1998. Final Functional Equivalent Document – Water Quality Control Policy for Guidance on the Development of Regional Toxic Hot Spot Cleanup Plans. Division of Water Quality.

State Water Resources Control Board, Central Coast Regional Water Quality Control Board California Department of Fish and Game, Moss Landing Marine Laboratories, University of California Santa Cruz. 1998. Chemical and Biological Measures of Sediment Quality in the Central Coast Region.

Stillwell, Jim. Moss Landing Harbor District. Telephone conversation in November, 1997.

Sustainable Conservation. 1996. Partners in Restoration: Creating Model Incentives and Access for Watershed Restoration. Grant No. 95-8694. Final Report to the David and Lucille Packard Foundation.

U.S. Environmental Protection Agency, 1990. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. USEPA Office of Water. 840-B-92-002.

U.S. EPA Envirofacts, 1998. U.S. EPA World Wide Web Site.

U.S. EPA. 1993. Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters (6217(g)). Issued under the Authority of the Coastal Zone Act Reauthorization Amendments of 1990.

U.S. EPA. 1993b. Guidance for assessing chemical contaminant data for use in fish advisories. Volume 1. EPA 823-R-93-002. Office of Water. Washington, D.C.

U. S. EPA, 1997. The incidence and severity of sediment contamination in surface waters of the United States. Volume 1, National Sediment Quality Survey. Document No. EPA 823-R-97-006.

U.S. Food and Drug Administration. 1984. Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances.

Sites Of Concern (Sites That Do Not Currently Qualify As Candidate Toxic Hot Spots)

The sites described below showed indications of toxicity or other related problems, but insufficient evidence was available to rank them as candidate hot spots. They are listed here for consideration as targets of future monitoring or analysis efforts. Chemicals which exceeded ERMs or PEL for sediment; EPA Screening Levels, NAS or FDA Action levels for tissue are indicated in bold print. (* See references listed under Candidate Sites)

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference *
Santa Maria River	Santa Maria Estuary	Santa Maria Estuary – Station #30020	Aquatic Life Concerns, Human Health Concerns - Only one sample taken by BPTCP, but high values of some chemicals, sediment toxicity, bioaccumulation	**DDT, Dieldrin, Nickel,** Toxaphene, Endrin	1, 3
Santa Cruz Harbor	Santa Cruz Yacht Harbor	Santa Cruz Yacht Basin – Station #30001.0, #35001.0, #35002.0	Aquatic Life Concerns – Sediment Chemistry, bioaccumulation; limited toxicity data	**PAHs, PCBs, Copper, Mercury, Chlordane,** Tributyltin	1, 5
Monterey Harbor	Monterey Yacht Harbor Marina	Monterey Yacht Club - #30002.0	Aquatic Life Concerns – Sediment Toxicity, Sediment Chemistry, bioaccumulation (multiple visits)	**PAHs, Copper, Zinc,** Toxaphene, PCBs, Tributyltin	1, 5

Water body name	Segment Name	Site Identification	Reason for Listing	Pollutants present at the site	Report reference *
	Monterey Boatyard	Monterey Boatyard - Station #35003.0, #30012.0	Aquatic Life Concerns - Sediment Toxicity with associated Sediment Chemistry (single visit)	**PAHs**	1
	Monterey Harbor - Mid Harbor	Monterey Stormdrain #3 - Station #30014.0	Aquatic Life Concerns - Sediment toxicity with associated Sediment Chemistry (single visit)	**PAHs**	1
Pajaro River	Pajaro River Estuary	Pajaro River Estuary – Station #30006.0	Aquatic Life Concerns - Limited sediment toxicity data with associated sediment chemistry, bioaccumulation	**Nickel, Chromium,** Dieldrin, PCB, Toxaphene, DDT (upstream sites also show endosulfan, chlordane, endrin, heptachlor epoxide)	1, 6, 7

Additional Comments on Sites of Concern

Santa Maria River Estuary

Though insufficient data was collected to designate the Santa Maria Estuary as a candidate Toxic Hot Spot, the single visit to this site showed high levels of some chemicals, as well as high toxicity. DDT values were the highest in the Region, exceeding guideline values even after organic carbon normalization.

The Department of Fish and Game has collected toxicity data on the lower Santa Maria River, as part of the Guadalupe Natural Resources Damage Assessment for the cleanup effort at Unocal's Guadalupe Oil Field site. The Santa Maria River site was selected as a reference site in one study for the Damage Assessment, but showed high toxicity (Melissa Boggs, pers. comm.). The final results of these studies have not yet been released for public use, but once available should provide additional insight into the problems at the Santa Maria site. Additional monitoring of this site is warranted.

Santa Cruz Harbor

Santa Cruz Harbor had a wide variety of chemical exceedances, including mercury, copper, PCBs, PAHs, and chlordane, resulting in the highest ERM and PEL quotient values in the Region 3 BPTCP dataset. Quotient values are used to characterize overall pollution content, when more than one pollutant is present at a site. Toxicity was only detected from one of multiple visits at the Yacht Harbor, but was not conducted at other sites in the Harbor. Additional monitoring of this site is warranted.

Pajaro River Estuary

BPTCP identified elevated levels of nickel and chromium in the single sample analyzed for this site. These two metals are widespread throughout the Region and are thought to be geological in origin. In addition, low confidence is placed in the ERM and PEL values for these metals (Long *et al.*, 1998 in SWRCB *et al.*, 1998). Tissue data from the State Mussel Watch Program indicates elevated levels of a wide variety of chemicals in the lagoon, particularly banned organochlorine pesticides. A focused study of this area by the University of Santa Cruz revealed toxicity in 78% of agricultural drainage ditch samples, 14% of tributary slough samples, and 19% of river and estuary samples. Temporal patterns indicated that agricultural ditches and the upper river may be more important sources of toxic runoff to the estuary than were the freshwater sloughs (Hunt et al, in press). Additional monitoring of this site is underway as part of a joint AMBAG/RWQCB effort and should further characterize the problem. Initial results from this effort did not detect sediment toxicity at the four sites monitored in the watershed.

Monterey Harbor

Recent data submitted by the City of Monterey to the RWQCB indicate that levels of PAHs in sediments in the Harbor taken as a result of dredge spoil testing and other activities show minimal impact from the chemicals of concern identified by BPTCP in previous years.

Benthic assemblages showed no significant impacts at Monterey Boatyard where a lead slag heap had been cleaned up in the late 1980s, nor did associated lead values exceed ERM or PEL guideline values. The patterns of species abundance and distribution showed no clear pattern as distance increased from the cleanup site, and in fact was most complex near the site, but this may be attributable to differences in habitat (SWRCB et al., 1998). The Monterey Yacht Harbor had pollutants present typical of marinas, including copper, zinc, PAHs and tributyltin. Multiple toxicity was shown from two visits, with associated chemistry. However, toxicity was also seen at "reference" sites outside the Harbor mouth. This confounds interpretation of toxicity data within the Harbor.

Mussel Watch data showed bioaccumulation values at the Marina exceeding EPA Screening Levels for Toxaphene, PCBs, and Tributyltin in 1991, 1992, and 1993 (SMW, 1995). However, no FDA or NAS standards were exceeded. The Harbor is relatively well flushed.

Because the pollutants of concern in Monterey Harbor are typical of those found in harbor and urban areas, it is recommended that existing efforts by the Monterey Bay National Marine Sanctuary and local agencies to address nonpoint pollution in the Sanctuary continue to be supported by State and federal funding mechanisms. The Sanctuary has developed Action Plans to address urban and harbor nonpoint source pollution. The City of Monterey is one of the collaborators in recent development of a Model Urban Runoff Program for the Sanctuary.

The aggressive and continuing implementation of Best Management Practices in the Harbor by the City, new stormwater programs being developed in the area, and the recent announcement of a new contract position for Harbor Water Quality Project Manager in the Monterey Bay National Marine Sanctuary ensure that Monterey Harbor will continue to benefit from water quality improvements in the future.

Other Sites

Samples from Morro Bay either were toxic but had no associated chemistry analysis, or had exceedances of chromium and nickel but did not prove to be toxic. Other sites in the Region which showed toxicity from a single visit, but for which associated sediment chemistry testing was not conducted include Santa Barbara Harbor, Goleta Slough, Scott Creek, Soquel Lagoon, and San Luis Harbor. All of these sites warrant further investigation for sediment chemistry and toxicity, and will be assessed as part of the Central Coast Ambient Monitoring Program coastal confluences assessment.

APPENDIX A – Compilation of Data Collected by the California Department of Fish and Game (pre-treatment, 1996) and Dames and Moore (post-treatment, 1997-98) at the Canada de la Huerta Site

Shell Hercules Gas Plant, Canada de la Huerta, Santa Barbara County													
		Sampling Site								Standards			
	Date	MW-2	MW-3	MW-3S	MW-4	LC3	R1/LC2	R2/LC1	M1/B	COP	CTR	BP	ERL
PCB, ug/l (ppb) in Groundwater													
	Jan-89	12.0			66.0					0.000019	0.00017	0.3	
	Sep-89	79.0								0.000019	0.00017	0.3	
	Oct-90	45.0			NA					0.000019	0.00017	0.3	
	Aug-96	11.8	ND	Dry						0.000019	0.00017	0.3	
	Mar-97	22.0	ND	Dry						0.000019	0.00017	0.3	
	Jun-97	6.2	ND	Dry						0.000019	0.00017	0.3	
	Sep-97	19.0	ND	Dry						0.000019	0.00017	0.3	
	Dec-97	210.0	ND	Dry						0.000019	0.00017	0.3	
	Mar-98	14.0	ND	ND						0.000019	0.00017	0.3	
Benzene, ug/l (ppb) in Groundwater													
	Jan-89	30000.0			0.9					5900	1.2	1	
	Sep-89	8900.0								5900	1.2	1	
	Oct-90	1600.0			ND					5900	1.2	1	
	Aug-96	4400.0	ND	Dry						5900	1.2	1	
	Mar-97	2300.0	ND	Dry						5900	1.2	1	
	Jun-97	1700.0	ND	Dry						5900	1.2	1	
	Sep-97	850.0	ND	Dry						5900	1.2	1	
	Dec-97	160.0	ND	Dry						5900	1.2	1	
	Mar-98	1500.0	ND	ND						5900	1.2	1	
Toluene, ug/l (ppb) in Groundwater													
	Jan-89	1900.0			ND					85000	6800		
	Sep-89	380.0								85000	6800		

	Oct-90	47.0			ND					85000	6800		
	Aug-96	52.0	ND	Dry						85000	6800		
	Mar-97	240.0	ND	Dry						85000	6800		
	Jun-97	ND	ND	Dry						85000	6800		
	Sep-97	ND	ND	Dry						85000	6800		
	Dec-97	5.0	ND	Dry						85000	6800		
	Mar-98	11.0	ND	ND						85000	6800		
Ethylbenzene, ug/l (ppb) in Groundwater													
	Jan-89	390.0			3.0					4100		680	
	Sep-89	60.0								4100		680	
	Oct-90	ND			ND					4100		680	
	Aug-96	ND	ND	Dry						4100		680	
	Mar-97	ND	ND	Dry						4100		680	
	Jun-97	25.0	ND	Dry						4100		680	
	Sep-97	ND	ND	Dry						4100		680	
	Dec-97	9.0	ND	Dry						4100		680	
	Mar-98	ND	ND	ND						4100		680	
Total Xylenes, ug/l (ppb) in Groundwater													
	Jan-89	100.0			ND							1750	
	Sep-89	60.0										1750	
	Oct-90	2.0			ND							1750	
	Aug-96	200.0	ND	Dry								1750	
	Mar-97	ND	ND	Dry								1750	
	Jun-97	ND	ND	Dry								1750	
	Sep-97	19.0	ND	Dry								1750	
	Dec-97	6.0	ND	Dry								1750	
	Dec-97	34.0	ND	ND								1750	
TPH, ug/l (ppb) in Groundwater													
	Aug-96	2300.0	ND	Dry									
	Mar-97	2600.0	ND	Dry									

PCB, ug/l (ppb) in Surface Water													
	Jan-89					3.6				0.000019	0.00017	0.3	
	Sep-89					12.0				0.000019	0.00017	0.3	
	Oct-90					120.0				0.000019	0.00017	0.3	
	Apr-93					0.5				0.000019	0.00017	0.3	
	Jun-96						2.7	4.3	1.4	0.000019	0.00017	0.3	
	Aug-96					2.6	1.2	1.2		0.000019	0.00017	0.3	
	Mar-97							14.0	2.9	0.000019	0.00017	0.3	
	Mar-97					6.5	3.3	3.1		0.000019	0.00017	0.3	
	Jun-97					2.3	2.3	1.2		0.000019	0.00017	0.3	
	Sep-97					4.7	1.0	1.0	9.5	0.000019	0.00017	0.3	
	Dec-97					4.7	6.2	4.5	5.3	0.000019	0.00017	0.3	
	Mar-98					1.2	1.2	1.2	0.5	0.000019	0.00017	0.3	
TPH, ug/l (ppb) in Surface Water													
	Jun-96						1900.0	1000.0					
	Aug-96					410.0	370.0	280.0					
	Mar-97							ND	230.0				
	Mar-98					240.0	240.0	180.0					
PCB, ug/kg (ppb) in Sediment													
	Pre-90						6600000.0		38000.0				180.
	Jun-96						6700.0	24000.0	2800.0				180.
	Mar-97							180.0	280.0				180.
	Mar-98					320	960	230	4100				180.
TPH, ug/kg (ppb) in Sediment													
	Pre-90						3500000						
	Jun-96						81000.0	92000	110000				
	Mar-97							28000	51000.0				

COP = California Ocean Plan – Objectives for Protection of Human Health (30-day average)
CTR = USEPA California Toxics Rule – For Protection of Human Health in water or organisms – 40 CFR, vol. 62, no. 150. August 5, 1997
BP = Central Coast Regional Water Quality Control Board Basin Plan – General Objectives for PCBs, Protection of Domestic or Municipal Supply for Benzene, Ethylbenzene, and Xylene
ERM = NOAA Effects Range Median

Shell Hercules Gas Plant, Canada de la Huerta, Santa Barbara County													
		Sampling Site							Standards				
	Date	LC3	R1/LC2	R2/LC1	M1/B	M2	M3	M4	MTRL	EPA	NAS	FDA	ERL
PCB - Congeners, ng/g (ppb) In Sediment													
	Dry Weight												
	Aug-96	20111	16484	35253									
	Mar-97	26204	37252	5395									
	Wet Weight												
	Aug-96	13118	10731	20440									180.
	Mar-97	13927	21453	3364									180.
PCB - Congeners, ng/g (ppb) (Bioaccumulation)													
Tadpoles													
	Dry Weight												
	Jun-96		97450	56485									
	Wet Weight												
	Jun-96		8283	5310					0.6	10	500	2000	
Shore Crabs													
	Dry Weight												
	Jun-96				497.3								

	Wet Weight												
	Jun-96				140.7				0.6	10	500	2000	
Mussels													
	Dry Weight												
	Jun-96				37.7								
	Mar-97				347.6		61.0	230.7					
	Wet Weight												
	Jun-96				4.5				0.6	10	500	2000	
	Mar-97				36.8		7.7	29.1	0.6	10	500	2000	
Sand Crabs													
	Dry Weight												
	Jun-96				20.7	10.5							
	Mar-97				328.8		261.3	256.4					
	Wet Weight												
	Jun-96				3.2	1.7			0.6	10	500	2000	
	Mar-97				61.2		49.1	48.6	0.6	10	500	2000	
Fish Tissue, Rubberlip Surfperch													
	Dry Weight												
	Mar-97					16.6							
	Wet Weight												
	Mar-97					1.8			0.6	10	500	2000	
Fish Tissue, Barred Surfperch													
	Dry Weight												
	Mar-97					35.2							
	Wet Weight												
	Mar-97					3.9			0.6	10	500	2000	

Liver Tissue, Rubberlip Surfperch													
	Dry Weight												
	Mar-97					197.6							
	Wet Weight												
	Mar-97					64.0			0.6	10	500	2000	
Liver Tissue, Barred Surfperch													
	Dry Weight												
	Mar-97					232.1							
	Wet Weight												
	Mar-97					100.2			0.6	10	500	2000	
Worm Tissue													
	Dry Weight												
	Aug-96	428823	1135240	428823									
	Mar-97	91646	17285	19729									
	Wet Weight												
	Aug-96	279721	739041	248632					0.6	10	500	2000	
	Mar-97	11217	2116	2415					0.6	10	500	2000	
Sediment Toxicity (% Survival)													
	Jun-96		TOXIC	TOXIC	TOXIC								
	Aug-96	TOXIC	TOXIC	NON-TOXIC									
	Mar-97		NA	NON-TOXIC	NON-TOXIC								
	Mar-97	TOXIC	TOXIC	NON-TOXIC									

	Mar-98			NON-TOXIC	NON-TOXIC								
Sediment Toxicity (Growth)													
	Jun-96		NON-TOXIC	NON-TOXIC	TOXIC								
	Aug-96	Toxic	NON-TOXIC	NON-TOXIC									
	Mar-97		NA	TOXIC	TOXIC								
	Mar-98			NON-TOXIC	TOXIC								
Water Toxicity (Growth)													
	Jun-96		NA	NA	NA								
	Aug-96	Toxic	TOXIC	TOXIC									
	Mar-97		NA	TOXIC	TOXIC								
	Mar-97			TOXIC	TOXIC								
	Mar-98												
Water Toxicity (Survival)													
	Mar-98			TOXIC	TOXIC								

MTRL = California Ocean Plan Maximum Tissue Residual Level
EPA = USEPA Screening Level
NAS = US National Academy of Sciences Screening Level
FDA = US Food and Drug Administration Action Level
ERL = NOAA Effects Range Median Level

Rainfall Variation and Important Events at Tajiguas Landfill: 1973 - 1998