REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

FINAL

REGIONAL TOXIC HOT SPOT CLEANUP PLAN

MARCH 1999

Located in San Pablo Bay off the coast of San Rafael.

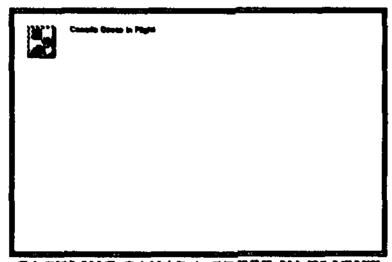
PRIMARY WILDLIFE
West Marin Island, rising 85 feet above the bay waters, supports the largest heron and egret rookery in the San Francisco Bay area. Sheltered covers and shallow mudflats support wintering populations of diving ducks and feeding sites for the fledged herons and egrets.

HABITAT
340 acres: the islands form the core of the refuge with surrounding submerged tidelands.

RECREATION AND EDUCATION
The refuge is closed to the public for safety purposes.
See San Pablo Bay NWR Complex

MERCED NWR

c/o San Luis NWR Complex
947 West Pacheco Blvd., Suite C
P.O. Box 2176
Los Banos, California 93635
(209) 826-3508

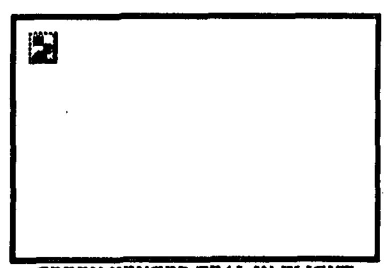


CACKLING CANADA GEESE IN FLIGHT
-GARY ZAHM

DIRECTIONS
Drive 8 miles south of Merced on State Highway 59, then 8 miles west on Sandy Mush Road.

PRIMARY WILDLIFE

- Large wintering populations of pintails, green-winged teal, shovelers, mallards, gadwalls, four species of geese, plus sandhill cranes.
- Fall and spring migrants include phalaropes, yellowlegs, dowitchers, sandpipers, long-billed curlews, black-bellied plovers and white-faced ibis.
- Summer residents include nesting mallards, gadwalls, cinnamon teal, avocets, black-necked stilts, American bitterns, and several species of herons and egrets.
- Ring-necked pheasants are common.



GREEN-WINGED TEAL IN FLIGHT
-GARY ZAHM

REGIONAL TOXIC HOT SPOT
CLEANUP PLAN

REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

Part I

I. INTRODUCTION

In 1989, The California State legislature established the Bay Protection and Toxic Cleanup Program (BPTCP). The BPTCP has four major goals: (1) to provide protection of present and future beneficial uses of the bays and estuarine waters of California; (2) identify and characterize toxic hot spots; (3) plan for toxic hot spot cleanup or other remedial or mitigation actions and; (4) develop prevention and control strategies for toxic pollutants that will prevent creation of new toxic hot spots or the perpetuation of existing ones within the bays and estuaries of the State.

This Regional Toxic Hot Spot Cleanup Plan (Cleanup Plan) is intended to provide direction for the remediation or prevention of toxic hot spots in the San Francisco Bay Region (pursuant to Water Code Sections 13390 et seq.). Pursuant to Sections 13140 and 13143 of the Water Code, this Cleanup Plan is necessary to protect the quality of waters and sediments of the State from discharges of waste, in-place sediment pollution and contamination, and any other factor that can impact beneficial uses of enclosed bays, estuaries and coastal waters.

This Cleanup Plan includes a specific definition of a Toxic Hot Spot and site ranking criteria from the Water Quality Control Policy for Guidance on the Development of Regional Toxic Hot Spot Cleanup Plans (Part I). In Part II of the Cleanup Plan the list of candidate toxic hot spots and the ranking matrix are presented. The last section of the Cleanup Plan (Part III) contains a characterization of the high priority candidate toxic hot spots and the preliminary assessment of actions to address the problems identified at the sites.

LOWER KLAMATH NWR

c/o Klamath Basin NWR Complex
Hill Road, Route 1, Box 74
Tulelake, California 96134
(530) 667-2231
See Oregon for Upper Klamath NWR

DIRECTIONS
Located on the California-Oregon border 24 miles south of Klamath Falls, Oregon. This refuge has several entrances. Write for map.

PRIMARY WILDLIFE

- Peak of nearly 1 million waterfowl use the combined areas of Lower Klamath and Tule Lake during fall migration.
- Major waterfowl production area. Predominant nesting species include gadwall, mallard, cinnamon teal, pintail, ruddy ducks and Canada geese.
- Large summer populations of white pelicans, cormorants, herons, egrets, terns, white-faced ibis, grebes, gulls, avocets, black-necked stilts and killdeer.
- Largest wintering concentration of bald eagles (500+) in the lower 48 States uses the combined area of Lower Klamath and Tule Lake as daily feeding grounds.

HABITAT
The nation's first waterfowl refuge; 53,598 acres of water, marsh, agricultural crops and uplands.

RECREATION AND EDUCATION

- Wildlife observation, study, and photography
- 10-mile gravel auto tour route gives access to the heart of the refuge
- Waterfowl hunting
- Pheasant hunting

SPECIAL NOTE
Refuge farming permittees annually plant approximately 3,500 acres of grain. A third of the crop is left standing as a wildlife food supply.

Visit the Klamath Basin NWR Complex website

MARIN ISLANDS NWR

c/o San Pablo Bay National Wildlife Refuge
P.O. Box 2012
Mare Island, CA 94592-0012
Phone: (707) 562-3000

DIRECTIONS

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. 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 (Figure 1).

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

KLAMATH BASIN NWR COMPLEX (Bear Valley, Clear Lake, Tule Lake, Lower Klamath, Upper Klamath, and Klamath Marsh NWRs)

Hill Road, Route 1, Box 74
Tulelake, California 96134
(530) 667-2231

Visit the Klamath Basin NWR Complex website

KLAMATH MARSH NWR

See Oregon

LIVINGSTON STONE NFH

16349 Shasta Dam Blvd.
Shasta Lake, California 96019
(530) 275-0549

DIRECTIONS
Located at the base of Shasta Dam. Take the Shasta Dam Blvd. exit from I-5 north of Redding and proceed west for about 8 miles to the dam.

PRIMARY FISH
Endangered Sacramento River winter chinook salmon. This is the only national fish hatchery in the Pacific Region to raise an endangered species.

RECREATION AND EDUCATION
Currently closed to public access. The Bureau of Reclamation has a display on the hatchery in the Shasta Dam Visitor Center. Tours of the dam begin at the visitor center and the hatchery is described during the tour.

Figure 1. Region

- The refuge has two interpretive trails: 3-mile Hookton Slough Trail open daily, and 1.75-mile Shorebird Loop Trail open seasonally.
- Peak viewing season is September through April.
- Guided walks on the Lanphere Dunes Unit on the first and third Saturdays of each month.
-

KERN NWR COMPLEX (Kern, Pixley, and Blue Ridge NWRs)

P.O. Box 670
Delano, California 93216
(661) 725-2767

KERN NWR

DIRECTIONS
From Interstate 5, take Highway 46 east 5 miles to Corcoran Road and turn north. Drive 10.6 miles to the refuge at the intersection of Corcoran Road and Garces Highway. From Highway 99: At Delano, exit Highway 99 at Highway 155 exit. Turn south on 155, which is Garces Highway. Travel 19 miles west on Garces Highway to the refuge at the intersection of Corcoran Road and Garces Highway.

PRIMARY WILDLIFE

- Wintering area for migratory waterfowl, shorebirds, marsh, and waterbirds in the southern San Joaquin Valley.
- Refuge also provides habitat for the endangered San Joaquin kit fox, Tipton kangaroo rat, and blunt-nosed leopard lizard.

HABITAT
The refuge is located in the historic Tulare Lake Basin. One hundred years ago, this area was covered by an inland lake and wetland complex totaling over 625,000 acres. The refuge is one of the few remaining wetlands left in the area; 10,618 acres which include natural valley grasslands and developed marsh.

RECREATION AND EDUCATION

- Wildlife observation, study, and photography; best times are November through April.
- 6.5-mile self-guided auto tour open daily except during waterfowl hunting season.
- Waterfowl hunting (October through January)

SPECIAL NOTE
Marsh habitat acreage varies from year to year because of limited water supply.

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.

Legislative Authority

California Water Code, Division 7, Chapter 5.6 established a comprehensive program to protect the existing and future beneficial uses of California's enclosed bays and estuaries. SB 475 (1989), SB 1845 (1990), AB 41 (1989), and SB 1084 (1993) added and modified Chapter 5.6 [Bay Protection and Toxic Cleanup (Water Code Sections 13390-13396.5)] to Division 7 of the Water Code.

The BPTCP has provided a new focus on RWQCB's efforts to control pollution of the State's bays and estuaries by establishing a program to identify toxic hot spots and plan for their cleanup. Water Code Section 13394 requires that each RWQCB complete a toxic hot spot cleanup plan. Each Cleanup Plan must include: (1) a priority listing of all candidate toxic hot spots covered by the Cleanup Plan; (2) a description of each toxic hot spot including a characterization of the pollutants present at the site; (3) an assessment of the most likely source or sources of pollutants; (4) an estimate of the total costs to implement the Cleanup Plan; (5) an estimate of the costs that can be recovered from parties responsible for the discharge of pollutants that have accumulated in sediments; (6) a preliminary assessment of the actions required to remedy or restore a toxic hot spot; and (7) a two-year expenditure schedule identifying State funds needed to implement the plan.

Limitations

This proposed regional toxic hot spot cleanup plan contains information on sites that are believed to be the worst sites in the Region. The candidate toxic hot spots identified in the Cleanup Plan are not considered known toxic hot spots until approved by the State Water Resources Control Board (SWRCB) in the consolidated toxic hot spot

(805) 644-5185

PRIMARY WILDLIFE
Area is a traditional feeding site for the endangered California condor. Condors used the area frequently from October through May. A variety of other birds occur during migration and year round.

HABITAT
1,871 acres of rugged mountains, rock outcroppings, chaparral, hardwood groves, stands of big-cone Douglas fir and open grasslands.

RECREATION AND EDUCATION
Public use is severely limited because of the sensitive situation of the California condor. The U.S. Forest Service maintains two observation points in the Los Padres National Forest.

HUMBOLDT BAY NWR

1020 Ranch Road
Loleta, California 95551
(707) 733-5406

DIRECTIONS
Humboldt Bay Refuge is adjacent to Highway 101, near the cities of Arcata and Eureka, California. Wildlife-oriented recreational opportunities are available in the South Humboldt Bay portion of the refuge. Take the Hookton Road exit from Highway 101 at the south end of the Bay. To the Hookton Slough trailhead, drive 1.2 miles west on Hookton Road; the parking area is on the north side of Hookton Road. To the Refuge office and Salmon Creek Unit: southbound traffic, turn right at the end of the off ramp, then immediately left onto Ranch Road; northbound traffic, take the overpass, turn right onto Ranch Road.

PRIMARY WILDLIFE

- Important staging area (especially spring) for the Pacific black brant and other migratory waterfowl.
- Migration staging area and wintering area for shorebirds; in winter, it is not unusual for over 100,000 birds to use the Bay as a feeding or resting site.

HABITAT
Humboldt Bay contains the largest remaining eelgrass beds south of Willapa Bay in Washington. These also make the Bay an important spawning, nursery, and feeding area for fish and other marine life. The refuge exists primarily to protect and enhance wetland habitats for migratory waterbirds using the Bay, especially black brant. The Lanphere Dunes Unit protects endangered and rare plants within rare dune plant communities, the Humboldt Bay wallflower and beach layia.

RECREATION AND EDUCATION

- Wildlife observation
- Waterfowl hunting

cleanup plan. Many of the actions presented in this plan are general and may be specified in more detail as the actions are implemented through RWQCB actions.

II. TOXIC HOT SPOT DEFINITION

Codified Definition of A Toxic Hot Spot

Section 13391.5 of the Water Code defines toxic hot spots as:

"...[L]ocations in enclosed bays, estuaries, or adjacent waters in the 'contiguous zone' or the 'ocean' as defined in Section 502 of the Clean Water Act (33. U.S.C. Section 1362), the pollution or contamination of which affects the interests of the State, and where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in the water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives."

Specific Definition of A Toxic Hot Spot

The following specific definition provides a mechanism for identifying and distinguishing between "candidate" and "known" toxic hot spots. A Candidate Toxic Hot Spot is considered to have enough information to designate a site as a Known Toxic Hot Spot except that the candidate hot spot has not been approved by the RWQCB and the SWRCB. Once a candidate toxic hot spot has been adopted into the consolidated statewide toxic hot spot cleanup plan then the site shall be considered a known toxic hot spot and all the requirements of the Water Code shall apply to that site.

Candidate and known toxic hot spots are locations (sites in waters of the State) in enclosed bays, estuaries or the ocean. Dischargers (e.g.,

South Farallon Islands.
- California sea lions, harbor seals and northern fur seals haul out on the islands.

HERRING GULL
-CARLOS ALFARO

HABITAT
211 acres of rocky islands.

RECREATION AND EDUCATION

- Although the refuge is closed to public access, wildlife can be observed, studied and photographed at a distance from boats.
- Whale watching and saltwater fishing in nearby waters.
- One-day educational boat trips conducted June-November by the Oceanic Society, (415) 474-3385, bring passengers very close to the islands. Marine mammals are easily seen in the surf or hauled out on the Islands, and most of the refuge's nesting seabirds can be viewed in the proper season. Many trips also encounter whales, dolphins, or porpoises.

ELEPHANT SEALS
-W.E. TOWNSEND

GRASSLANDS WMA

c/o San Luis NWR Complex
947 West Pacheco Blvd., Suite C
P.O. Box 2176
Los Banos, California 93635
(209) 826-3508

SPECIAL NOTE
The U.S. Fish and Wildlife Service's primary objective for the Grasslands Wildlife Management Area is to protect wetland habitat. Through the use of one-time payments of Duck Stamp Act funds, private landowners have agreed to perpetually maintain the wetlands and associated upland habitat. The current size of this management area is 85,000 acres, with over 63,000 acres permanently protected via conservation agreements.

NO PUBLIC USE
The public is not permitted on this area as the Service did not acquire public use rights. This area was established primarily to protect wintering waterfowl. There are several county roads (especially Santa Fe Grade) that provide public vehicular access through these wildlife-rich marshlands.

HOPPER MOUNTAIN NWR

2493-A Portola Road
P.O. Box 5839
Ventura, California 93005

publicly owned treatment works, industrial facilities, power generating facilities, agricultural land, storm drains, etc.) are not toxic hot spots.

Pesticide residues should not be considered under the Bay Protection and Toxic Cleanup Program if they are detected in the water column in a pattern of infrequent pulses moving by the sampling location. Such detections will be addressed using cooperative approaches such as the Management Agency Agreement between the SWRCB and the Department of Pesticide Regulation, the NPS Management Plan, and existing authorities including the Porter-Cologne Water Quality Control Act and Clean Water Act.

Candidate Toxic Hot Spot:

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

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

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

2. The water or sediment exhibits toxicity associated with toxic pollutants that is significantly different from the toxicity observed at reference sites (*i.e.*, when compared to the lower confidence interval of the reference envelope or, in the absence of a reference envelope, is significantly toxic as compared to controls (using a t-test) and the response is less than 90 percent of the minimum significant difference for each specific test organism), based on toxicity tests acceptable to the SWRCB or the RWQCBs.

ELLICOTT SLOUGH NWR

c/o Don Edwards San Francisco Bay NWR Complex
P.O. Box 524
Newark, California 94560-0524
(510) 792-0222

DIRECTIONS
Located 4 miles west of Watsonville on San Andreas Road.

PRIMARY WILDLIFE
The refuge and adjacent State of California Ecological Reserve were established to preserve the habitat of the endangered Santa Cruz long-toed salamander.

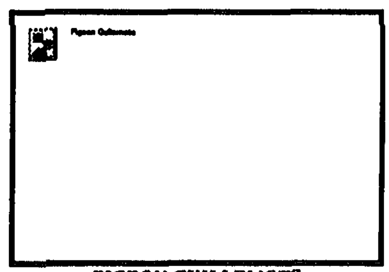
HABITAT

- 139 acres of coastal uplands.
- Adjacent Ecological Reserve contains a vernal pond.

RECREATION AND EDUCATION
Refuge closed to public access

FARALLON NWR

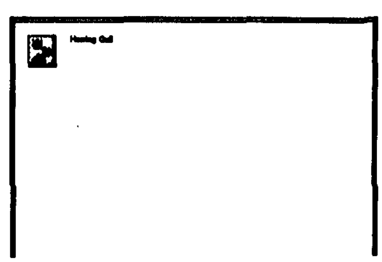
c/o Don Edwards San Francisco Bay NWR Complex
P.O. Box 524
Newark, California 94560-0524
(510) 792-0222



PIGEON GUILLEMOTS
-JEFF FOOTE

DIRECTIONS
Islands located approximately 30 miles offshore of San Francisco in the Pacific Ocean. The refuge is not open to public access.

PRIMARY WILDLIFE



- Largest seabird breeding colony on the Pacific coast south of Alaska, hosting more than 300,000 birds each summer. Breeding species include western gull, Cassin's auklet, rhinoceros auklet, common murre, Brandt's cormorant, double-crested cormorant, pelagic cormorant, pigeon guillemot, ashy storm petrel, Leach's storm petrel, tufted puffin, and American black oystercatcher.
- Stellar sea lions and northern elephant seals breed and pup on the

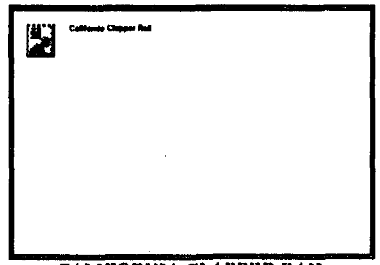
To determine whether toxicity exists, recurrent measurements (at least two separate sampling dates) should demonstrate an effect. Appropriate reference and control measures must be included in the toxicity testing. The methods acceptable to and used by the BPTCP may include some toxicity test protocols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

3. The tissue toxic pollutant levels of organisms collected from the site exceed levels established by the United States Food and Drug Administration (FDA) for the protection of human health, or the National Academy of Sciences (NAS) for the protection of human health or wildlife. When a health advisory against the consumption of edible resident non-migratory organisms has been issued by the Office of Environmental Health Hazard Assessment (OEHHA) or Department of Health Services (DHS), on a site or water body, the site or water body is automatically classified as a "candidate" toxic hot spot if the chemical contaminant is associated with sediment or water at the site or water body.

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

   <u>Shellfish:</u> Except for existing information, each sampling episode should include a minimum of three replicates. The value of interest is the average value of the three replicates. Each replicate should be comprised of at least 15 individuals. For existing State Mussel Watch information related to organic pollutants, a single

(510) 792-0222, Visitor Center and Refuge headquarters
(408) 262-5513, Environmental Education Center



CALIFORNIA CLAPPER RAIL
-MIKE BOYLAN

DIRECTIONS

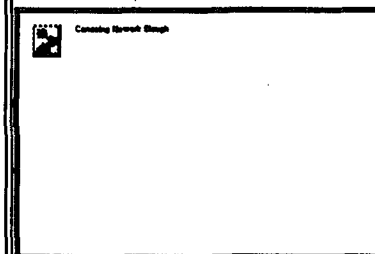
The visitor center and refuge headquarters are located near the Dumbarton Bridge toll plaza. Take the Thornton Avenue exit from Highway 84 and follow the signs. The Environmental Education Center is located in the Alviso District of San Jose; from Highway 237, go north on Zanker Road, then west on Grand Boulevard.

PRIMARY WILDLIFE

•

Five endangered species: California brown pelican, California clapper rail, California least tern, peregrine falcon, and salt marsh harvest mouse.

- Migratory waterfowl and shorebirds.
- Harbor seals.
- Saltwater fishes including striped bass, surfperch, sturgeon, starry flounder, leopard shark, topsmelt, and anchovy.



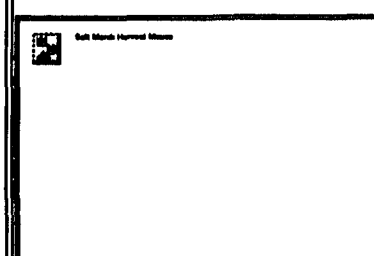
CANOEING NEWARK SLOUGH
-DON WEDEN

HABITAT

More than 18,000 acres of estuarine habitat, including uplands, open water, mudflats, salt ponds, and salt marshes.

RECREATION AND EDUCATION

- Visitor Center in Fremont and Environmental Education Center in Alviso provide interpretive programs, bookstore, educational programs, and special events
- Wildlife observation, study, and photography
- Hiking and biking trails
- Fishing from piers and shore
- Waterfowl hunting
- Volunteer program
- Quarterly newsletter
- San Francisco Bay Wildlife Society, a nonprofit cooperative association.



SALT MARSH HARVEST MOUSE
-SHELLHAMMER

Visit the Don Edwards San Francisco Bay NWR website composite sample (20-100 individuals), may be used instead of the replicate measures. When recurrent measurements exceed one of the levels referred to above, the site is considered a candidate toxic hot spot.

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

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

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

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

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

Abnormal Development: Abnormal development can be determined using measures of physical or behavioral disorders or

Willows, California 95988
(530) 934-2801

DIRECTIONS
Exit Maxwell Rd. off Interstate 5 approximately 9 miles north of Williams. Continue east to Four Mile Rd. which parallels the west refuge boundary.

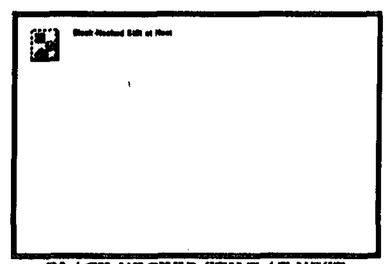
PRIMARY WILDLIFE

- Waterfowl present from September through March. Hundreds of thousands of ducks and geese from November through January.
- Numerous birds and mammals present year round.

HABITAT
5,634 acres comprised of seasonal marsh, permanent ponds, watergrass, and uplands.
RECREATION AND EDUCATION

- Wildlife observation, study, and photography from perimeter roads
- Waterfowl and pheasant hunting

DON EDWARD SAN FRANCISCO BAY NWR COMPLEX (Antioch Dunes, Castle Rock, Don Edwards San Francisco Bay, Ellicott Slough, Farallon, Marin Islands, Salinas River, and San Pablo Bay NWRs)



BLACK-NECKED STILT AT NEST
-THOMAS ROUNDTREE

Mailing address:
P.O. Box 524
Newark, California 94560-0524
(510) 792-0222

DON EDWARDS SAN FRANCISCO BAY NWR
1 Marshlands Road (across from the old Dumbarton Bridge toll plaza)
Fremont, California

aberrations. Evidence that the disorder can be caused by toxic pollutants, in whole or in part, must be available.

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

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

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

Known Toxic Hot Spot:

A site meeting any one or more of the conditions necessary for the designation of a "candidate" toxic hot spot that has gone through a full SWRCB and RWQCB hearing process, is considered to be a "known" toxic hot spot. A site will be considered a "candidate" toxic hot spot until approved by the SWRCB as a "known" toxic hot spot in the consolidated toxic hot spot cleanup plan.

III. STATEWIDE MONITORING APPROACH

As part of the legislative mandates, the BPTCP has implemented regional monitoring programs to identify toxic hot spots (Water Code Section 13392.5). The BPTCP has pioneered the use of effects-based measurements of impacts in California's enclosed bays and estuaries. The Program has used a two-step process to identify toxic hot spots. In miles, turn left on A-17, drive 1 mile to Balls Ferry Bridge on Sacramento River, turn right, drive 1-1/2 miles then turn left at the next road and drive to the station entrance sign.

PRIMARY FISH

- Chinook salmon and steelhead which migrate up the Sacramento River from the Pacific Ocean.
- 20 million chinook salmon and about 600,000 steelhead are reared annually.

RECREATION AND EDUCATION
The hatchery is open daily from 7:30 a.m. to dusk

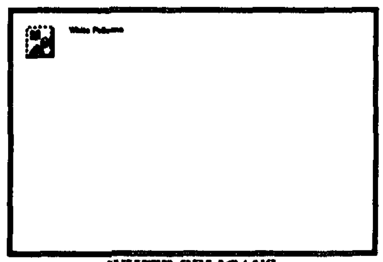
COLUSA NWR

c/o Sacramento NWR
752 County Road 99W
Willows, California 95988
(530) 934-2801

DIRECTIONS
From Colusa, drive a half mile west on Highway 20 to refuge entrance.

PRIMARY WILDLIFE

- Waterfowl present September through March. Peak populations occur during December and January.
- Numerous birds and mammals present year round.



WHITE PELICANS
-D. BOONE

HABITAT
4,040 acres comprised of seasonal marsh, permanent ponds, watergrass, and uplands.

RECREATION AND EDUCATION

- Wildlife observation and photography
- 3-mile graveled automobile tour meanders through freshwater wetlands.
- 1-mile Discovery Walk offers a place to stroll along a dense riparian slough and a marsh.
- Self-guiding autotour and walking trail open sunrise to sunset, year round
- Interpretive panels and pamphlets at kiosk
- Waterfowl and pheasant hunting

DELEVAN NWR

c/o Sacramento NWR Complex
752 Country Road 99W

most cases, the first step was to screen sites using toxicity tests. In the second step, the highest priority sites with observed toxicity were retested to confirm the effects. This section presents descriptions of the BPTCP monitoring objectives and sampling strategy.

Monitoring Program Objectives

The four objectives of BPTCP regional monitoring are:

1. Identify locations in enclosed bays, estuaries, or the ocean that are potential or candidate toxic hot spots. Potential toxic hot spots are defined as suspect sites with existing information indicating possible impairment but without sufficient information to be classified further as a candidate toxic hot spot.

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

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

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

Sampling Strategy

Screening Sites and Confirming Toxic Hot Spots

In order to identify toxic hot spots in the sediment a two step process was used. Both steps are designed around an approach with three measures (sediment quality triad analysis) plus an optional bioaccumulation component. The triad analysis consists of toxicity testing, benthic community analysis, and chemical analysis for metals and organic chemicals.

SPECIAL NOTES

- The lake is regulated by a Bureau of Reclamation dam to provide irrigation water to the Tulelake area.
- Contact Klamath Basin NWRs for public use regulations.

COACHELLA VALLEY NWR

c/o Sonny Bono Salton Sea NWR Complex
906 West Sinclair Road
Calipatria, California 92233-9744
(760) 348-5278

DIRECTIONS
From Palm Springs follow Ramon Road approximately 10 miles, then north on Palm Canyon Drive for approximately 1 mile to preserve visitor station. From Indio go west on Interstate 10, take Washington exit, follow Washington approximately 2 miles to Palm Canyon Drive, follow signs to visitor station.

PRIMARY WILDLIFE
Threatened Coachella Valley fringe-toed lizard and flat-tailed horned lizard (candidate species for federal listing).

HABITAT
13,000 acres consisting of palm oasis woodlands, perennial desert pools, and blow-sand habitat.

RECREATION AND EDUCATION

- Wildlife observation, study and photography
- Horseback riding limited to specified trails
- Hiking along designated trails

SPECIAL NOTE
The area has the state's second largest grove of native fan palms and also has the Coachella milk-vetch, a species of special concern.

COLEMAN NFH

24411 Coleman Fish Hatchery Road
Anderson, California 96007
(530) 365-8622

DIRECTIONS
The hatchery is located beside Battle Creek, about 11 miles southeast of Anderson, California. Turn east off Interstate 5 at Deschutes Road, then drive 2 miles, turn right onto Balls Ferry Road, drive 3

The first step is a screening phase that consists of measurements using toxicity tests or benthic community analysis or chemical tests or bioaccumulation data to provide sufficient information to list a site as a potential toxic hot spot or a site of concern. Sediment grain size, total organic carbon (TOC), NH_3 and H_2S concentrations are measured to differentiate pollutant effects found in screening tests from natural factors.

A positive result or an effect in any of the triad tests would trigger the confirmation step (depending on available funding). The confirmation phase consists of performing all components of the sediment quality triad: toxicity, benthic community analysis, and chemical analysis, on the previously sampled site of concern. Assessment of benthic community structure may have not been completed if there was difficulty in measuring or interpreting the information for a water body.

Region-specific Modifications of the Monitoring Approach

In the San Francisco Bay Region over 120 reports were reviewed to determine if there was evidence that a site qualified as a potential toxic hot spot. In addition to this list, sites were identified where there were potential sources of contaminants. After this review, 127 stations were selected for screening using two toxicity tests: the 10 day amphipod test measuring survival and the urchin larvae test measuring normal development. In order to qualify as a toxic hot spot under the aquatic life definition, a site must have recurrent toxicity, therefore, toxicity tests were always conducted during both the screening and confirmation phases of sampling. Mercury and PCB concentrations were analyzed at each station during screening to identify sites that may be sources of these contaminants to fish. Mercury and PCBs were measured because high concentrations of these contaminants formed the basis of an advisory on consuming fish from San Francisco Bay (see Cleanup Plan A). Full chemical analysis was conducted on sediment from sites that exhibited toxicity. Confirmation sampling was conducted on sites that exhibited toxicity in the screening and had elevated levels of contaminants.

DIRECTIONS
Castle Rock is an island located a half mile offshore of Crescent City, California. The refuge is not open to public access.

PRIMARY WILDLIFE

- Established in 1981 to protect an important migration staging area of the threatened Aleutian Canada goose. Over 21,000 Aleutian Canada geese roost on the island, flying off at dawn to feed in adjacent agricultural lands.
- Second largest seabird breeding colony in California.
- Haul-out for a variety of marine mammals, including California sea lion, Stellar sea lion and northern elephant seal.

HABITAT
A 14-acre offshore rock with steep cliffs and sparse vegetation.

RECREATION AND EDUCATION
Castle Rock is not open to the public. Wildlife can be observed from the mainland shore.

CLEAR LAKE NWR

c/o Klamath Basin NWR Complex
Route 1, Box 74
Tulelake, California 96134
(530) 667-2231

DIRECTIONS
Located about 15 miles southeast of Tulelake, California. Turn east off Highway 139, 23 miles south of Tulelake, then drive 9 miles northeast on Clear Lake Reservoir Road. Access to the north side of the refuge is from Kowoloski Road, 4 miles south of Malin, Oregon. Roads are impassable during wet weather.

PRIMARY WILDLIFE

- White pelicans, cormorants, and other colonial nesting birds nest on small islands.
- Pronghorn antelope and sage grouse live in the dry grasslands.

HABITAT
The 33,440-acre refuge includes a 23,770-acre lake surrounded by dry grasslands.

RECREATION AND EDUCATION

- Refuge closed to visitor access from spring through fall to protect nesting colonial and upland birds from disturbance
- Wildlife observation, study, and photography
- Waterfowl hunting
- Antelope hunting

In San Francisco Bay benthic community analyses have been difficult to interpret due to fluctuations in salinity, grain size and total organic carbon. Seasonal cycles of many organisms in the benthic community are also not well understood. In addition, non-indigenous organisms are continually being introduced and taking over the niches of established species. Due to these uncertainties, in this Region, benthic organisms were collected and/or bioaccumulation tests were conducted and /or Toxicity Identification Evaluations (TIEs) were performed at stations that went through the confirmation phase to form the third leg of the triad. Benthic community analyses were most often conducted when a gradient was sampled at a site or when there was such high toxicity that benthic impacts were thought to be probable.

Surficial sediments were collected in this program to evaluate the effects of the bioavailable layer of sediment on aquatic organisms. Recurrent samples were collected for toxicity tests to determine if this layer remained toxic over time. Due to the dynamic nature of the sediments in this Region, sediment samples were collected to a depth of 5 cm., the same depth that is sampled in the San Francisco Estuary Regional Monitoring Program. A description of methods and results of screening and confirmation studies in San Francisco Bay are included in Sediment Quality and Biological Effects in San Francisco Bay (Hunt et al., 1998).

Special Studies Performed in the Region

Several other studies were conducted through the BPTCP in this region in addition to the screening and confirmation of toxic hot spots. In 1991 and 1992, the Pilot Regional Monitoring Program (PRMP) was conducted. The main purpose of this study was to develop the design and methods for an ongoing regional monitoring program. In 1993, the San Francisco Estuary Regional Monitoring Program (RMP) was established which is administered through the San Francisco Estuary Institute (SFEI) and funded by discharger groups. Through this program, water column chemistry and toxicity, sediment chemistry and toxicity and bioaccumulation are measured throughout the estuary several times a year. Special studies are also conducted in order to gain a better understanding of contaminants in the estuary. The PRMP also

BUTTE SINK WMA

c/o Sacramento NWR Complex
752 County Road 99W
Willows, California 95988
(530) 934-2801

SPECIAL NOTE
The Fish and Wildlife Service has acquired easements to protect habitat. Within the 18,000-acre management area, conservation easements have been purchased on 11,000 acres, requiring landowners to maintain wetland marshes and habitats on their property in perpetuity.

NO PUBLIC USE
The public is not permitted on this area as the Service did not acquire public use rights. This area was established primarily to protect wintering areas for waterfowl.

CALIFORNIA-NEVADA FISH HEALTH CENTER

24411 Coleman Hatchery Road
Anderson, CA 96007
(530)365-4271
(530)365-7150 (fax)

DIRECTIONS
Take the Anderson exit off I-5 to Deschutes Rd. where you will see Fish and Wildlife Service signs for the hatchery; travel 3 miles east and turn south on Ball's Ferry Road; travel 3 miles and turn east on Ash Creek Road; cross over the Sacramento River and turn right, going south, on Grover Road. The road to the hatchery entrance is about 2 miles on the left after a sharp "S" turn (across the Grover Ranch barn). The hatchery is 2 miles down the road on the right-hand side of the road. The laboratory is on the NW corner of the hatchery grounds in a converted residence.

PRIMARY FUNCTION
Diagnostic and inspection services for federal, tribal, and some state fish facilities in California and Nevada. Health and physiological monitoring research of salmonids.

RECREATION AND EDUCATION
The center is open Monday through Friday, 7:30 a.m. - 4:00 p.m. Please call ahead to arrange visits.

CASTLE ROCK NWR

c/o Humboldt Bay NWR
1020 Ranch Road
Loleta, California 95551
(707) 733-5406
See also Humboldt Bay NWR

had a screening component where sediment chemistry and toxicity were measured in wetlands throughout the Bay. The third component was a gradient study, conducted in Castro Cove, to develop methods for the BPTCP and the RMP. The results of these studies are contained in San Francisco Estuary Pilot Regional Monitoring Program: Sediment Studies (Flegal et al., 1994).

In 1994, a study was conducted under the BPTCP to measure contaminant levels in fish in San Francisco Bay. This was the first study conducted in the Bay to determine if concentrations of contaminants in fish being consumed by the public were elevated and if a health advisory was necessary. Results of the study indicated that six chemicals or chemical groups exceeded screening levels developed for the study based on U.S. EPA guidance (U.S. EPA , 1993, 1995). These chemicals were mercury, PCBs, DDT, dieldrin, chlordane and dioxins. Results of the study are contained in the report Contaminant Levels in Fish Tissue from San Francisco Bay (SFBRWQCB, 1995). As a result of the study, the Office of Environmental Health Hazard Assessment (OEHHA) issued an interim health advisory on consuming fish caught in San Francisco Bay and the Delta. Regular monitoring of contaminants in fish, studies on consumption patterns and public outreach and education are currently being performed in this Region (see Cleanup Plan A).

In 1994 and 1995, a study was conducted to identify sediment reference sites in San Francisco Bay, identify toxicity test methods that may be more appropriate for the Bay and to develop a statistical method to distinguish between a toxic site and ambient conditions. This study was important because sediment toxicity was being observed, using standard toxicological and statistical methods, at sites throughout the Bay that were selected to represent ambient conditions. Since the purpose of the BPTCP was to identify toxic hot spots, new methods needed to be developed that could distinguish between ambient conditions and sites potentially needing cleanup. This study identified five reference sites in the Bay (2 in San Pablo Bay, 1 in the Central Bay and 2 in the South Bay), evaluated nine different toxicity tests for use in toxic hot spot screening and confirmation studies and developed a statistical method to

Highway 33 west to Klipstein Canyon Road. Klipstein Canyon Road traverses the refuge, ending at Cerro Noroeste Road. Turn right to return to Highway 33 or turn left following Cerro Noroeste Road to enjoy a scenic overlook of the refuge and the San Joaquin Valley. Watch for free flying condors foraging or passing along the high ridgelines in route to other foraging and roosting areas.

SPECIAL NOTE
Currently one of the focal points for research activities toward recovery of the California condor.

BLUE RIDGE NWR

c/o Kern NWR Complex
P.O. Box 670
Delano, California 93216
(805) 725-2767

PRIMARY WILDLIFE
Area is a traditional summer roosting site for the endangered California condor.

HABITAT
897 acres of rugged mountains, rock outcroppings, chaparral and coniferous trees.

RECREATION AND EDUCATION
The refuge is closed to public access due to the sensitivity of California condors and its isolation and difficulty in access.

SPECIAL NOTE
The refuge is managed as part of a Wildlife Habitat Area to maintain and improve habitat for the California condor through a cooperative agreement with the U.S. Forest Service, Bureau of Land Management, and California Department of Fish and Game.

BUTTE SINK NWR

c/o Sacramento NWR Complex
752 County Road 99W
Willows, California 95988
(530) 934-2801

SPECIAL NOTE
The Butte Sink NWR was established in 1980 as a wildlife sanctuary to protect wetlands for wintering waterfowl. This refuge is comprised of 733 acres.

NO PUBLIC USE
The U.S. Fish and Wildlife Service does not permit public use on this refuge.

distinguish between ambient conditions and sites potentially needing cleanup. The results of this study are in the report Evaluation and Use of Sediment Reference Sites and Toxicity Tests in San Francisco Bay (Hunt et al., 1998). Once reference sites were identified, toxicity tests were chosen and the statistical method was developed, screening and confirmation studies began.

Region Specific Issues Regarding Cleanup of Toxic Hot Spots

Local regulations in the Bay area will require approval of any dredging or fill within San Francisco Bay by a local agency, the Bay Conservation and Development Commission (BCDC). This has been problematic on previous projects that had attempted to address some specific areas of contamination within bay sediments through consolidation and capping. An additional level of coordination and review will be required for all cleanup plans for toxic hot spots within San Francisco Bay that include dredging or capping, even with clean material. This may result in delays in implementation or the inability to implement the most cost effective remedy for some sites.

IV. STATEWIDE CRITERIA FOR RANKING TOXIC HOT SPOTS

A value for each criterion described below shall be developed provided appropriate information exists or estimates can be made. Any criterion for which no information exists shall be assigned a value of "No Action". The RWQCB shall create a matrix of the scores of the ranking criteria. The RWQCBs shall determine which sites are "high" priority based on the five general criteria (below) keeping in mind the value of the waterbody. The RWQCBs shall provide the justification or reason a rank was assigned if the value is an estimate based on best professional judgment.

Human Health Impacts

Human Health Advisory issued for consumption of non-migratory aquatic life from the site (assign a "High"); Tissue residues in aquatic

Newark, California 94560-0524
(510) 792-0222

DIRECTIONS
The refuge includes two separate tracts of land, located along Wilbur Avenue and Fulton Shipyard Road, just west of the city of Antioch, California.

PRIMARY WILDLIFE

- Protects critical habitat for three endangered species: Lange's metalmark butterfly, Contra Costa wallflower, and Antioch Dunes evening primrose.
- Isolated dunes ecosystem with a unique assemblage of plants, insects, and reptiles.

HABITAT

- 55 acres of remnant and restored sand dunes along the San Joaquin River.

RECREATION AND EDUCATION
In order to protect the endangered species and their habitat, the refuge is closed to the public.

BEAR VALLEY NWR

see Klamath Basin NWR Complex

BITTER CREEK NWR

c/o Hopper Mountain NWR Complex
P.O. Box 5839
Ventura, California 93005
(805) 644-5185

PRIMARY WILDLIFE
Traditional feeding and roosting habitat for the California condor. Also provides habitat for the San Joaquin kit fox, golden eagle, Southern bald eagle, and American peregrine falcon.

HABITAT
13,656 acres consisting of 12,656 acres of annual grasslands and 1,000 acres of juniper and scrub oak with grass understory.

RECREATION AND EDUCATION
The refuge is closed to visitors, but it can be viewed from county roads. From Maricopa, take

organisms exceed FDA/DHS action level and U.S. EPA screening levels ("Moderate").

Aquatic Life Impacts

For aquatic life, site ranking shall be based on an analysis of the substantial information available. The measures that shall be considered are: sediment chemistry, sediment toxicity, biological field assessments (including benthic community analysis), water toxicity, toxicity identification evaluations (TIEs), and bioaccumulation.

Stations with hits in any two of the biological measures if associated with high chemistry, are assigned a "High" priority. A hit in one of the measures associated with high chemistry is assigned "moderate", and high sediment or water chemistry only shall be assigned "low". In analyzing the substantial information available, RWQCBs should take into consideration that impacts related to biological field assessments (including benthic community structure) are of more importance than other measures of impact.

Water Quality Objectives[1]:

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

Water quality objective or water quality criterion: Exceeded regularly (assign a "High" priority), occasionally exceeded ("Moderate"), infrequently exceeded ("Low").

Areal Extent of Toxic Hot Spot

Select one of the following values: More than 10 acres, 1 to 10 acres, less than 1 acre.

1. Water quality objectives to be used are found in Regional Water Quality Control Board Basin Plans or the California Ocean Plan (depending on which plan applies to the water body being addressed). Where a Basin Plan contains a more stringent value than the statewide plan, the regional water quality objective will be used.

National Wildlife Refuge Wildlife Management Area National Wildlife Range Waterfowl Production Area National Wildlife Facility	National Fish Hatchery National Fish Facility

Abbreviations Used:
NWR = national wildlife refuge
NFH = national fish hatchery
WMA = wildlife management area
WPA = waterfowl production area

You can click on the map to go to a specific location.

ANTIOCH DUNES NWR

c/o Don Edwards San Francisco Bay NWR Complex
P.O. Box 524

Natural Remediation Potential

Select one of the following values: Site is unlikely to improve without intervention ("High"), site may or may not improve without intervention ("Moderate"), site is likely to improve without intervention ("Low").

Overall Ranking

The RWQCB shall list the overall ranking for the candidate toxic hot spot. Based on the interpretation and analysis of the previous ranking criteria, ranks shall be established by the RWQCBs as "high", "moderate" or "low".

V. 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 waterbodies are listed as impaired under section 303(d) of the Clean Water Act. Currently, approximately 500 waterbodies 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

Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6	
tal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Coliform

Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6	
tal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Colifor	otal Colifor	ecal Coliform

Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6	
TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC

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 (see p. 12), 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

North Coast Sampling Results 05/03/2001

Pillar Point #7	Fitzgerald Marine Reserv	Montara Beach	Linda Mar Beach #5	Linda Mar Beach #6	Rockaway Beach	Sharp Park Beach #3	Sharp Park Beach #6
FS	FS	FS	FS	FS	FS	FS	FS
	30	10				10	10
20			20	10	10		
10	220	10	20			10	10
				10	10		
20	25	10	15	10	10	10	10
10	15	10	20	10	10	10	10
20	180		20	10	10		
		10				10	10
	10						
30	85	10				10	10
			10	10	10		
45	140	10				10	20
			25	10	10		
20	20	10	25	10	10	10	10
	110	10	30	10	10	10	10
30							
30	350	10	5	10	10	10	25
	75	10				10	10
20			35	45	30		
Pillar Point #7	Fitzgerald Marine Reserv	Montara Beach	Linda Mar Beach #5	Linda Mar Beach #6	Rockaway Beach	Sharp Park Beach #3	Sharp Park Beach #6
FS	FS	FS	FS	FS	FS	FS	FS
		10				10	10
25	10		25	10	10		
	40	10	35	10	10	20	20
25							
75	115	10				10	10
			12	4	2		
	10						
		10	15	10	10	10	10
55	10						
	10	10	20	10	10	10	10
10							
			15	10	10		
20	20	10				15	
							10
10	180	10	10	10	15	10	20
	15						
10	20	10		10	45	10	10
					15		
25	15	10				15	10
			10	10	25		
	10						
10		10	20	15	10	10	10
35	20	10				10	10
			10	25	10		
10	10	10	25	10	10	10	10
35	20	10	110	10	20	10	10
			180				
	10	20	15	10	10	20	10
25							
10	10	10				10	10
			10	10	20		

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.

50	50	10	10	20	20							
10	10	10	10	790	170							
80	80	50	50	170	130							
50	50	20	20	80	50							
10	10	130	80	10	10							
170	170	130	80	230	80							
130	130	790	130	110	80							
330	230	1100	700	230	130							
2400	2400	230	230	10	10							
490	110	330	230	140	140							
330	130	130	130	230	130							
50	50	170	110	230	130							
2400	1300	330	170	170	170							
130	130	1100	490	490	170							
Behind Rec Center		**Behind Apt Bldgs**		**Aquatic park**		**Coyote Point**		**Leo J. Ryan Center**		**Lakeside Dr.**		
Total	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	
130	130	80	80	80	80							
10	10	210	130	20	10							
10	10	10	10	10	10							
130	80	330	130	130	50							
790	170	790	170	230	80							
230	130	230	230	2400	2400							
80	80	10	10	10	10							
490	130	330	130	230	130							
50	50	10	10	40	20							
10	10	10	10	80	50							
10	10	220	220	330	170							
3500	2400	3500	2400	2400	2400							
1100	700	1700	1300	2400	790							
1100	330	1300	490	330	170							
790	790	490	490	2400	2400							
2400	2400	2400	2400	2400	2400							
24000	5400	24000	9200	24000	9200							
9200	2400	2200	1100	1700	1100							
5400	2400	9200	3500	9200	2400							
700	330	1700	700	1300	330							
								20	20			

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

Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6		
FS		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		
		10		10		25		10		15		10		10		
10																
10		15				10		15		10						
				10								10		10		
10		10		10		15		10		10		10		10		
10				10								10		10		
		20				15		10		25						
10		10		20		10		10		10		10		10		
						10		10		10						
10		10		10								10		10		
240		10		10								25		10		
20		10		10		20		20		10		10		10		
10		10		10		10		15		25		10		10		

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

Waterbody 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

Marina Lagoon Sampling Results

05/03/2001

Behind Rec Center		Behind Apt Bldgs		Aquatic park		Coyote Point		Leo J. Ryan Center		Lakeside Dr.		
Total	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	
330	80	2400	2400	3500	1700							
80	80	230	130	170	70							
3500	3500	16000	5400	790	490							
5400	3500	3500	3500	110	110							
110	70	2400	330	3500	3500							
700	170	700	310	10	10							
230	80	2400	2400	230	130							
1700	1100	170	110	10	10							
16000	5400	3500	1700	16000	1700							
790	490	16000	9200	490	80							
3500	2400	24000	3300	9200	9200							
130	20	230	230	80	20							
80	10	490	20	70	20							
10	10	3300	2400	230	130							
110	20	24000	24000	130	80							
1100	460	790	790	790	490							
9200	9200	5400	700	1700	330							
24000	16000	24000	24000	24000	9200							
1400	1100	1100	460	5400	1700							
490	330	1300	700	1700	1700							
790	490	16000	170	130	80							
700	700	2400	790	330	80							
1700	490	1100	310	3500	3500							
5400	3500	1300	790	1700	1700							
490	230	490	130	1800	840							
1700	700	2400	1300	3500	2400							
790	490	2400	1300	5400	5400							
790	220	3500	790	16000	9200							
790	490	16000	16000	5400	3500							
950	700	9200	2400	1100	310							
790	490	700	330	330	230							
220	170	700	490	40	40							
70	40	10	10	50	10							
130	130	40	40	50	50							
230	130	10	10	20	20							

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

Waterbody 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

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	Gazos Creek Access		Bean Hollow Creek		Bean Hollow Beach		Pescadero Beach		Pomponio Creek		Pomponio Beach		San Gregorio Creek		San Gregorio Beach		Francis Beach		Venice Beach		Roosevelt Beach			
	Total	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*		
9/29/98			50	50	10	10	10	10	130	80	20	10	790	330	10	10	10	10			10	10		
10/6/98																	10	10			10	10		
10/13/98			80	50	10	10	10	10	50	50	10	10	210	170	10	10	10	10			20	20		
10/20/98																	10	10			10	10		
10/27/98			130	20	10	10	10	10	230	130	10	10	230	130	10	10	10	10			10	10		
11/3/98																	10	10			10	10		
11/10/98																	20	10			20	20		
11/17/98																	10	10			20	20		
12/1/98																	10	10			10	10		
12/8/98																	10	10			10	10		
12/15/98																	80	20			10	10		
12/22/98																	10	10			10	10		
12/29/98																	10	10			10	10		
1/5/99																	10	10			10	10		
1/12/99																	10	10			10	10		
1/19/99																	10	10			10	10		
1/27/99																	10	10			10	10		
2/2/99																	70	20			10	10		
2/9/99																	10	10			10	10		
2/16/99																	10	10			10	10		
2/23/99																	10	10			10	10		
3/2/999																	80	80			10	10		
3/9/99																	10	10			10	10		
3/16/99																	10	10			10	10		
3/23/99																	10	10			10	10		
3/30/99																	10	10			10	10		
4/7/99			10	10	10	10	10	10	2400	790	230	80	950	170	230	80	10	10			10	10		
4/14/99			10	10	10	10	10	10	230	230	10	10	230	230	10	10	70	20			10	10		
4/21/99			80	20	10	10	10	10	24000	24000	50	10	700	80	80	20	10	10			10	10		
4/28/99			10	10	10	10	10	10	2400	2400	10	10	110	80	10	10	50	20			20	20		
5/5/99			10	10	10	10	10	10	1400	1400	10	10	230	130	10	10	10	10			10	10		
5/12/99			20	10	10	10	10	10	1300	330	10	10	230	80	10	10	10	10			10	10		
5/19/99			10	10	10	10	10	10	330	230	10	10	230	80	10	10	50	20			10	10		
5/26/99			10	10	10	10	10	10	790	490	10	10	170	130	10	10	10	10			10	10		
6/1/99																	10	10			10	10		
6/9/99			10	10	10	10	10	10	80	80	10	10	230	50	10	10	10	10			10	10		
6/16/99			10	10	10	10	10	10	130	80	10	10	130	130	10	10	10	10			10	10		
6/23/99			10	10	10	10	10	10	80	80	80	20	10	10	10	10	10	10			10	10		
6/28/99			10	10	10	10	10	10	80	50	10	10	330	130	10	10	10	10			10	10		
7/6/99			10	10	10	10	10	10	10	10	10	10	790	170	10	10	10	10			10	10		
7/12/99			10	10	10	10	130	80	330	230	10	10	170	170	10	10	10	10			10	10		
7/19/99			10	10	10	10	50	50	10	10	10	10	80	50	10	10	10	10			10	10		
7/26/99			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10			10	10		
8/2/99			10	10	10	10	10	10	10	10	10	10	330	170	10	10	10	10			10	10		
8/9/99			10	10	10	10	10	10	10	10	10	10	330	130	10	10	10	10			10	10		
8/16/99			10	10	10	10	10	10	10	10	10	10	230	80	10	10	10	10			10	10		
8/23/99	790	220	10	10	10	10	10	10	10	10	10	10	790	790	10	10	10	10			50	20		
8/31/99			10	10	10	10	10	10	10	10	10	10	230	230	10	10	10	10			10	10		
9/8/99	70	50	10	10	10	10	10	10	20	20	10	10	1100	210	10	10	10	10	10	10	10	10		
9/13/99	10	10	10	10	10	10	10	10	80	50	10	10	490	170	10	10	10	10	10	10	10	10		
9/20/99	10	10	10	10	10	10	50	50	40	40	10	10	460	170	10	10	10	10	10	10	10	10		
9/27/99	60	20	40	40	10	10	10	10	790	170	10	10	2400	790	10	10	10	10	330	170	10	10		
10/4/99	790	170	20	20	10	10	10	10	330	130	50	50	230	80	10	10	10	10	10	10	10	10		
10/12/99	10	10	80	20	10	10	10	10	790	130	10	10	230	130	80	80	10	10	10	10	10	10		
10/20/99	10	10	10	10	10	10	10	10	10	10	10	10	490	140	10	10	10	10	220	170	10	10		
10/26/99	230	230	10	10	10	10	130	50	230	10	230	50	230	50	10	10	10	10	130	130	10	10		
	Gazos Creek Access		Bean Hollow Creek		Bean Hollow Beach		Pescadero Beach		Pomponio Creek		Pomponio Beach		San Gregorio Creek		San Gregorio Beach		Francis Beach		Venice Beach		Roosevelt Beach			
	Total	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*	*Total*	*Fecal*		
11/2/99	170	130	50	10	10	10	10	10	40	40	10	10	790	130	10	10	10	10	330	170	10	10		
11/17/99	230	80	50	50	10	10	10	10	2400	790	230	80	230	130	10	10	130	130	790	130	130	130		
12/7/99	80	80	-	-	10	10	10	10	790	170	10	10	490	130	50	50	130	130	490	170	10	10		
12/21/99	10	10	-	-	10	10	10	10	10	10	10	10	80	80	10	10	10	10	790	230	50	50		
1/4/99	10	10	-	-	10	10	10	10	10	10	10	10	130	130	10	10	10	10	230 | 1300	230 | 790	10	10		
1/19/00	490	140	-	-	10	10	70	50	2400	790	490	140	790	170	700	130	10	10	790	170	330	80		
2/1/00	140	110	-	-	10	10	130	130	2400	790	490	170	230	80	10	10	10	10	330	80	490	130		
2/15/00	80	50	790	230	80	50	700	170	1100	460	80	50	490	140	130	130	790	170	220	170	170	110		
2/29/00	230	130	790	330	330	170	330	110	3500	1100	130	50	2800	1400	2400	790	80	50	790	330	170	110		
3/6/00																	10	10	80	80	10	10		
3/14/00	20	10	330	20	20	20	10	10	330	170	80	50	80	80	10	10	130	130	790	170	10	10		
3/20/00																	110	70	50	10	20	20		
3/28/00	10	10	10	10	10	10	10	10	1100	310	10	10	310	170	10	10	50	20	230	130	10	10		
4/4/00	10	10	10	10	10	10	10	10	230	130	10	10	490	170	10	10	10	10	50	10	10	10		
4/11/00	50	50	130	80	20	10	10	10	1700	790	70	20	790	170	10	10	10	10	270	130	10	10		
4/18/00	10	10	130	130	10	10	10	10	230	130	10	10	490	170	10	10	10	10	80	10	700	170		
4/25/00	10	10	20	10	10	10	10	10	330	130	10	10	80	50	10	10	10	10	130	10	10	10		
5/2/00	10	10	230	20	10	10	10	10	490	130	10	10	490	140	10	10	10	10	10	10	10	10		
5/9/00	130	80	700	140	50	20	10	10	1100	460	10	10	790	330	10	10	10	10	2400	2400	490	170		
5/15/00																	10	10	10	10	10	10		

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5/16/00	50	50	10	10	10	10	10	10	460	460	10	10	460	330	10	10								
5/22/00																	50	50	50	20	10	10		
5/23/00	490	80	40	40	10	10	10	10	1400	790	10	10	490	140	10	10								
5/30/00	10	10	10	10	10	10	10	10	230	130	10	10	330	110	10	10	10	10	10	10	10	10		
6/5/00	80	20	20	20	20	20	20	20	790	130	20	20	220	170	20	20	20	20	20	20	20	20		
	Gazos Creek Access		Bean Hollow Creek		Bean Hollow Beach		Pescadero Beach		Pomponio Creek		Pomponio Beach		San Gregorio Creek		San Gregorio Beach		Francis Beach		Venice Beach		Roosevelt Beach			
	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC		
6/12/00	10	10	980	20	288	20	20	10	869	195	31	10	2613	341	317	20	10	10	30	10	10	10		
6/15/00													2224	314										
6/20/00	84	30	979	10	218	10	10	10	285	85	10	10	2143	206	10	10	10	10	110	52	31	10		
6/26/00	10	10	303	155	455	30	10	10	852	189	10	10	913	144	10	10	451	132	113	10	260	151		
7/3/00	10	10	857	10	20	10	10	10	1005	160	10	10	933	189	10	10	41	10	146	40	10	10		
7/10/00	519	164	914	10	10	10	10	10	892	73	10	10	480	52	10	10	82	10	227	30	50	10		
7/17/00	10	10	1034	10	10	10	10	10	958	160	10	10	1968	317	10	10	10	10	86	10	173	10		
7/24/00	10	10	821	10	10	10	51	10	913	189	830	10	471	86	892	187	10	10	231	41	10	10		
7/31/00	10	10	960	10	20	10	10	10	1210	74	41	20	1354	63	10	10	10	10	10	10	70	20		
8/7/00	52	10	813	10	10	10	20	10	833	97	20	10	847	63	10	10	10	10	905	187	10	10		
8/14/00																	10	10	683	158	10	10		
8/15/00	10	10	1134	10	10	10	10	10	1464	189	10	10	441	31	41	10								
8/21/00	10	10			10	10	10	10	1054	31	933	10	830	199	10	10	63	10	1789	379	10	10		
8/23/00			1162	10																				
8/24/00																			10	10				
8/28/00	10	10	960	10	10	10	10	10	991	86	10	10	1607	448	10	10	10	10	246	97	189	20		
9/5/00																	10	10	594	52	10	10		
9/6/00	10	10	1376	10	20	10	10	10	546	30	10	10	1063	74	41	10								
9/12/00																	10	10	2613	907	404	10		
9/13/00	10	10	857	10	10	10	10	10	960	10	10	10	1789	389	10	10								
9/14/00																			20	10				
	Gazos Creek Access		Bean Hollow Creek		Bean Hollow Beach		Pescadero Beach		Pomponio Creek		Pomponio Beach		San Gregorio Creek		San Gregorio Beach		Francis Beach		Venice Beach		Roosevelt Beach		Pescadero Creek	
	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC
9/18/00	10	10	1025	10	20	10	20	10	384	10	10	10	3076	657	10	10	1143	10	10	10	272	31	504	10
9/25/00	20	10	1134	10	31	10	98	10	438	10	10	10	1956	313	10	10	836	10	122	31	960	10	187	41
10/2/00	10	10	1266	41	31	10	10	10	364	10	10	10	10462	3076	10	10	10	10	110	20	109	31	364	41
10/10/00	135	31	749	10	63	10	52	20	717	74	20	10	2046	309	10	10							1523	110
10/11/00																	10	10	122	31	10	10		
10/16/00							10	10	663	41	10	10	1515	98	10	10	10	10	74	10	10	10	882	20
10/17/00	10	10	809	10	10	10																		
10/23/00	10	10	455	10	10	10	830	52	733	31	10	10	275	10	878	10	10	10	565	132	10	10	419	10
10/30/00																	727	10	2247	323	1172	31		
10/31/00	10	10	1291	20	10	10	10	10	6131	882	10	10	3255	933	10	10							110	41
11/2/00																			3076	495				
11/6/00																	41	10	161	20	52	10		
11/13/00	10	10	1134	10	10	10	10	10	487	135	10	10	990	173	10	10							809	74
11/14/00																	10	10	512	146	10	10		
11/21/00																	259	63	2481	794	301	63		
11/27/00	10	10	1183	10	10	10	10	10	932	189	10	10	852	86	10	10	110	20	670	148	161	52	830	134
12/4/00																	41	10	10	10	10	10		
12/11/00	10	10	880	10	10	10	10	10	160	31	10	10	733	74	10	10	10	10	932	199	31	20	933	63
12/18/00																	10	10	538	62	10	10		
12/28/00																	10	10	262	10	74	10		
1/8/01	520	20	20	10	10	10	10	10	1650	282	203	41	1143	74	10	10	10	10	292	30	258	10	691	20
	Gazos Creek Access		Bean Hollow Creek		Bean Hollow Beach		Pescadero Beach		Pomponio Creek		Pomponio Beach		San Gregorio Creek		San Gregorio Beach		Francis Beach		Venice Beach		Roosevelt Beach		Pescadero Creek	
	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC
1/15/01																	10	10	223	52	10	10		
1/17/01									379	63			624	98										
1/22/01	10	10			10	10											10	10	110	10	10	10		
1/23/01							10	10	24192	15530	521	135	933	148	10	10							876	41
1/29/01									7701	1043														
2/5/01	10	10			10	10	10	10	2046	285	10	10	880	148	10	10	10	10	122	31	10	10	457	132
2/12/01																	785	31	495	63	744	41		
2/13/01									9208	816														
2/20/01	10	10			10	10	993	145	4884	960	175	31	1956	538	583	62	448	10	904	63	203	10	1585	389
2/26/01							10	10	1872	199			931	189			10	10	282	31	223	20		
3/5/01	435	98	557	122	295	31	6867	598	24192	2187	3873	512	11198	2755	4884	785			6131	1259	504	63	5475	691
3/6/01																	52	10						

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		Below House		**Flower Fields**		**Ratlove Road**		**Western Boundary**							
		20	10	1300	790	2200	1100	9200	2200						
		At Ocean		**Etheldore bridge**		**Chapman East**		**Above Henry's**		**Below Henry's**					
		16000	1100	24000	1800	24000	1400	130	80	16000	790				
		Above sheds		**Below Henry's**		**Bridge at Henry's**		**Pwr pole by pump**							
		20	20	16000	2200	40	40	9200	2200						
		Betw shed and pole		**old shed**		**black pipe**		**30 ft off bridge**		**past tire**					
		24000	24000	24000	24000	24000	24000	80	50	80	80				
		TC	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**				
1															
5															
		Henry's pump		**Etheldore bridge**		**Turrello Rch-bl pip**		**Chapman Bridge**							
		TC	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**						
		1273	41	7270	2143	6488	115	1726	416						
8															
0															
6															
5															
		Pump station		**Below Henry's**											
		657	63	723	98										
		Etheldore bridge		**Chapman W**		**Foot bridge**		**Pump by Camper**		**Black H2O tank**		**Chapman Bridge**		**Chapman W Bdry**	
		TC	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**	**TC**	**EC**
		6488	1935	9208	2247	7270	2143	8164	2613	1956	213	2046	305	1872	228

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At Etheldore	
2400	1300
Above Stables	
16000	5400

				Victor's Property				
	Eastern Boundary		Below drink tub		Bridge by House		Tributary by House	
	20	20	20	10	20	10	50	20

Part II

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

Waterbody 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

North Coast Sampling Results

4/25/01

Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6		
FS		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		
		30		10								10		10		
20						20		10		10						
10		220		10		20						10		10		
								10		10						
20		25		10		15		10		10		10		10		
10		15		10		20		10		10		10		10		
20		180				20		10		10						
				10								10		10		
		10														
30		85		10								10		10		
						10		10		10						
45		140		10								10		20		
						25		10		10						
20		20		10		25		10		10		10		10		
		110		10		30		10		10		10		10		
30																
30		350		10		5		10		10		10		25		
		75		10								10		10		
20						35		45		30						
Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6		
FS		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		*FS*		
				10								10		10		
25		10				25		10		10						
		40		10		35		10		10		20		20		
25																
75		115		10								10		10		
						12		4		2						
		10														
				10		15		10		10		10		10		
55		10														
		10		10		20		10		10		10		10		
10																
						15		10		10						
20		20		10								15				
														10		
10		180		10		10		10		15		10		20		
		15														
10		20		10				10		45		10		10		
										15						
25		15		10								15		10		
						10		10		25						
		10														
10				10		20		15		10		10		10		
35		20		10								10		10		
						10		25		10						
10		10		10		25		10		10		10		10		
35		20		10		110		10		20		10		10		
						180										
		10		20		15		10		10		20		10		
25																
10		10		10								10		10		
						10		10		20						

Waterbody 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

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Pillar Point #7		Fitzgerald Marine Reserv		Montara Beach		Linda Mar Beach #5		Linda Mar Beach #6		Rockaway Beach		Sharp Park Beach #3		Sharp Park Beach #6		
FS		FS		FS		FS		FS		FS		FS		FS		
		10		10		25		10		15		10		10		
10																
10		15				10		15		10						
				10								10		10		
10		10		10		15		10		10		10		10		
10				10								10		10		
		20				15		10		25						
10		10		20		10		10		10		10		10		
						10		10		10						
10		10		10								10		10		
240		10		10								25		10		
20		10		10		20		20		10		10		10		
10		10		10		10		15		25		10		10		

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South Coast Sampling Results

4/25/01

2/20/01	10		10		25		10		10		20		30		10		
2/26/01											10		10		10		
3/5/01					140		300		110				210		10		

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South Coast Sampling Results 4/25/01

	Gazos Creek Access	Bean Hollow Beach	Pescadero Beach	Pomponio Beach	San Gregorio Beach	Francis Beach	Venice Beach	Roosevelt Beach
	FS	FS	FS	FS	FS	FS	FS	FS
5/15/00						20	10	10
5/16/00	20	20	10	10	10			
5/22/00						10	15	15
5/23/00	25	15	10	10	10			
5/30/00	10	10	10	10	15	10	45	10
6/5/00	15	10	10	10	10	10	10	10
6/12/00	10	10	10	10	20	10	10	10
6/20/00	30	10	10	10	10	10	10	10
6/26/00	10	10	10	10	10	35	15	45
7/3/00	10	10	10	10	10	10	15	10
7/10/00	55	10	10	10	10	20	20	10
7/17/00	10	10	10	10	10	10	10	10
7/24/00	10	10	10	15	35	10	25	10
7/31/00	10	10	10	20	10	30	10	25
8/7/00	10	10	10	10	10	10	45	10
8/14/00						10	35	10
8/15/00	10	10	10	10	10			
8/21/00	10	10	10	10	10	35	55	10
8/24/00							5	
8/28/00	25	10	10	10	10	10	25	10
9/5/00						10	15	10
9/6/00	10	25	10	10	10			
9/12/00						10	245	20
	Gazos Creek Access	Bean Hollow Beach	Pescadero Beach	Pomponio Beach	San Gregorio Beach	Francis Beach	Venice Beach	Roosevelt Beach
	FS	FS	FS	FS	FS	FS	FS	FS
9/13/00	10	10	10	10	10			
9/14/00							20	
9/18/00	10	10	10	10	10	15	10	10
9/25/00	10	10	20	10	10	10	10	10
10/2/00	20	15	10	10	10	10	10	10
10/10/00	20	10	10	10	25			
10/11/00						10	10	10
10/16/00			10	10	10	10	10	10
10/17/00	10	10						
10/23/00	10	10	25	20	10	10	35	10
10/30/00						25	85	10
10/31/00	10	10	10	10	10			
11/2/00							215	
11/6/00						10	10	35
11/13/00	10	10	10	10	10			
11/14/00						10	30	10
11/21/00						10	155	30
11/27/00	10	10	10	10	10	10	25	10
12/4/00						15	20	10
12/11/00	10	10	10	10	10	10	20	10
12/18/00						10	40	10
	Gazos Creek Access	Bean Hollow Beach	Pescadero Beach	Pomponio Beach	San Gregorio Beach	Francis Beach	Venice Beach	Roosevelt Beach
	FS	FS	FS	FS	FS	FS	FS	FS
12/28/00						10	20	20
1/8/01	10	10	10	20	10	10	10	10
1/15/01						10	10	10
1/22/01	10	10				10	25	20
1/23/01			10	10	10			
2/5/01	10	10	10	10	10	10	10	10
2/12/01						30	20	10

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Figure 2. Locations of Candidate Toxic Hot Spots

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

Waterbody 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.

Part III

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 available data was insufficient to establish an advisory based on these other four chemicals. Therefore, while the general discussion in Part III.B will include DDT, dieldrin, chlordane and dioxins, the remediation plan (Part III.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 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 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.

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 Gualalupe 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 E), 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 #2).

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. Estimate of the total cost to implement the cleanup plan

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 Appendix A.

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

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

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.

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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 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 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.

Figure B-1. Peyton Slough

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
BPTCP Studies (Pilot RMP and Screening/Confimation 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	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.	Percenent 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. Preliminary assessment of actions required to remedy or restore THS to an unpolluted condition including recommendations for remedial actions

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 Appendix A.

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 for RWQCB and other regulatory staff oversight

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

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 Appendix A.

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.

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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 program 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 Cleanup 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.

<u>Pacific Eco-Risk Laboratories</u>

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

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 northwest 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 Appendix A.

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.

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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.

Figure E-1. Point Potrero

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 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. Assessment of the areal extent of the THS

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. Assessment of the most likely sources of pollutants

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. <u>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.</u>

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 Appendix A.

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

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

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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

Figure F-1. Mission Creek

Figure F-2. Mission Creek -Detail

conditions (see Part I Specific Definition of a Toxic Hot Spot). The primary basis 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 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 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 source 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).

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>

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.

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. 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, the cleanup options will include those listed above plus, at a minimum, the following:

d. reduce or eliminate 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. Implement the remediation option(s) selected from the Feasibility Study.

4. 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 could 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 Appendix A.

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.

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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.

Figure G-1. Islais Creek

Figure G-2. Islais Creek - Detail

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 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 *Strongelocentrotus 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. Assessment of areal extent of the toxic hot spot

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 the combined sewer overflows (CSO) operated by the City and County of San Francisco. Another likely source is San Francisco's treatment plant discharge outfall at Quint Street. Because of recent improvements in the quality of the discharges from these sources in the past two years, historic discharges are probably more of a factor. Other sources may also contribute. 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 source 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.

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.

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. 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, the cleanup options will include those listed above plus at a minimum the following:
   d. reduce or eliminate 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. Implement the remediation option(s) selected from the Feasibility Study.

4. 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 cost could 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 see Appendix A.

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

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

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.

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APPENDIX A

BENEFICIAL EFFECTS OF REMEDIATION *

Beneficial effect	Values quantifying these beneficial effects	Beneficial use affected
Lower toxicity in planktonic and benthic organisms	Greater survival of organisms in toxicity tests.	MAR, EST
Undegraded benthic community	Species diversity and abundance characteristic of undegraded conditions.	MAR, EST
Lower concentrations of pollutants in water	Water column chemical concentration that will not contribute to possible human health impacts.	MIGR, SPWN, EST, MAR, REC 1, REC 2
Lower concentrations of pollutants in fish and shellfish tissue	Lower tissue concentrations of chemicals that could contribute to possible human health and ecological impacts.	MAR, EST, REC 1, COMM
Area can be used for sport and commercial fishing.	Anglers catch more fish. Impact on catches and net revenues of fishing operations increase.	REC 1, COMM
Area can be used for shellfish harvesting or aquaculture	Jobs and production generated by these activities increase. Net revenues from these activities are enhanced.	SHELL, AQUA
Improved conditions for seabirds and other predators	Increase in populations. Value to public of more abundant wildlife.	WILD, MIGR, RARE
More abundant fish populations	Increase in populations. Value to public of more abundant wildlife.	MAR, EST
Commercial catches increase	Impact on catches and net revenues of fishing operations.	COMM
Recreational catches increase, more opportunities for angling	Increased catches and recreational visitor-days.	REC 1
Improved ecosystem conditions	Species diversity and abundance characteristic of undegraded conditions.	EST, MAR
Improved aesthetics	Value to public of improved aesthetics. In some cases, estimates of the value to the public of improved conditions may be available from surveys.	REC 2
More abundant wildlife, more opportunities for wildlife viewing	Impact on wildlife populations. Impact on recreational visitor-days.	MAR, WILD, RARE, REC 2

* From State Water Resources Control Board. Water Quality Control Policy for Guidance on Development of Regional Toxic Hot Spot Cleanup Plans. September 1998. pp 43.