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REVISED DRAFT FEASIBILITY STUDY REPORT FOR PARCEL F

05/11/2007

BARAJAS AND ASSOCIATES, INC.

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Revised Draft

Feasibility Study Report for Parcel F

Hunters Point Shipyard
San Francisco, California

May 11, 2007

Prepared for:
Base Realignment and Closure
Program Management Office West
San Diego, California

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Prepared under:
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Contract Task Order 004

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Revised Draft

Feasibility Study Report for Parcel F
Hunters Point Shipyard
San Francisco, California

Contract Number N68711-03-D-5106
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Prepared For:

Department of the Navy

Prepared By:

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In Association With

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B Applicable or Relevant and Appropriate Requirements

C Memorandum of Agreement

D Cost Summary

Attachment

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2 HHRA Risk Calculation Memorandum (prepared by Battelle)

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4 PCB Flux Model Description (prepared by Sea Engineering, Inc.)

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ACRONYMS AND ABBREVIATIONS

§	Section
µg/kg	Microgram per kilogram
ARAR	Applicable or relevant and appropriate requirement
BBL	Blasland, Bouck & Lee, Inc.
bgs	Below ground surface
BPTCP	Bay Protection and Toxic Cleanup Program
Cal. Code Regs.	*California Code of Regulations*
CCSF	City and County of San Francisco
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
ch.	Chapter
cm	Centimeters
cm/yr	Centimeters per year
COC	Chemical of concern
CSO	Combined sewer outfall
CTE	Central tendency exposure
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethene
DDT	Dichlorodiphenyltrichloroethane
div.	Division
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentrations
ERA	Ecological risk assessment
ER-M	Effects range-median
ESAP	Environmental Sampling and Analysis Program
FFA	Federal Facility Agreement
FS	Feasibility study
FSDG	Feasibility study data gaps
FWS	Fish and Wildlife Service
GIS	Geographic information system
GRA	General response action
HHRA	Human health risk assessment
HPS	Hunters Point Shipyard

IR	Installation Restoration
LFR	Levine-Fricke-Recon
L/kg	Liter per kilogram
mg/kg	Milligram per kilogram
MLLW	Mean lower low water
MNR	Monitored natural recovery
MOA	Memorandum of Agreement
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OEHHA	Office of Environmental Health Hazard Assessment
O&M	Operation and maintenance
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppm	Part per million
PRC	PRC Environmental Management, Inc.
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RME	Reasonable maximum exposure
RMP	Risk management plan
ROD	Record of Decision
RPD	Redox potential discontinuity
RSC	Rapid sediment characterization
RTDF	Remediation Technologies Development Forum
SFEI	San Francisco Estuary Institute
SLERA	Screening-level ecological risk assessment
SPMD	Semipermeable membranes device
STLC	Soluble threshold limit concentration
SUF	Site use factor
TBC	To be considered
TCLP	Toxicity characteristic leaching procedure
TCRA	Time-critical removal action
Tetra Tech	Tetra Tech EM Inc.
tit.	Title
TMSRA	Technical Memorandum in Support of a ROD Amendment
TOC	Total organic carbon

ACRONYMS AND ABBREVIATIONS (Continued)

TRV	Toxicity reference value
TTLC	Total threshold limit concentration
USC	*United States Code*
Water Board	San Francisco Bay Regional Water Quality Control Board
yd^3	Cubic yard

EXECUTIVE SUMMARY

This report presents the results of the Revised Draft feasibility study (FS) conducted for Parcel F at Hunters Point Shipyard (HPS) in San Francisco, California. A previous Draft FS Report for Parcel F was prepared in 1998 (Tetra Tech EM Inc. [Tetra Tech] and Levine Fricke Recon [LFR] 1998). Based on concerns from the regulatory agencies, the Navy decided to conduct additional investigations and perform further data evaluation before finalizing the FS. HPS is a former naval shipyard and is about 866 acres in size. Parcel F is the offshore area at HPS and consists of 446 acres of underwater property. The purpose of this FS Report is to develop and evaluate remedial alternatives to address the chemical contamination found in sediments at Parcel F.

In 1940, the U.S. Department of the Navy (Navy) obtained ownership of HPS for shipbuilding, repair, and maintenance. After World War II, activities at HPS shifted to submarine maintenance and repair. Between 1976 and 1986, the Navy leased most of HPS to Triple A Machine Shop, Inc., a private ship repair company. The Navy resumed occupancy of HPS in 1987.

Past shipyard operations left hazardous materials on site; as a result, HPS was included on the National Priorities List in 1989 as a Superfund site pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990.

PREVIOUS INVESTIGATIONS

Numerous investigations have been conducted at Parcel F (see Section 1.3). The investigations included the collection of surface and subsurface sediment samples for chemical and ecological toxicity evaluations. Fish and invertebrate tissue samples also were collected at Parcel F and analyzed for chemicals. During Phase 1A and Phase 1B Ecological Risk Assessments (PRC Environmental Management, Inc. [PRC] 1994, 1996b). Parcel F was subdivided into 11 subareas. Based on the previous investigation results, the following five areas were identified for further evaluation: Areas I, III, VIII, IX, and X. Areas III and X in Parcel F are the primary focus in this FS for addressing risk posed by subtidal sediments; the remaining areas are addressed for source control measures. Area III is located adjacent to Point Avisadero, and Area X is adjacent to Parcel E-2 and is also referred to as the South Basin.

NATURE AND EXTENT OF CONTAMINATION

Chemistry results for sediment in Parcel F indicated the highest chemical concentrations are found in Areas III and X (see Section 1.5). The horizontal and vertical distribution of chemicals in Area III sediments is localized and discontinuous rather than exhibiting a gradient away from a well-defined source. Chemicals of potential concern did not tend to co–occur in Area III and the distribution pattern showed localized areas of elevated chemical concentrations in sediment. This suggests an episodic input of contamination. In Area X, the highest concentrations of

metals and polychlorinated biphenyls (PCB) in surface sediment are found along the eastern shoreline of Area X. Chemical concentrations in this area decreased with increasing distance from the eastern shoreline of the South Basin. The highest concentrations of metals and PCBs generally were found in the 0- to 2-foot interval. The highest PCB concentrations in the South Basin were found in subsurface sediment samples from the mouth of Yosemite Creek.

FATE AND TRANSPORT OF CHEMICALS TO PARCEL F SEDIMENTS

The chemicals of concern (copper, mercury, and total PCBs) at Parcel F exhibited similar behavior by adsorbing to sediments. Therefore, the primary transport mechanism for chemicals to Parcel F is the movement of sediment by overland flow or erosion. Identifying the major transport mechanisms of chemicals reaching Parcel F sediments was necessary to develop remedial alternatives for Parcel F and to address the potential of recontamination once a remedy is in place. Additionally, understanding the timeframe and relative magnitude of chemical transport pathways is necessary for adequate consideration of how effective remedial alternatives will be in meeting the remedial action objectives (RAO). The Navy has used the information gained from numerous studies to prioritize source control and removal activities along the Parcels B, E, and E-2 shorelines. The Navy implemented the following source control measures: removal of contaminated soil and sediment along the Parcel B, E, and E-2 shorelines; storm drain cleaning program, extensive removal of contaminated soil, sediment, and debris along the Parcels B, E, and E-2; and installation of a sheet-pile wall on the bay side of the former industrial landfill located in Parcel E-2.

REMEDIAL ACTION OBJECTIVES

This FS Report presents the RAOs and defines the areas at Parcel F HPS that require remediation based on the RAOs. The following RAOs were identified for Parcel F:

1. Reduce the risk of benthic feeding and piscivorous birds, including surf scoters, to acceptable levels from exposure to copper, mercury, and PCBs through consumption of contaminated prey and incidental ingestion of sediment.

2. Limit or reduce the potential risk to human health from consumption of shellfish from Parcel F.

3. Limit or reduce the potential biomagnifications of total PCBs at higher trophic levels in the food chain to reduce the potential risk to human health from consumption of sport fish.

After development of the RAOs, numerical remediation goals were developed for the chemicals of concern (COC) found in Parcel F sediments, as listed below. Numerical remediation goals were not developed for the third RAO because the mobility of fish results in uncertainty in calculating the magnitude of PCB fish tissue loading that could be attributed to the COCs in Parcel F sediments.

- Copper: 271 milligrams per kilogram (mg/kg)
- Mercury: 1.87 mg/kg
- Total PCBs: 1,240 micrograms per kilogram (μg/kg)

To determine the areas to be carried forward for remedial evaluation, remediation goals were applied on a point-by-point (or polygon-by-polygon) basis in each area (I, III, VIII, IX, and X). The area-weighted average approach is protective of benthic-feeding and piscivorous birds with larger foraging ranges that would be exposed to a range of concentrations at Parcel F, and areas addressed for ecological concerns included the areas that pose a potential risk to human health from the ingestion of shellfish.

IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

The primary purpose of this phase of the FS process is to identify and evaluate a range of potentially applicable general response actions, remedial technologies, and process options for sediments in Parcel F (see Section 3.0). A general response action may be accomplished by several types of remedial technologies (such as capping and in-situ stabilization) or removal technologies (such as excavation and dredging); process options are specific methods within each technology type. The screening process evaluated the various technologies for effectiveness, implementability, and cost. Remedial action technologies and process options that are inappropriate or infeasible for the sediment at Parcel F were eliminated. Process options that were retained after screening were combined into potential remedial alternatives for the site.

DEVELOPMENT OF REMEDIAL ALTERNATIVES

The areas to be addressed in this FS Report are adjacent to potential sources of contaminated soil and sediment along the shoreline at Parcels B and E-2 and Yosemite Creek. Numerous source control measures have been implemented at HPS; however, three areas will need to be further addressed before work begins on Parcel F to prevent recontamination. The additional source control measures include excavation of soil contamination at Parcel B, further removal in the PCB hotspot area along the shoreline in Parcel E-2, and an evaluation of Yosemite Creek as a potential ongoing source of contamination to Area X (South Basin) (see Section 4.1).

Additionally, modeling was conducted to evaluate the short- and long-term effectiveness of each remedial alternative under consideration in this FS Report. The model evaluated three sediment transport processes using site-specific data for Parcel F: (1) sediment accumulation rates, (2) sediment bed erosion, and (3) transport due to diffusion and bioturbation in the sediment bed (see Attachment 4). These parameters were modeled to estimate the recovery of the affected sediments through burial while considering the potential effects of erosional events caused by storms and transport in the sediment bed resulting from diffusion and bioturbation.

The following eight remedial alternatives were developed from the general response actions and remedial technologies:

- Alternative 1: No Action
- Alternative 2: Removal and Off-Site Disposal
- Alternative 3A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls
- Alternative 3B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls
- Alternative 4A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 4B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 5A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 5B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls

DETAILED AND COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

To select the most appropriate remedy for Parcel F, the remedial alternatives above were evaluated with respect to the first seven of the nine National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria; two threshold, five primary balancing, and two modifying criteria. The seven combined threshold and primary balancing criteria are considered the evaluation criteria, while the remaining two are considered modifying criteria.

- **Threshold criteria (2)** relate directly to the statutory requirements each remedial alternative must meet: (1) overall protection of human health and the environment; and (2) compliance with applicable or relevant and appropriate requirements.
- **Primary balancing criteria (5)** are those upon which the preliminary selection of the remedy is based: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, and volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost.
- **Modifying criteria (2)** include agency and public comments on the proposed alternatives in the FS Report and will be addressed during the development of the Proposed Plan: (1) state acceptance; and (2) community acceptance.

The comparative analysis of remedial alternatives evaluates the relative performance of each alternative with respect to seven of the nine specific NCP evaluation criteria. The results for

Areas III and X for each alternative were then combined to develop a relative ranking for comparison purposes.

Alternative 1 (no action) would not provide additional protection of human health or the environment at Parcel F. All of the remaining alternatives meet the threshold criterion of overall protection of human health and the environment and would comply with ARARs, with Alternatives 5A and 5B providing the best overall protectiveness for Areas III and X.

Alternative 1 (no action) would not meet the criterion for long-term effectiveness because the effectiveness of natural recovery processes would not be verified. Alternatives 5A and 5B would best meet the criterion of long-term effectiveness for Areas III and X because they combine the removal of the most highly contaminated sediments with monitored natural recovery (MNR) processes, as well as placement of a cap in Area III. Alternative 2 ranked slightly lower than Alternatives 5A and 5B because in Area III the pattern of contamination is localized at varying depths, and it would be difficult to control releases of contamination to adjacent areas during dredging operations. Alternatives 3A, 3B, 4A, and 4B would provide moderate long-term effectiveness.

Under Alternatives 1, 2, 4A, 4B, and 5A, there would be no reduction of the toxicity, mobility, or volume through treatment on site, thus none of these alternatives meet the criterion. Alternatives 3A and 3B would moderately reduce the toxicity and mobility through treatment in Area X. Under these alternatives, PCBs would be reduced by mixing the sediment with activated carbon. Alternative 5B was rated low because the placement of backfill mixed with activated carbon could reduce the bioavailability of residual PCBs.

Alternative 5B best meets the criterion for short-term effectiveness, with Alternative 5A ranked slightly lower because under this alternative only clean backfill would be used rather than backfill mixed with activated carbon. Alternatives 1, 2, 3A, and 3B would moderately meet the criterion for short-term effectiveness. Alternative 1 (no action) is rated moderate for short-term effectiveness because the environment and surrounding community would not be disturbed.

Alternative 1 would be the easiest to implement because no action would be involved. Alternatives 2, 4A, 4B, 5A, and 5B are similarly ranked. Although implementation of these alternatives would pose unique challenges as described in Section 4.0, overall they are comparable in terms of implementability. Alternatives 3A and 3B are ranked the lowest because the in-situ component of these alternatives is relatively new; although the results of the treatability study are promising.

No costs are associated with Alternative 1. The costs for Alternatives 4A ($13.0 M) and 4B ($15.1M) are the next lowest due to inclusion of MNR. Alternatives 3A ($23.1M) and 3B ($25.3M) are the next most costly, followed by Alternatives 5A ($26.8M) and 5B ($28.9. M). Alternative 2 ($42.6M) is the most expensive of the alternatives.

The Navy will select their preferred remedial alternative after receipt and resolution of regulatory agency comments. The Navy will present their preferred alternative to the public in the Proposed Plan.

1.0 INTRODUCTION

This report presents the results of the Revised Feasibility Study (FS) conducted for Parcel F at Hunters Point Shipyard (HPS) in San Francisco, California (see Figure 1-1). A previous Draft FS Report for Parcel F was prepared in 1998 (Tetra Tech EM Inc. [Tetra Tech] and Levine Fricke Recon [LFR] 1998). Based on concerns from the regulatory agencies, the Navy decided to conduct additional investigations and perform further data evaluation before finalizing the FS. This FS Report addresses risk posed by sediments in Parcel F. Parcel F is the offshore area at HPS and consists of 446 acres of underwater property (see Figure 1-2). The information used to prepare this FS Report is primarily based on the analytical results and findings from the Final Validation Study (Battelle, [Blasland, Bouck & Lee, Inc.] BBL, Neptune & Company, and Sea Engineering, Inc. 2005) and the Feasibility Study Data Gaps (FSDG) Investigation Draft Technical Memorandum (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

The following sections summarize the purpose and organization of this FS Report, the site location and history, the previous investigations, the environmental setting, the nature and extent of contamination, the fate and transport of contaminants, and the results of the risk assessments.

1.1 PURPOSE AND ORGANIZATION OF REPORT

This FS Report develops and evaluates remedial alternatives to address contaminated sediments in Parcel F. The FS process presented in this report consisted of the following steps.

1. Develop remedial action objectives (RAO), including remediation goals, that specify chemicals and media of concern and potential exposure pathways.

2. Develop general response actions (GRA) that address the RAOs and remediation goals.

3. Identify and screen remedial technologies and process options.

4. Combine process options to develop remedial alternatives and perform a detailed analysis of the alternatives against the nine criteria defined in the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40 *Code of Federal Regulations* Section [§] 300.430(e).

5. Perform a comparative analysis of the remedial alternatives.

This FS Report was prepared in accordance with the U.S. Environmental Protection Agency's (EPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" and "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites" (EPA 1988b, 2005).

Location Map

Barajas & Associates, Inc.

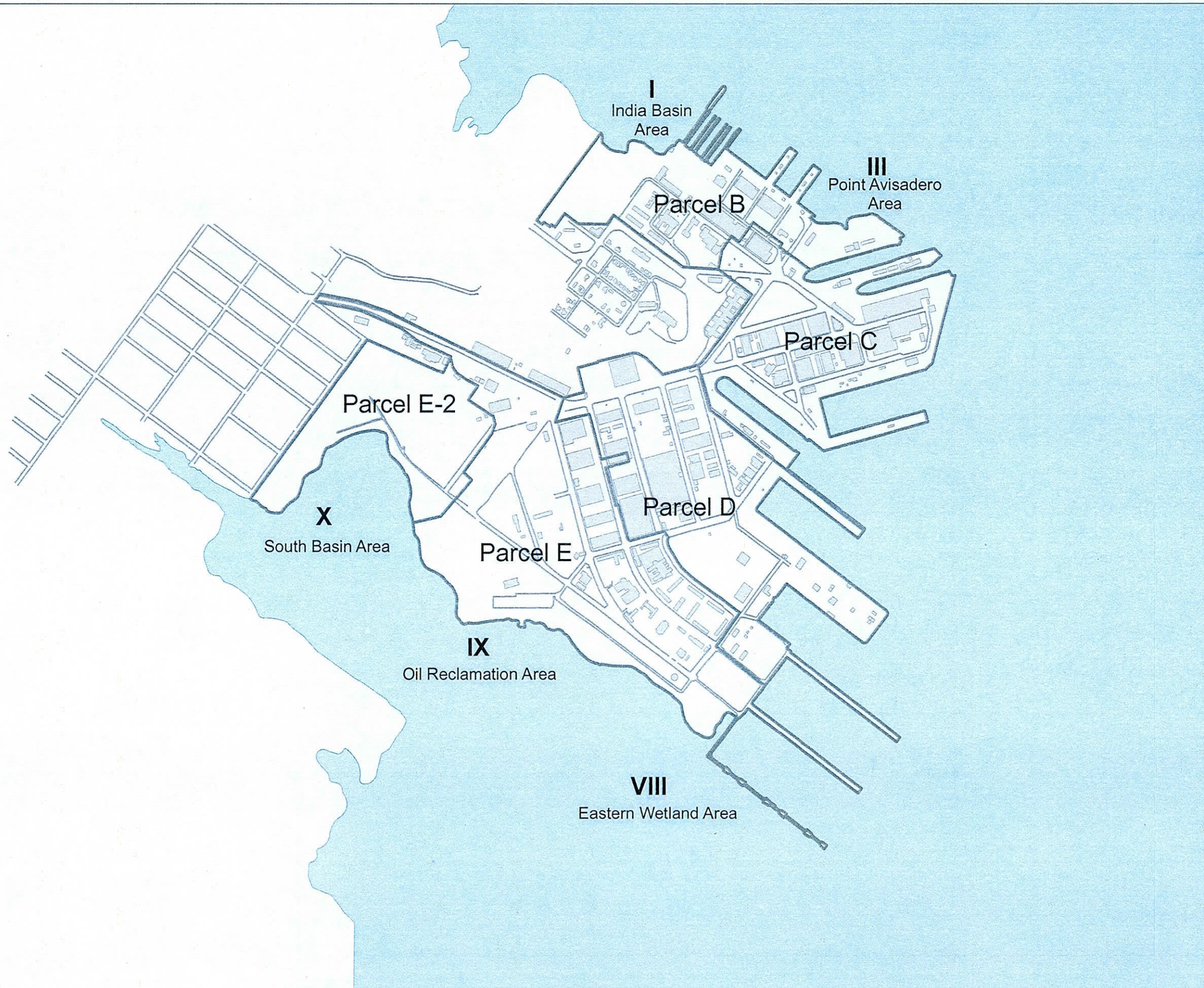
Hunters Point Shipyard, San Francisco, California
U.S. Navy Southwest Division, NAVFAC, San Diego

FIGURE 1-1

HUNTERS POINT LOCATION MAP

Revised Parcel F Feasibility Study

2007-05-07 V...s_Point\Projects\Parcel_F\HPS Bay Area Site Location Map_8.5x11 portrait.mxd TIEMI-SF Kevin Ernst



Road
Building
San Francisco Bay

N

1,000 0 1,000
Feet

Barajas & Associates, Inc.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 1-2

PARCEL F SUBAREAS

Revised Parcel F Feasibility Study

2006-12-19 v:\hunters point\projects\parcel_f\offshore_modeling\shipyard_siteloc.mxd TtEMI-AL simon.cardinale

This FS contains the following sections.

- Section 1.0, Introduction – describes the purpose and scope of the FS Report, provides the site background, summarizes previous investigations, describes the environmental setting at Parcel F, summarizes the nature and extent and fate and transport of chemicals, and presents the results of the risk assessments.

- Section 2.0, Remedial Action Objectives – presents the RAOs for Parcel F. This section also describes development of remediation goals for the media of interest and chemicals of concern and proposed federal and state of California applicable or relevant and appropriate requirements (ARAR).

- Section 3.0, Identification and Screening of Remedial Technologies – describes the GRAs appropriate for Parcel F and evaluates remedial technologies and process options that apply to Parcel F.

- Section 4.0, Development and Evaluation of Remedial Alternatives – describes each remedial alternative developed from the remedial technologies and process options retained after the evaluation in Section 3.0. This section also evaluates each remedial alternative against the nine criteria defined in EPA guidance.

- Section 5.0, Comparative Analysis of Remedial Alternatives – compares the remedial alternatives retained to identify the alternative that most effectively meets the RAOs.

- Section 6.0, References – lists the references used to prepare this report.

Figures and tables are presented after they are first mentioned in the text. In addition, the following appendices and attachments are included in this FS Report.

- Appendix A, Tetra Tech Offshore Geographic Information System (GIS) Model
- Appendix B, ARARs
- Appendix C, Memorandum of Agreement
- Appendix D, Cost Summary
- Attachment 1, Figures from FSDG Technical Memorandum (prepared by Battelle)
- Attachment 2, Human Health Risk Assessment (HHRA) Risk Calculation Memorandum (prepared by Battelle)
- Attachment 3, Demonstration Plan for Field Testing of Activated Carbon Mixing and In Situ Stabilization of Polychlorinated Biphenyls (PCB) in Sediment at HPS Parcel F (prepared by Stanford University)
- Attachment 4, PCB Flux Model Description (prepared by Sea Engineering, Inc.)

1.2 SITE LOCATION AND HISTORY

HPS is a former naval shipyard located on a peninsula in southeast San Francisco that extends east into San Francisco Bay (see Figure 1-1). In 1940, the Navy obtained ownership of HPS for shipbuilding, repair, and maintenance. After World War II, activities at HPS shifted to submarine maintenance and repair. HPS also was the site of the Naval Radiological Defense Laboratory. HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of HPS to Triple A Machine Shop, Inc., a private ship repair company. The Navy resumed occupancy of HPS in 1987.

Past shipyard operations left hazardous materials on site; as a result, HPS was included on the National Priorities List in 1989 as a Superfund site pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990. Closure at HPS involves conducting environmental remediation and making the property available for nondefense use.

HPS is 866 acres in size, with Parcel F comprising approximately 446 acres offshore of HPS. The Navy proposed dividing HPS into separate parcels to conduct remedial investigations (RI) and FSs and to expedite remedial actions in support of transferring the property. As a result, the Navy divided the facility into seven contiguous parcels: A, B, C, D, E, E-2, and F. The Navy transferred Parcel A to the San Francisco Redevelopment Agency in December 2004; as a result, Parcel A is no longer Navy property. The remaining six parcels are shown on Figure 1-2. During the Phase 1A and Phase 1B Ecological Risk Assessments (PRC Environmental Management, Inc. [PRC] 1994, 1996b), Parcel F was subdivided into 11 subareas. Based on the previous investigation results, the following five areas were identified for further evaluation: Areas I, III, VIII, IX, and X (see Figure 1-2). Areas III and X in Parcel F are the primary focus in this FS Report for addressing risk posed by subtidal sediments. The remaining areas are briefly discussed in this report to describe source control measures that have been implemented on the adjacent onshore parcels to minimize the migration of chemicals into Parcel F. Area III is located adjacent to Point Avisadero, and Area X is adjacent to Parcel E-2 and is also referred to as the South Basin.

1.3 PREVIOUS INVESTIGATIONS

Since 1991, various investigations have been conducted at Parcel F to evaluate shoreline and offshore contamination. A summary of each of these previous investigations is presented below.

1.3.1 Environmental Sampling and Analysis Plan Program, 1991

In 1991, chemicals in sediment, water chemistry, and toxicity were measured as part of the Environmental Sampling and Analysis Plan (ESAP) Program to assess Parcel F offshore areas (Aqua Terra Technologies 1991). Seventeen sediment collection stations (rectangular areas

ranging in size from 1.5 to 4.0 acres) were located around the perimeter of HPS. Ten grab samples of surficial sediments were collected randomly within each sampling station and composited for analysis. Based on the findings from the ESAP Program, it was determined that quantitative data collected in the future should focus on offshore sediments as the main cause of toxicity to human and ecological receptors present at the site.

1.3.2 Ecological Risk Assessments, 1991 to 1996

Between 1991 and 1996, two ecological risk assessments (ERA) were performed at Parcel F (Phase 1A and Phase 1B). The Phase 1A ERA, which was a basewide investigation conducted from 1991 to 1994, included a qualitative analysis of existing site data, biotic surveys, and fate and transport analyses of offshore areas (PRC 1994). This investigation was considered part of the EPA framework for the problem formulation step. The Phase 1B ERA, which was conducted from 1994 to 1996, focused on the data gaps identified during the Phase 1A assessment and consisted of a screening-level risk assessment (PRC 1996b). Phase 1B ERA sampling locations focused on areas of potential contamination from activities at HPS, including stormwater outfall discharge zones, areas offshore from IR sites, and offshore areas where these activities were established around the perimeter of HPS. Sediment core samples were collected from a total of 23 sampling locations. The risk assessment used conservative estimates of exposure to assess the potential risk. Based upon regulatory agency comments on the Phase 1B ERA, and the references to the meeting held between the Navy and regulatory agencies on December 3, 1996, the Navy decided to begin a preliminary FS for Parcel F. .

1.3.3 Feasibility Study, 1998

An FS was completed at Parcel F in 1998 (Tetra Tech EM Inc. [Tetra Tech] and Levine-Fricke-Recon [LFR] 1998). Data from the FS established two remediation footprints for Parcel F based on two different decision flow processes. Five areas were delineated as part of the area of concern referred to as the "low-volume footprint." Effects range-median (ER-M) values (Long and Morgan 1991; Long and others 1995) and bioaccumulation criteria for PCBs and dichlorodiphenyltrichloroethane (DDT) were used as the primary criteria to identify the areas of concern. It was established that the five areas of the low-volume footprint are the areas of highest ecological hazard. These five areas are Areas I, III, VIII, IX, and X (see Figure 1-2).

1.3.4 Validation Study, 2000

As a follow-on to the FS, a Validation Study was conducted to further investigate the five areas of the low-volume footprint and to refine the ERA. A sediment screening study was conducted in the spring 2000 to further delineate the low-volume footprint areas and evaluate the chemical distribution within each area (Battelle and others 2001). This study was also conducted to ensure that the sampling design for the Validation Study was adequate and covered the full range of chemical concentrations and potential exposures. The data reported from the sediment screening are presented in the Validation Study Work Plan (Battelle and others 2001). The Validation Study concluded that offshore sediments in Area III (Point Avisadero) and Area X (South Basin) pose potentially unacceptable ecological risks to upper trophic-level receptors from ingestion of

contaminated prey. The primary chemicals for ecological receptors are copper and mercury in Area III and PCBs in Area X. The HHRA indicated potentially unacceptable risks from consumption of shellfish in Areas IX and X as a result of PCBs.

1.3.5 Shoreline Investigation, 2002

In 2002, a shoreline investigation was conducted to evaluate whether contamination in Parcels E and E-2 had the potential to migrate (or had migrated) to sediments in the adjacent offshore area of Parcel F and to define areas that posed an unacceptable risk within the shoreline area. As part of the investigation, a screening-level ecological risk assessment (SLERA) was conducted to evaluate whether the chemicals detected along the shoreline posed risk to ecological receptors in the narrow intertidal zone of Parcels E and E-2. The receptors evaluated during the SLERA included benthic invertebrates, birds, and mammals in the shoreline area. The overall investigation was part of the Parcel E standard data gaps investigation; the results were presented in the Draft Parcels E and E-2 Shoreline Characterization Technical Memorandum (SulTech 2005). The Technical Memorandum indicated that source control measures are warranted along the shoreline at Parcels E and E-2 and that remedial alternatives should be evaluated to address the potential risk to invertebrates, birds, and mammals as part of the FS for Parcels E and E-2. The Navy implemented time-critical removal actions to address the contamination along the Parcels E and E-2 shoreline in 2006 which are discussed in Section 1.6.2 of this FS Report. Portions of the removal action are still under investigation.

1.3.6 Feasibility Study Data Gaps Investigation, 2003

In 2003, an FSDG investigation was conducted with an overall focus on collecting additional data for subtidal sediment to support the Parcel F FS Report for Areas III and X and to delineate surface sediments for mercury between Areas VIII and IX. The specific objectives for each area were as follows:

- Area III – This area required further spatial delineation of copper, mercury, and PCBs in sediments, primarily in areas of historically high chemical concentrations, and characterization of the debris field in support of planning for the FS.
- Area X – This area required additional evaluation of the volume of PCBs in sediments and further delineation of onshore-to-offshore PCB transport pathways. The goals were to ensure that all sources of contamination were identified and controlled and to more accurately characterize the distribution, transport, and fate of PCBs in offshore sediment to support the evaluation of remedial alternatives.
- Areas VIII and IX – Additional spatial delineation of concentrations of mercury in sediments within a potential hotspot area was needed between Areas VIII and IX.

Data from the FSDG investigation are summarized in the FSDG Technical Memorandum (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

1.4 ENVIRONMENTAL SETTING

This section discusses the geology and physical features, hydrogeology, climate, and ecology of HPS.

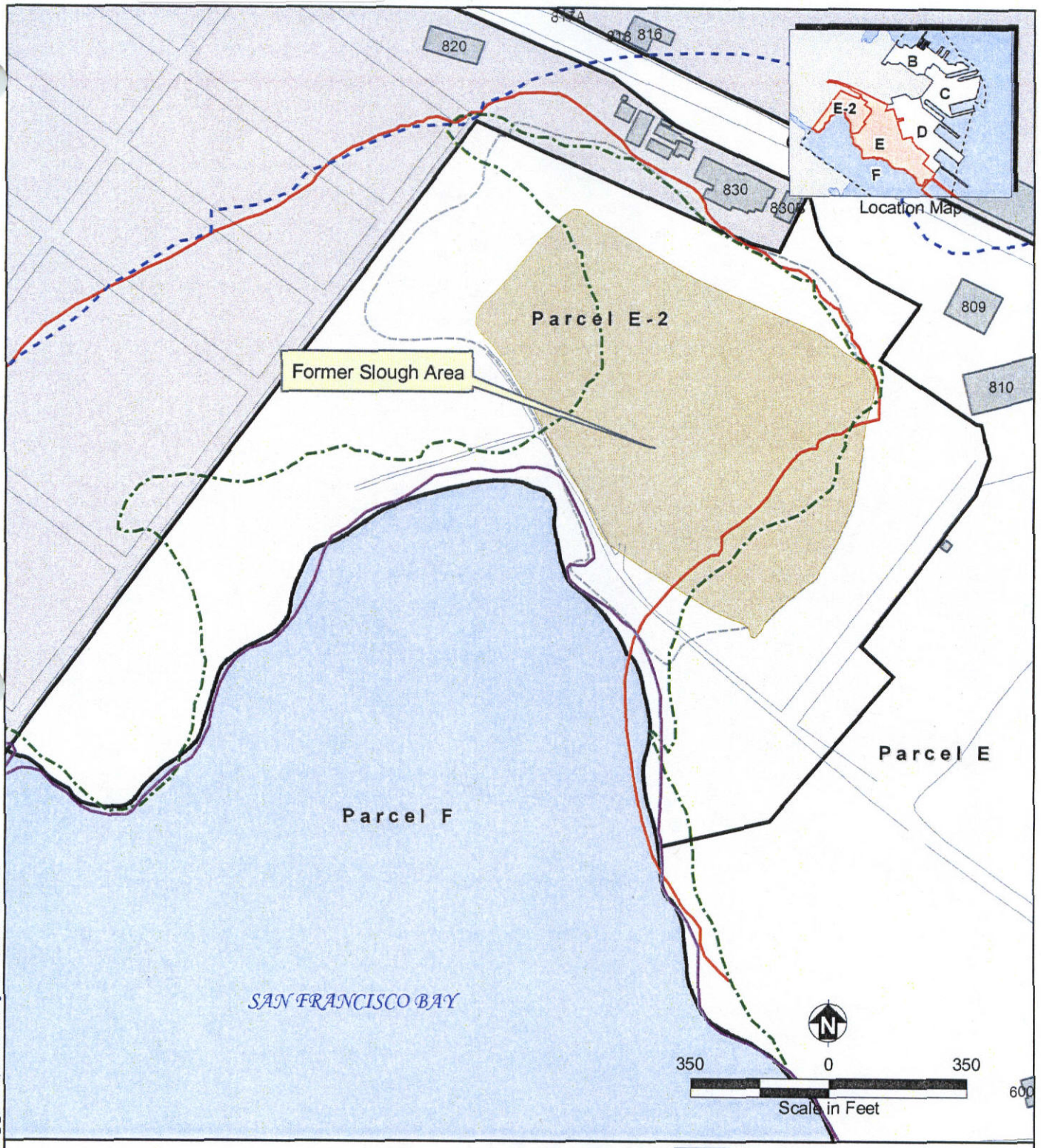
1.4.1 Geology and Physical Features

Between 1935 and 1975, soils from the hillside located on Parcel A and additional fill materials were placed on the outboard side of HPS levees in San Francisco Bay, thus increasing the land area of the HPS facility from less than 100 acres to the current size of approximately 866 acres. The artificial fill used may contain serpentinite bedrock, excavated Bay Mud, sands, gravels, construction debris, industrial debris, and sandblast waste (Tetra Tech, Uribe & Associates, and LFR 1997). As a result, the subsurface stratigraphy at HPS includes three artificial fill units: (1) serpentinite bedrock-derived fill, primarily serpentine with chert, shale, and related materials; (2) industrial fill (including sandblast waste, construction debris, and dredged material); and (3) backfill consisting of poorly graded sands and gravel. Generally, these fill materials overlie Bay Mud deposits and, to a lesser extent, undifferentiated sedimentary deposits (PRC 1996b).

Based on cores collected along the shoreline at Parcels E and E-2 the (landmass upland to the South Basin), the shallow geology consists of artificial fill, similar to the adjacent upland areas. Figure 1-3 illustrates the filling history over time from 1935 to 1969. The figure was developed using aerial photographs and converting the three-dimensional image to the two-dimensional plane. The fill left an inlet that extended from the South Basin to the northern corner of Parcel E-2. The inlet was later filled with shipyard wastes, including construction and industrial debris and waste, domestic refuse, sandblast waste, paint sludge, solvents, and waste oils (Tetra Tech, Uribe & Associates, and LFR 1997). This inlet is referred to as the "former slough."

The South Basin (Area X) is a shallow embayment on the south side of HPS, with water depths ranging from 6 to less than 2 feet. Yosemite Creek enters the South Basin and is characterized as a shallow, tidally influenced channel with no permanent flow (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005).

Point Avisadero (Area III) is a 3.5-acre peninsula located in the northeastern portion of HPS. It is bordered on the north and east by San Francisco Bay, on the south by Dry Dock 3, and on the west by the rest of HPS (see Figure 1-2). Point Avisadero is flat with a steep armored riprap bank. The riprap banks extend well below low tide elevation. A high-resolution bathymetric survey conducted during the FSDG investigation shows a shelf of sediment approximately minus 5 feet mean lower low water (MLLW) deep located northwest of the drainage tunnel outfall. This shelf and the eastern bank of Point Avisadero both slope steeply to the northeast to a depth of about minus 35 feet MLLW, after which the bottom continues to deepen to minus 80 feet MLLW in the southeast direction.



Year of Shoreline

- 1935
- 1946
- 1955
- 1969

- Parcel Boundary
- Parcel F Boundary
- Landfill Cap Extent
- Extent of Solid Waste
- Non-Navy Property
- Building
- Road

Source: Digitized from 1969 aerial photograph

Barajas & Associates, Inc.

Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 1-3

HISTORY OF SHORELINE FILLING

Revised Parcel F Feasibility Study

2007-05-07 ...s_Point\Projects\Parcel_F\Parcel_F_FS\History of shoreline filling.mxd TIEMI-SF Kevin Ernst

1.4.2 Hydrogeology

Previous hydrogeological investigations conducted by the Navy identified three water-bearing zones at HPS in the area upland to Parcel F: the A-aquifer, B-aquifer, and bedrock water-bearing zone (PRC 1996b). The A-aquifer consists of saturated porous media such as fill materials and undifferentiated upper sand deposits overlying Bay Mud deposits. Depth to groundwater at the A-aquifer at Parcel E and E-2 (adjacent to Parcel F Areas VIII, IX, and X) ranges from 5 to 7 feet below ground surface (bgs) and 2 to 15 feet bgs at Parcel B (adjacent to Parcel F Areas I and III) (PRC 1996b; Tetra Tech 2003c). Detailed information about groundwater in Parcels E and E-2 is presented in the Final Parcel E Groundwater Summary Report for the Phase III Groundwater Data Gaps Investigation (Tetra Tech 2003c). Detailed information about groundwater in Parcel B is presented in quarterly reports summarizing the remedial action monitoring program (RAMP) (for example, CE2-Kleinfelder 2006).

1.4.3 Climate and Hydrodynamic Setting

The climate in the vicinity of HPS is characterized by partly cloudy, cool summers with little precipitation and mostly clear, mild winters with moderate precipitation. Most of the annual precipitation falls between November and April. Summer temperatures are influenced by low fog in the mornings and a steady flow of marine air from the Pacific Ocean in the afternoons. Extremely hot or cold temperatures are rare because of the marine air flow. The warmest temperatures in the area occur near the coast in late summer and fall (U.S. Soil Conservation Service 1991).

From 1948 through 2004, the recorded average daily air temperature at the San Francisco International Airport, located 10 miles south of Hunters Point, ranged from a monthly low of 42.4 °F in January to a monthly high of 73.5 °F in September. The recorded average monthly precipitation at the San Francisco International Airport for the same period ranged from a low of 0.02 inch in July to a high of 4.47 inches in January (Western Regional Climate Center 2005).

Area III. Results of the sediment dynamics study conducted in Area III of Parcel F (offshore from Point Avisadero) indicated that surface sediment was resuspended 16 percent of the time during the winter deployment in 2001, and 4 percent of the time during the summer deployment. (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). Resuspension was credited to strong tidal currents. Strong tidal currents pass Point Avisadero, flowing southeast during flood tides and north-northwest during ebb tides (except along the northern shoreline, where an eddy current flows to the southeast). Overall, the net residual circulation and sediment flux in the area is to the southeast (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). Elevated levels of contamination are generally not found at water depths of greater than minus 65 feet MLLW, which suggested that any sediments transported to this depth were advected away from the site. The shelf to the north and west of Point Avisadero is a net depositional environment. Subsurface peaks of contamination at many stations also indicated that net deposition has occurred since the time of contaminant release (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

Area X. Circulation in South Basin is restricted and tidal currents are very weak. The most significant sediment resuspension occurs as a result of storm waves that are generated from the southeast winds during the winter. Sediment stability was evaluated in the South Basin in Parcel F by analyzing site-specific critical shear stress and erosion rate data provided by Sedflume measurements in conjunction with hydrodynamic measurements conducted during the Parcel F Validation Study (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005; Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). The data were used to assess the likelihood that sediment would erode under typical and extreme hydrodynamic conditions and to predict the maximum depth of erosion. Hydrodynamic measurements of waves and currents were conducted in the South Basin during a winter month and a summer month to characterize the seasonal hydrodynamic conditions. In addition, close to 8 years of continuous wind measurements were obtained from the National Oceanic and Atmospheric Administration's offshore buoy 46026 located 18 miles west of San Francisco. These measurements were used for analysis of extreme wind events and to calculate the maximum wave height possible in South Basin. The maximum wave height from the analysis was used in conjunction with the site-specific hydrodynamic measurements to calculate a maximum sustained bottom shear stress exerted on sediments in the South Basin. According to the analysis, up to 4.2 centimeters of erosion may be expected in a typical year during a winter storm event, whereas the maximum probable erosion during a 25-year event was estimated to be approximately 6 centimeters assuming a maximum event duration of 18.6 hours (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). It should be noted that the model used to predict depth of erosion does not predict deposition. Radioisotope data from South Basin cores indicates that the net sediment accumulation rate is approximately 1 centimeter per year (cm/yr). Appendix F of the FSDG Technical Memorandum (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) provides a detailed description of the investigation.

1.4.4 Ecology

Parcel F includes three marine habitats that blend with one another in transition zones: open water aquatic, intertidal wetland, and bay mudflats. Many species of mobile marine animals move among these habitats, either daily with the tides or seasonally. The subsections below describe typical species in the open water, intertidal wetland, and mudflat habitats at Parcel F.

1.4.4.1 Open-Water Habitat

The shallow bay habitat of Parcel F is a feeding area for dozens of species of fishes, many with commercial or recreational value, including the Pacific herring (*Clupea harengus palasii*), northern anchovy (*Engraulis mordax*), lingcod *(Ophiodon elongatus),* starry flounder *(Platichthys stellatus),* jacksmelt (*Catherinops californiensis*), and several surfperches (Family Embiotocidae), as well as at least 40 other species of fish, crabs, and shrimp. Jacksmelt dominated catches in terms of biomass and abundance during sampling for the human health evaluation. A variety of surfperch species (such as shiner surfperch, black surfperch, walleye surfperch, white surfperch, and silver surfperch) were also caught in this area.

Pacific herring spawn on hard substrates and in eelgrass along the shallow margins of the central bay, including Parcel F (URS Corporation 2006). Shallow bay habitat is also a nursery area for juvenile halibut and sanddabs (*Citharichthys stigmaeus*), leopard shark, shiner perch (*Cymatogaster aggregata*), herring, and other fishes.

The abundance of fishes and marine invertebrates in the nearshore shallow waters of Parcel F supports a diversity of birds that feed on them, including double-crested cormorant *(Phalacrocorax auritus)* and several dabbling and diving duck species such as the surf scoter *(Melanitta perspicillata)*. The waters near the wetland habitat are commonly occupied by large numbers of wintering ducks, including bufflehead *(Bucephala albeola),* lesser scaup *(Aytha affinis),* barrow's goldeneye *(Bucephala islandica),* and surf scoter (PRC 1996b).

The birds observed at Parcel F are representative of species assemblages known to occur in the bay. Diving ducks consisted of up to 75 percent of the bay's waterfowl, depending on the month, during a bay-wide winter bird survey conducted in 1990 (Accurso 1992). More recent mid-winter surveys (1998 to 2000) reported that scaup made up about 67 percent of waterfowl in the open water of the central bay. Scoters were the next most abundant birds, representing more than 29 percent of total waterfowl in the central bay (U.S. Fish and Wildlife Service [FWS] 2005). These diving birds feed on benthic invertebrates such as mollusks and crustaceans.

Marine mammals observed using the bay waters around HPS include the California sea lion *(Zalophus califorinanus)* and harbor seal *(Phoca vitulina)*. Harbor seals, which are the only marine mammals that are permanent residents in the bay, use rocks or sandflats as resting areas (haul-out sites). No haul-outs occur near Parcel F (URS Corporation 2006).

The sediments that underlie the open water can be many feet thick; however, only the surface sediments are considered biologically active. The nature and thickness of the biologically active zone was assessed during the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). Results of a literature review indicated that the depth of the biologically active zone in marine sediments averages about 10 centimeters and rarely exceeds 30 centimeters. A well-mixed zone is usually found above the redox potential discontinuity (RPD). Below the RPD, a mid-depth zone is characterized by decreasing bioturbation with increasing depth. A deep mixing zone can extend from the mid-zone to more than 1 meter into the sediment. Observations of biota in sediment cores collected during the Parcel F Validation Study (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005), and the Sedflume cores collected in 2003 are consistent with this pattern (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). A well-mixed oxidized zone from 2 to 10 centimeters thick was reported. Polychaetes and burrows were observed to depths of 20 to 30 centimeters, although at lower densities than in the surficial layer. In addition, sediment profile images obtained at 20 stations in the South Basin demonstrated that the mean apparent depth of RPD was 2 to 10 centimeters, indicating the approximate depth of active bioturbation and porewater exchange caused by bioturbation. Feeding voids were observed to depths up to 15 centimeters, which possibly indicated the particle mixing depth by head-down feeders (polychaetes) (Germano & Associates, Inc. 2004).

1.4.4.2 *Intertidal Wetlands and Mudflats Habitat*

About 3 acres of intertidal wetlands are located along the Parcels E and E-2 shoreline (Tetra Tech 2002), which is adjacent to the South Basin Area of Parcel F. The Parcel B shoreline includes about 1.5 acres near the India Basin (Area I) of Parcel F, as well as a small area of tidal marsh (SulTech 2006a). Other areas are heavily riprapped to control erosion. Field observations of both Parcels B and E show similar habitats and species assemblages. Vegetation observed in the tidal wetlands includes halophytic plant species typically associated with tidal salt or nontidal salt marshes. The dominant plant species are common pickleweed (*Salicornia virginica*) and saltgrass (*Distichlis spicata*). Except for the ice plant (*Carpobrotis edulis*), little vegetation was observed along either the Parcel B or E shoreline (Tetra Tech 2002; SulTech 2006a).

The areas of shoreline that are rip-rapped support species that attach to or use hard substrate for shelter, including crabs, isopods, mussels (mainly *Mytilus edulis*), and barnacles. Barnacles and mussels generally attach to hard structures and filter food from the water column. Crabs and isopods typically find shelter under rocks, where they feed on other small invertebrates. However, clams were not observed along the riprap at Point Avisadero (Area III) (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005).

The soft Bay Mud substrate provides habitat for many benthic invertebrates, including worms (oligochaetes and polychaetes), crustaceans, copepods, isopods, insects, gastropods, and bivalves. The intertidal mudflats in the South Basin are exposed at low tide, making benthic invertebrate prey available to a variety of foraging birds. Birds reported or expected to forage in the intertidal wetlands and mudflats or in adjacent offshore areas include the black-bellied plover (*Pluvialis squatarola*), black turnstone (*Arenaria melanocephala*), sanderling (*Calidris alba*), western sandpiper *(Calidris mauri)*, long-billed curlew (*Numenius americanus*), dunlin (*Calidris alpine*), double-crested cormorant (*Phalacrocorax auritus*), and surf scoter (*Melanitta perspicillata*). Wading birds, such as the willet (*Catoptrophorus semipalmatus*), killdeer (*Charadrius vociferous*), and great blue heron (*Ardea herodias*), may also use the shoreline area. Some carnivorous birds move easily between intertidal and upland habitats; these include the American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), and peregrine falcon (*Falco peregrinus*) (Harding Lawson Associates 1991; PRC 1996b; Tetra Tech and LFR 2000).

Fish move over the area to feed when high tide covers the bay flats. Nearshore fishes typical of the bay include longfin smelt (*Spirinchus thaleichthys*), staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), and leopard shark (*Triakis semifasciata*) (URS Corporation 2006).

No mammals are known to occur on the bay flats at HPS. Mammals observed along the shoreline include the California ground squirrel (*Spermophilus beecheyi*), which uses the riprap areas for burrows. In October 2001, an almost-complete skeleton of a large male raccoon (*Procyon lotor*) was found along the shoreline of the Parcel E-2 Panhandle Area. In addition, the house mouse (*Mus musculus*) is expected to use the shoreline for forage and shelter (Tetra Tech and LFR 2000).

1.5 NATURE AND EXTENT OF CONTAMINATION

Sediment is the medium of interest for this FS Report based on the previous investigations at Parcel F. This section describes the evaluation of the nature and extent of chemicals detected in sediment collected from Parcel F. The Final Validation Study Report (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005) and the FSDG Technical Memorandum (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) describe in detail the chemical distribution in sediments of Parcel F. The nature and extent of chemicals in sediment are described for the following five subareas of Parcel F: Area I (India Basin), Area III (Point Avisadero), Area VIII (Eastern Wetland), Area IX (Former Oil Reclamation Ponds Area), and Area X (South Basin). Only Areas III and X are the focus of this FS for addressing risks posed by subtidal sediments. The remaining areas (I, VIII, and IX) are included in this FS Report because source control measures were implemented along the shoreline of these areas to minimize potential contamination of Parcel F.

1.5.1 Area I

Analytical results for surface sediment samples (0 to 5 centimeters) indicated that chemical concentrations generally were less than San Francisco Bay ambient threshold levels and ER-M values in Area I (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005). Similar to the analytical results for surface sediments, the lowest chemical concentrations in subsurface sediments in Parcel F were found in Area I, as well as Area VIII. Concentrations of mercury in one subsurface sediment core sample collected from 2 to 4 feet bgs in Area I slightly exceeded the ER-M value of 0.71 milligram per kilogram (mg/kg). Otherwise, all concentrations of metals from subsurface sediment cores collected in Area I were below ER-M values , as were all organic chemical concentrations (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005).

1.5.2 Area III

Copper was detected at elevated concentrations relative to San Francisco Bay ambient threshold and ER-M values in surface sediment samples collected in Area III during the Validation Study and the FSDG Investigation (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005; Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The highest concentration of copper (6,550 mg/kg) was found in the sample (0 to 5 centimeters) collected at a sampling location immediately offshore of the northeast point of land at Point Avisadero. Concentrations of lead also exceeded its ER-M value in a surface sediment sample from one sampling location in Area III from samples collected during the Validation Study. Concentrations of mercury in surface sediment collected during the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) and the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) exceeded the San Francisco Bay ambient threshold level and exceeded the ER-M values.

Metals concentrations also exceeded ER-M values in subsurface sediment samples although the distribution of the exceedances was localized and discontinuous. Concentrations of copper in subsurface sediments were highest (more than 500 mg/kg) within about 200 feet from the shoreline, to a water depth of approximately minus 65 feet MLLW, and extending to a depth of at least 60 to 90 centimeters (2 to 3 feet) in subsurface sediments from some locations. Although the general spatial distribution of copper is similar to mercury, the two metals do not appear to co-occur (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005)

Concentrations of mercury in subsurface sediment were highest (more than 2 mg/kg) in subsurface sediment samples from locations north and northeast of Point Avisadero, within about 200 feet of the shoreline (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005. The highest concentrations of mercury were detected in subsurface samples from the 5- to 15-centimeter (0.16- to 0.5-foot) depth interval, although concentrations above 2 mg/kg were also detected in subsurface sediment samples from the 60- to 90-centimeter (2- to 3-foot) depth interval (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The highest concentration of 252 mg/kg was detected in the sample collected from the 30- to 45-centimeter (1- to 1.5-foot) depth interval at a location (PA-165) east to northeast of Point Avisadero (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) (see Figure 2-21 in Attachment 1). High concentrations of mercury in sediment in localized sampling locations with large differences in concentration between adjacent sampling locations were commonly observed.

PCB concentrations exceeded the ER-M value in surface sediment samples collected from Area III during both the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) and the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). Figures 2-24a through 2-24f in Attachment 1 show the distribution of PCBs based on rapid sediment characterization (RSC) data in Area III sediments with increasing depth as measured in the FSDG investigation. The extent of high total PCB concentrations (above 1,000 micrograms per kilogram [μg/kg]) is not as widespread as the area affected by high concentrations of total copper and mercury (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). High total PCB concentrations (approximately 2,000 to 6,000 μg/kg) were detected in subsurface sediment samples from the 45- to 60-centimeter (1.5- to 2.0-foot) and 60- to 90-centimeter (2- to 3-foot) depth intervals at two locations east to northeast of Point Avisadero (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) (see Figures 2-24e and 2-24f in Attachment 1).

1.5.3 Area VIII

Area VIII surface sediment samples (0 to 5 centimeters) had chemical concentrations generally less than San Francisco Bay ambient threshold levels and ER-M values (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). Similar to the analytical results for surface sediments in Area I, the lowest chemical concentrations in subsurface sediments were found in Area VIII.

1.5.4 Area IX

Concentrations of mercury in surface sediment collected during the Validation Study exceeded the San Francisco Bay ambient threshold level but did not exceed the ER-M values (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). Similarly, PCB concentrations exceeded the ER-M value in surface sediment samples collected from Area IX during both the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) and the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

1.5.5 Area X

Copper was detected at concentrations that exceeded the San Francisco Bay ambient thresholds in sediment surface samples collected in Area X during the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). Concentrations of mercury in surface sediment collected during the Validation Study exceeded the San Francisco Bay ambient threshold level and ER-M value. The highest subsurface concentrations of metals in Area X were found in the top 0- to 60-centimeter (0- to 2-foot) core interval in the Validation Study and were generally found in the samples collected along the eastern shore of Area X and near the mouth of Yosemite Creek. Concentrations of metals in sediment did not exceed the ER-M value in any of the 4- to 6-foot cores during the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005).

Pesticides detected in surface sediment samples collected during the Validation Study were primarily found in Area X (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). The detected pesticides were 4,4'-dichlorodiphenyldichloroethane (DDD); 4,4'-dichlorodiphenyldichloroethene (DDE); 4,4'-DDT; gamma-chlordane; alpha-chlordane; and dieldrin. The distribution of total DDx (sum of 4,4'-DDT; 4,4'-DDE; and 4,4'-DDD) in surface sediments was highest in Area X but remained within the range observed in San Francisco Bay ambient (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). The highest concentrations of total DDx were found in samples collected along the eastern shore of South Basin and near the mouth of Yosemite Creek.

PCB concentrations exceeded the ER-M value in surface sediment samples collected from Area X during both the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) and the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The highest total PCB concentration found in surface sediment was approximately 7,000 µg/kg in a sample from the northeast shoreline of South Basin as part of the FSDG investigation. Total PCB concentrations decreased in samples collected farther from the eastern shoreline of the Area X and increased again in samples collected near the mouth of Yosemite Creek (see Figures 2-4a through 2-4f in Attachment 1). The PCB concentrations in surface sediments in South Basin are generally highest (>2,000 µg/kg) at the north end of South Basin, near the area where the former slough connects with South Basin.

Overall, PCB concentrations are higher 1 foot below the surface than at the surface in Area X. Attachment 1 includes plan view maps (see Figures 2-4a through 2-f) of PCB concentrations with increasing depth below the mudline based on the 2003 FSDG investigation data (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The plan view maps represent horizontal slices at 0.5-foot intervals through the three-dimensional model. At a depth of 1 foot below the mud line, the area with PCB concentrations greater than 2,000µg/kg is more extensive, both at the north end of South Basin and at the mouth of Yosemite Creek. At 1.5 feet below the mud line, the area of highest PCB concentrations decreases in vertical extent at the north end of South Basin and increases in vertical extent at the mouth of Yosemite Creek. At 2.5 feet below the mud line, PCB concentrations greater than 2,000 µg/kg at the northern end of South Basin are limited to the vicinity of Station SB-076, whereas the affected area at the head of Yosemite Creek has not diminished substantially with depth. The vertical extent limit of PCB concentrations above 2,000 µg/kg at the head of Yosemite Creek was not delineated that investigation. The highest surface concentrations are found along the northeastern shoreline of the South Basin, south of the Parcel E-2 landfill (Tetra Tech 2003a; Navy 2005).

1.5.6 Nature and Extent of Contamination Summary

Chemistry results for sediment in the five study areas in Parcel F indicated that chemical concentrations were generally not elevated above ambient threshold levels and ER-M values in Areas I, VIII, and IX. The highest chemical concentrations were found in Areas III and X. The horizontal and vertical distribution of chemicals in Area III sediments is localized and discontinuous rather than exhibiting a gradient away from a well-defined source. Chemicals of potential concern did not tend to co–occur in Area III, which suggests an episodic input of contamination.

In Area X, the highest concentrations of metals (copper, lead, and mercury) and PCBs in surface sediment are found along the eastern shoreline of Area X. Chemical concentrations in this area decrease with increasing distance from this eastern shoreline. The highest concentrations of metals and PCBs generally were found in the 0- to 2-foot interval. Concentrations were significantly lower in the 2- to 4-foot and the 4- to 6-foot depth intervals. The highest PCB concentrations in South Basin were found in subsurface sediment samples from the mouth of Yosemite Creek. Concentrations of metals and some pesticides also were elevated in samples collected near the mouth of Yosemite Creek.

1.6 FATE AND TRANSPORT OF CHEMICALS TO PARCEL F SEDIMENTS

This section summarizes the potential fate and transport of chemicals of concern at Parcel F and identifies potential historical and ongoing sources of chemicals to the offshore areas. The chemicals of concern (COC) at Parcel F exhibit similar behavior by adsorbing to sediments. Therefore, the primary transport mechanism for chemicals is the movement of sediment via overland flow or erosion. The Navy evaluated the fate and transport mechanisms of contamination reaching Parcel F using multiple lines of evidence from data collected primarily during four field investigations: Parcel F Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005), Parcel E Standard Data Gaps Investigation (Tetra Tech 2003a),

Parcel B Shoreline Characterization (Tetra Tech 2003b; Tetra Tech and Innovative Technical Solutions, Inc. 2004), and the FSDG Investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). Identifying the major transport mechanisms of chemicals reaching Parcel F sediments was necessary to develop remedial alternatives for Parcel F and to address the potential of recontamination once a remedy is in place. Additionally, understanding the time frame and relative magnitude of chemical transport pathways is necessary for adequate consideration of how effective remedial alternatives will be in meeting the RAOs. According to Navy policy and EPA guidance, site managers should identify all direct and indirect continuing sources of significant contamination to sediments as early as possible and before the implementation of a remedial action (Navy 2002; EPA 2002, 2005). This assessment should be followed by an evaluation of the continuing sources that can be controlled. The Navy has used the information gained from these investigations to prioritize source control and removal activities along the Parcels B, E, and E-2 shorelines. The description is organized with respect to each shoreline of HPS. Section 1.6.1 describes the potential sources of contamination to the Parcel F areas: Area I (India Basin) and Area III (Point Avisadero), which are adjacent to Parcel B, and the potential sources along the Parcels E and E-2 shoreline, which is adjacent to Areas VIII, IX, and X in Parcel F. Section 1.6.2 describes the source control measures implemented in onshore areas adjacent to the Parcel F areas.

1.6.1 Potential Sources and Transport Mechanisms of Contamination to Sediments in Parcel F

Area I (India Basin) and Area III (Point Avisadero): Installation Restoration (IR) sites 07 and 26 (IR-07 and IR-26) at Parcel B were identified during the Validation Study conducted in 2000 as potential historic source areas that could have resulted in the transport of contaminated soil to Areas I and III by overland flow and through the storm drains that empty along the Parcel B shoreline. IR-07 comprises approximately 9.5 acres in the northwestern portion of Parcel B (Tetra Tech and Innovative Technical Solutions, Inc. 2004). IR-07 is also known as the submarine base area. IR-07 was used for sandblasting and painting submarines. After 1948, IR-07 was filled with soil, rock and construction debris and by 1963 was completely filled (Tetra Tech and Innovative Technical Solutions, Inc. 2004). IR-26 is located on the eastern portion of Parcel B and located adjacent to Area III (Point Avisadero). The shoreline of IR-26 consists of heavy riprap that was placed for erosion control. In addition, the drainage tunnel at Dry Dock 3 may have acted as a conduit for contaminated material reaching Parcel F during the dewatering operations of the dry dock. Waste material from the dry docks—including paint chips, sandblast waste, oils, and other chemicals associated with ship maintenance and repair—may have been carried to the offshore area.

The Navy also evaluated the shoreline soils and sediments along Parcel B (upland to Areas I and III) in 2002 and 2003 to investigate the possible presence of contamination along the shoreline. The results of this investigation are described in the Parcel B Shoreline Characterization Technical Memorandum (Tetra Tech and Innovative Technical Solutions, Inc. 2004). These data indicated that nine metals (antimony, arsenic, barium, cadmium, copper, lead, manganese, thallium, and zinc) were present at concentrations above HPS ambient levels at IR-07. Polynuclear aromatic hydrocarbons (PAH), several pesticides, PCBs, and total petroleum

hydrocarbons also were detected. IR-26 contained soils contaminated with metals (chromium, copper, lead, and mercury) and PAHs (Tetra Tech and Innovative Technical Solutions, Inc. 2004). Two sandy shoreline areas were identified as having the potential for contaminating the offshore areas in Parcel F. These two areas are now being addressed as part of the evaluation of remedial alternatives for Parcel B in the Technical Memorandum in Support of a Record of Decision (ROD) Amendment (TMSRA) (SulTech 2006a).

The sediment chemistry results from Validation Study and FSDG investigation provided further evidence that the contamination in Area III was likely a result of episodic input (Battelle, BBL, Neptune & Company, and Sea Engineering Inc. 2005; Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The distribution of copper, mercury, and PCBs in sediment is localized, not continuous, and occurs at varying depths. It is possible that waste material was delivered to the area from the Navy ships during berthing operations and maintenance.

Areas VIII, IX, and X (Parcels E and E-2 Shoreline): The Navy suspected that metals and PCBs along the Parcel E and E-2 shoreline were a source of contamination to Parcel F sediments and conducted a Validation Study at Parcel F in 2000 in part to investigate potential chemical transport mechanisms (Battelle, BBL, Neptune & Company, and Sea Engineering Inc. 2005). Potential historical sources of contamination to offshore sediments were identified and included stormwater outfalls and two metal reefs, which were composed of metal and other debris annealed into a slag type of material. One area was located along the southeastern tip of the shoreline referred to as the "metal reef" and the second was located along the opposite end of the shoreline known as the Panhandle Area and referred to as the "metal slag area." Leaching and runoff of this material was a potential source of metals to the offshore area. Debris along the entire Parcels E and E-2 shoreline such metal waste, kiln bricks, and sandblast waste may also have been another source of contamination to the offshore area.

A former small arms firing range is located adjacent to Area IX (Former Oil Reclamation Area). Historical activities that may also have contributed to contamination of sediments in Area X of the South Basin include filling and disposal, residual onshore contamination, and surface runoff. The former landfill in Parcel E-2 was used from 1958 to 1974 for the disposal of materials such as construction and industrial debris and waste, domestic refuse, sandblast waste, paint sludge, solvents, waste oils, transformers and electrical equipment, and other potentially contaminated materials. No records to document the contents of the landfill or the disposal practices are available. A former drum storage area previously operated by Triple A Machine Shop, Inc., is also located on the eastern shoreline of Area X. No records exist about the types and quantities of materials stored in this area. If chemicals formerly stored in this area were released to the environment, then they could have been transported to the offshore area via drainage of surface water The Validation Study recommended that the contamination in the shoreline in all areas should be evaluated and addressed as part of the Parcels B and E activities (Battelle, BBL, Neptune &Company, and Sea Engineering, Inc. 2005).

Based in part on the Validation Study recommendation, the Navy decided to evaluate the shoreline along Parcels E, E-2, and B as a potential sources of contamination to Parcel F. The Navy conducted the Parcel E Standard Data Gaps Investigation in 2002 (Tetra Tech 2003a).

Upon review of the chemical results from the onshore and shoreline investigation of Parcels E and E-2, the Navy began prioritizing the source control activities. A time-critical removal action (TCRA) was initiated to address the most significant potential sources of contamination. The TCRAs were implemented along four areas along the Parcels E and E-2 shoreline; the metal slag area along the Panhandle Area, the PCB hotspot area near the landfill, IR-02 Northwest, and the metal debris reef near located in IR-02 near the tip of the Parcel E shoreline. The metal slag reef and IR-02 were identified as being a potential future source of contamination of metals to the Parcel F sediments but were undertaken as a TCRA due to the radiological component of these two sites. The TCRA of the PCB hotspot area was implemented because of its close proximity to in the Area X (South Basin) (Navy 2005). The Shoreline Technical Memorandum documented the results of the shoreline portion of the standard data gaps investigation and built upon the previous work conducted during the Parcel F Validation Study to confirm and refine the conceptual site model for the Area X (South Basin) as developed in the Validation Study. The technical memorandum concluded that most of the Parcels E and E-2 shoreline is a potential source of contamination and that the influx of metals from the shoreline to the offshore is likely from suspended materials transported into the bay by overland flow (SulTech 2005). Shoreline erosion was evaluated by considering the topographic elevation data for Parcels E and E-2. Although the erosion potential is low, erosion can still occur in localized areas along the shoreline.

Analysis conducted as part of the FSDG investigation (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) used the vertical core profiles in the South Basin (Area X), the radioisotope core data, and historical aerial photographs to better delineate how contamination in Parcel F occurred in the South Basin. The distribution of PCBs in the South Basin showed a peak of contamination at about 1 foot below the sediment mud line. This well-defined subsurface PCB concentration peak suggests that the *primary* release occurred over a specific period of time. The radioisotope cores, which indicated a net sedimentation rate of approximately 0.5 centimeters (0.2 inches) per year indicated that the primary release occurred during periods when Parcel E-2 was being filled. This conclusion further suggested that the fill material itself, or waste materials disposed with the fill, served as the primary sources of PCBs to the South Basin. The report concluded that PCBs may have gradually migrated alongshore and offshore into the South Basin from the mouth of the historical slough (see Figure 1-3) by sediment resuspension and transport.

Yosemite Creek is located in the South Basin at the southwestern corner of HPS. Yosemite Creek is listed as a Site of Concern under the Bay Protection and Toxic Cleanup Program (BPTCP) by the San Francisco Bay Regional Water Quality Control Board (Water Board) (1997). Before 1965, three hydraulically separate combined sewer outfalls (CSO) discharged to this area: one at the head of Yosemite Creek, one on the north side of the creek near Griffith Street, and one on the south side near Fitch Street. After 1965, the three overflow structures were hydraulically connected, and the CSO at the head of Yosemite Creek was replaced by an overflow weir located adjacent to the head of the creek on the south side. The wet weather overflows were directed to this weir after 1965. Chemicals identified during investigations of Yosemite Creek by the City and County of San Francisco (CCSF) included metals, PAHs, pesticides, and PCBs (Little 1999). CCSF conducted sediment investigations from 1998 to 2000; some of these data are included in Attachment 1.

Groundwater discharge was evaluated as a potential pathway for migration of metals and PCBs to Parcel F (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005; SulTech 2005). Under atmospheric (oxidizing) conditions and a normal range of pH (6 to 9), copper, lead, zinc, and other metals will not be dissolved in groundwater at more than a few tens of micrograms per liter, based on the mineral phases that control solubility (SulTech 2005). The dissolved concentration for copper in groundwater is maintained at about 10 micrograms per liter by copper hydroxy carbonates. Likewise, the dissolved concentration of lead in oxygenated groundwater is also maintained at low levels (less than 10 micrograms per liter) by the low solubility of lead hydroxy carbonates. Therefore, groundwater in contact with contaminated soils at depth in Parcels E and E-2 is unlikely to contribute to metals contamination in offshore sediments (SulTech 2006b). Data for groundwater samples from four nearshore wells in Parcel E-2 and showed that concentrations of dissolved copper ranged from 1.7 to 4.2 micrograms per liter and concentrations of dissolved lead ranged from 0.9 to 9.3 micrograms per liter in samples collected from 1992 through 2004 (SulTech 2006b). Although mercury has a generally more complex chemistry, transport of mercury by groundwater to Parcel F sediments is also expected to be relatively minor in comparison with other transport mechanisms.

Likewise, due to the hydrophobic nature of PCBs, the groundwater pathway for PCBs has been considered to be insignificant in comparison with shoreline erosion (SulTech 2006b). PCBs are highly immobile in groundwater because of the low aqueous solubility of PCBs under normal pH and Eh conditions. The very low concentration of PCBs in groundwater in comparison with the PCB concentrations found in sediment is further evidence that groundwater is not serving as a transport mechanism for PCBs to the offshore sediments. However, PCBs are more soluble in oils and organic solvents and therefore concern was raised when field observations at the TCRA sites along the Parcel E-2 shoreline adjacent to Area X indicated free hydrocarbon product was present in soil and as sheen on groundwater in areas that groundwater was exposed. Although the occurrence of free product alone does not necessary equate to it being a transport mechanism to Parcel F, the full extent of contamination in the PCB hotspot area is still under investigation. The relative contribution and magnitude of contamination transported by groundwater versus erosion will continue to be investigated while the TCRA at the PCB hotspot area is being completed.

1.6.2 Source Control Measures

Although Areas III and X are the primary focus in this FS Report, all areas of Parcel F are being addressed for source control measures. The subsections below describe the major source control measures implemented along the HPS shoreline to protect against releases to each subarea of Parcel F.

1.6.2.1 Area I (India Basin) and Area III (Point Avisadero)

Excavations at Parcel B at IR-07 and IR-26. Excavations at IR-07 and IR-26 were implemented in 1998 to 1999 and 2000 to 2002. More than 40,000 cubic yards (yd^3) of waste was removed to a depth of 10 feet. The excavations were eventually stopped because of the concern of potential loss of stability of the riprap (Tetra Tech and Innovative Technical

Solutions, Inc. 2004). These areas are currently being evaluated for the feasibility of placing a shoreline revetment as part of the Parcel B TMSRA (SulTech 2006a). The Navy intends to maintain these revetment walls at IR-07 and IR-26 as part of a permanent containment remedy.

Storm Drain Cleaning Program and Dry Dock 3 Tunnel. A program to clean the storm drains was initiated in 1997 because of concerns that contaminated sediment could migrate to Parcel F. Each cleaning event was following by video taping to ensure the cleaning event was successful. Storm drains were cleaned using a high-pressure jetting truck and vactor truck. The storm drains in this area ranged in diameter from 6 to 74 inches. All storm drains were cleaned except those that had inaccessible laterals or when the lines were submerged in water. A description of the storm drain cleaning program is included in the Draft Field Summary Report (IT Corporation 1997). The tunnel at Dry Dock 3 used for dewatering was cleaned in 1997, and the doors were sealed.

1.6.2.2 Areas VIII, IX, and X (Parcels E and E-2 Shoreline)

Parcels E and E-2 Shoreline Cleanup. During summer 2004, the Navy cleaned up the entire length of the Parcels E and E-2 shoreline. Tires, kiln bricks, and concrete blocks were removed and disposed of off site.

Metal Debris Reef Removal. About 11,200 yd^3 of material was excavated during the removal action over a period of 5 months. The area was backfilled to achieve the original grade.

Before Removal Action

After Removal Action

IR-2 Northwest and Central. A total of 50,000 yd^3 of material was removed as part of the removal action to address radiologically affected soils. Imported clean backfill was placed and is ongoing. Over 9,000 yd^3 of soil failed the radiological screening and was disposed of off site, along with approximately 2,000 yd^3 of debris and 1,952 radiological devices. Soil that was visibly contaminated with petroleum or that contained elevated metals concentrations was also disposed of off site (SulTech 2006c).

PCB Hotspot Removal. A total of 44,500 yd^3 of material was excavated and removed. During the removal action, 110 drums and 540 other assorted waste containers were removed. In some

areas excavation depths reached to a depth of 20 feet. A geotextile liner was placed prior to placement of imported clean fill. The area was ultimately hydroseeded and spread with hay.

Excavation up to 20 feet

Hydroseeding and Spreading Hay for Protection

Metal Slag Removal. Excavation activities at the metal slag area took place from May 2005 to January 2006. A total of 8,500 yd^3 of material was excavated and disposed of off site. The Navy is in the process of planning the wetland restoration of this area.

Soil Excavated for Off-Site Disposal

Metal Slag Area after Removal Action

Former Industrial Landfill. In the 1990s, a sheet-pile wall was installed and riprap was placed along the shoreline at Parcel E-2 to control the movement of chemicals into Area X. A cap was placed over most of the landfill after a fire in 2000 (Tetra Tech 2001). This cap was expected to control infiltration of surface water. Further monitoring and investigation were initiated in 2002, including delineating the lateral extent of the landfill, monitoring landfill gas, evaluating liquefaction potential, and delineating and assessing wetlands (Tetra Tech 2002).

Former Oil Reclamation Ponds. A former small arms firing range is located adjacent to Area IX (Former Oil Reclamation Ponds Area). Two oil reclamation ponds were constructed in IR-03, approximately 30 feet from the shoreline within bay fill. The ponds were used from 1944 to 1974 as part of a waste oil reclamation system. Together, the ponds had a capacity of

430,000 gallons. In 1974, the ponds were emptied and filled with soil (Naval Environmental Engineering Support Activity 1984). In 1996, an 800-foot-long sheet-pile wall that was keyed into the Bay Mud was placed adjacent to the shoreline, the ponds were closed, and the shoreline was stabilized in this area by placing a 6-inch clay layer covered by a 1-foot topsoil layer as part of onshore remediation activities (PRC 1996a; Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

Storm Drain Cleaning Program. The program to clean storm drains in Parcel B was initiated based on concerns that contaminated sediment could migrate to Parcel F. Video taping after the storm drains were cleaned was performed to ensure the cleaning activities were successful. The storm drains were cleaned using high-pressure jetting and vactor trucks. A description of the storm drain cleaning program is included in the Draft Field Summary Report (IT Corporation 1997).

1.7 SUMMARY OF HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT RESULTS

This section summarizes the results of the baseline risk assessments conducted for Parcel F.

1.7.1 Human Health Risk Assessment Results

The HHRA for Parcel F was presented in the Final Hunters Point Shipyard Parcel F Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). This study was conducted in accordance with risk assessment guidance from EPA (1989, 1992a). The objective of the HHRA was to calculate potential cancer risks and noncancer hazards associated with exposures to sediment from collection and ingestion of shellfish from HPS. Future adult residents were assumed to collect and consume shellfish from the intertidal areas of HPS. Shellfish have been observed along the shoreline of Parcels E and E-2; however, none were observed during the Validation Study along Parcel B in Area III (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). The direct contact exposure scenario represented an individual wading in the intertidal area and incidentally exposed to sediment during harvesting and cleaning the shellfish. Most of the shellfish collected and consumed by humans is likely to be mussels present along the shoreline and attached to piers (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005).

Risks to children associated with consumption of shellfish were not calculated because, as observed by the San Francisco Estuary Institute (SFEI) (2002), children under the age of 6 years are unlikely to consume shellfish. Only 13 of the SFEI (2001) study participants reported that children under the age of 6 eat locally caught fish, and only 2 percent reported that pregnant or breastfeeding woman eat a portion of the catch. Since 5 percent of the overall seafood consumption among San Francisco anglers is made up of shellfish (Wong 1997), it was assumed that less that 1 percent of Bay Area children under the age of 6 consume shellfish from the bay. However, risks to children from direct contact with sediment during collection of shellfish were estimated, and it was shown that the evaluation of the adult receptor was adequately protective (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005).

Risks from direct contact with sediments were more than 100 times lower than the risks from ingestion of shellfish. The assumption parameters were developed to be adequately conservative, and the consumption rates used in the initial evaluation represented an individual consuming full-body fillets (versus shellfish). On an area-wide basis, cumulative risks to humans from sediments in Parcel F were comparable with risks from ambient conditions in San Francisco Bay, except for exposure to PCBs. In general, risks associated with PCBs were highest on the southern side of HPS, particularly in Areas IX and X. However, the contribution of total PCBs to the area-wide cumulative risk in Areas IX and X is minimal (about 1 percent). Arsenic, chromium, and dioxins were the primary risk drivers for cumulative risk at HPS; concentrations of these chemicals in shellfish tissue were comparable with levels reported for the reference stations. Risks from exposure to total PCBs congeners via ingestion of shellfish were elevated as above the reference level at Area IX and X. The chemical concentrations in shellfish were found to be consistent with or below levels detected at reference locations for all other compounds.

After this risk assessment, the exposure assumptions were refined to better capture the site-specific risks associated with the consumption of shellfish at HPS (see Attachment 2). Wong (1997) reported that shellfish typically represent only 5 percent of total seafood consumption among San Francisco Bay anglers. Therefore, 5 percent of the assumed fish consumption rates was used to evaluate potential risk from the consumption of shellfish at HPS and the results were used to evaluate preliminary remediation goals in Section 2.0.

1.7.2 Human Health Risk Communication Results

Health concerns associated with fish consumption in San Francisco Bay is a regional issue. Concentrations of six chemicals or groups—including mercury, PCBs, dioxins, dieldrin, DDT, and chlordane in fish collected throughout the San Francisco Bay—are elevated enough to pose a potential risk to recreational anglers and have resulted in health advisory warnings (Office of Environmental Health Hazard Assessment [OEHHA] 1994). Although this issue is regional, concern has been raised about the relative risks of consuming locally caught fish at HPS. It is difficult to attribute concentrations measured in fish tissue to one specific source because of the mobility of most recreationally preferred fish species. Therefore, a statistically designed sampling program was developed by Battelle on behalf of the Navy to evaluate whether differences existed between levels of chemicals in fish from the vicinity of HPS and those collected elsewhere in the bay. The evaluation was not designed to estimate risks associated with the site to identify areas for evaluation in this FS Report, but rather was developed for risk communication purposes. (Unless otherwise cited, all information in this section is from Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005.)

The evaluation assumed that all exposure parameters relevant to estimation of risks associated with fish consumption are the same for anglers at both HPS and ambient locations except for fish tissue concentrations. Based on this assumption, a statistically significant difference in tissue concentrations would imply a corresponding difference in risk. Therefore, the objective of the evaluation was to assess whether the concentrations of chemicals in fish tissue near HPS were significantly elevated above reference locations. They data sets were statistically compared to

discern with 95 percent confidence whether the mean of the HPS data was consistent with the mean gathered from the reference locations to determine if they were significantly different.

Fish species commonly associated with human consumption were collected from three areas at HPS and four reference sites in the bay. Fish were collected at HPS from May 12 through May 19, 2001. Fish were collected from the following San Francisco Bay reference sites: San Francisco Pier 7, Berkeley Pier, and the San Mateo Bridge from May 21 through May 23, 2001. A fourth location, Bay Farm, was added on June 13, 2001.

Baited hook and line was the most effective method of collection, mirroring the most common techniques practiced by recreational fishers in these areas. Trawls also were conducted over soft-bottom areas using 16-otter trawl (0.5-inch mesh cod end). The HPS south region and the Berkeley Pier site were trawled; however, no target species were collected. Target species were defined as those species having the greatest potential of bioaccumulating total PCBs and the species most commonly eaten by fishermen.

Catch rates were highest in areas with structure and high tide flows. One of the primary target species (white croaker) for the human health evaluation was not collected at any sampling locations. Jacksmelt was the only target fish species collected at all sampling locations; jacksmelt generally dominated catches in terms of biomass and abundance. Jacksmelt catches were distributed fairly evenly between HPS and San Francisco Bay sites. The third target species, shiner surfperch, was the second most abundant species, although only four individuals were collected from all of the San Francisco Bay reference sites combined. A variety of other surfperch species (such as black surfperch, walleye surfperch, white surfperch, and silver surfperch) were caught and retained for inclusion in the human health evaluation.

Two composites each of jacksmelt and surfperch were prepared from each HPS sampling area (north, east, and south) and the four San Francisco Bay area reference sites. Fish were distributed as evenly as possible between the composites per area. Shiner surfperch were not caught in sufficient numbers at some locations to provide adequate tissue mass, and several surfperch species (shiner, silver, black, and walley) were therefore combined to obtain sufficient tissue for all analyses.

Results of the statistical comparisons of fish tissue data indicated that most of the chemicals present at HPS were statistically similar to ambient levels. Using conservative exposure assumptions, only arsenic in perch and total PCBs in jacksmelt were present at levels above EPA's risk threshold and target residential risk of 10^{-6}. The risks from arsenic at HPS were found to be consistent with risk found at the ambient stations. Further comparisons of the risks from HPS to ambient locations and regional monitoring program data showed that PCB concentrations were three times higher for jacksmelt than at ambient stations and four times higher than the regional monitoring program data for 1997 and 2000. Based on the statistical evaluation, total PCBs in jacksmelt were found to be above ambient levels.

1.7.3 Ecological Risk Assessment Results

Potential ecological effects were evaluated in the offshore sediment using samples from 59 sampling locations in five Parcel F areas (Areas I, III, VIII, IX, and X). Data were collected to address three principal lines of evidence: bulk sediment chemistry, direct toxicity to invertebrates, and bioaccumulation of chemicals by invertebrates under laboratory conditions. Limited field-collected tissue data and toxicity identification evaluation results also were used to support the bioaccumulation and toxicity evaluations. Site-specific data were used to develop preliminary remediation goals and identify areas for consideration in this Parcel F FS Report. (As with the human health risk evaluation, the information in this section is summarized from Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005 unless otherwise noted.)

Sediment toxicity was within acceptable levels throughout Parcel F. Amphipod survival was greater than the defined reference threshold level in all of the five Parcel F areas in a 10-day bulk sediment bioassay. Purple sea urchin (*Strongylocentrotus purpuratus*) larvae exposed to intact sediment-water interface cores developed normally at most stations. Normal larval development was less than the ambient threshold level for San Francisco Bay at 13 of the 59 stations. However, larval toxicity at these stations was not well correlated with elevated chemical concentrations in sediment. Several factors other than elevated chemical concentrations may have contributed to the reduction in larval development observed in this nonstandard test. For example, elevated ammonia concentrations were suspected of causing toxicity at stations in Areas III and VIII, where chemical concentrations are less than ambient levels. Poor water quality, field replicate variability, or the presence of native flora and fauna in the samples cores may have contributed to larval mortality at other stations where reduced larval development was not well correlated with chemical concentrations.

Uptake of chemicals from sediment to benthic invertebrates was evaluated to support risk estimates to birds, such as the surf scoter, that primarily feed on mollusks. Concentrations of chemicals in tissue samples from the clam, *Macoma nasuta,* exposed under standard laboratory protocols to sediments from Parcel F were used to estimate a daily dose to surf scoter that feed on clams in the field. The daily dose of ingested contaminants was estimated using the laboratory clam tissue (after the gut was purged, or depurated), as well as concentrations in sediment from each area of Parcel F. The dose estimate was compared with a daily dose considered safe for the surf scoter and other diving ducks that eat benthic invertebrates.

Chemical concentrations in most sediment samples pose little to no risk to surf scoters in Areas I and VIII. However, surf scoters in Areas III, IX, and X may be at risk from ingested doses of copper, lead, mercury, and PCBs, if the birds obtain more that 50 percent of the daily food intake from these areas. Although risk from lead was suggested by the dose estimate, the risk estimates for reference sites were also high because of the low toxicity reference value (TRV) for birds. Therefore, the risk could not be distinguished from the risk posed by ambient levels of lead in sediment throughout San Francisco Bay. Copper, mercury, and PCBs were identified as the primary risk drivers to the surf scoter in Areas III, IX, and X; lead was identified as a potential but unquantifiable contributor to risk. However, no further effort to quantify risk posed by lead

is warranted because the highest lead concentrations are found in the same areas as high concentrations of other metals or PCBs.

The Validation Study concluded that Area III (Point Avisadero) and Areas IX and X (South Basin) pose potential risk to birds feeding on benthic invertebrates and fishes. In Area III, copper and mercury were identified as the primary risk drivers; PCBs are of greatest concern in Areas IX and X. These chemicals also exceeded concentrations considered safe for benthic invertebrates directly exposed to sediment. No unacceptable ecological risk was indicated by sediments in Areas I (India Basin) or VIII (Eastern Wetland).

2.0 REMEDIAL ACTION OBJECTIVES

This section presents the remedial action objectives (RAO) and defines the areas at Parcel F Hunters Point Shipyard (HPS) that require remediation based on the RAOs. RAOs are medium-specific goals for protecting human health and the environment. Each RAO specifies (1) the chemicals of concern (COC), (2) the exposure routes, and (3) the receptors. RAOs include both an exposure pathway and a remediation goal for chemicals for a given medium because protectiveness can be achieved in two ways: by limiting or eliminating the exposure pathway, or by reducing or eliminating chemical concentrations. The RAOs are intended to provide a general description of the cleanup objectives and provide the basis for the development of specific remediation goals. The remediation goals should permit a range of alternatives to be developed, including each of the three major approaches (monitored natural recovery [MNR], capping, and removal) (U.S. Environmental Protection Agency [EPA] 2005).

The following RAOs were identified for Parcel F based on the results of the Final Parcel F Validation Study (Battelle, Blasland, Bouck & Lee, Inc. [BBL], Neptune & Company, and Sea Engineering, Inc. 2005):

1. Reduce the risk of benthic feeding and piscivorous birds, including surf scoters, to acceptable levels from exposure to copper, mercury, and polychlorinated biphenyls (PCB) through consumption of contaminated prey and incidental ingestion of sediment.

2. Limit or reduce the potential risk to human health from consumption of shellfish from Parcel F.

3. Limit or reduce the potential biomagnifications of total PCBs at higher trophic levels in the food chain to reduce the potential risk to human health from consumption of sport fish.

The COCs (copper, mercury, and total PCBs) in sediment were identified based on potential risks to ecological receptors. PCBs also were shown to cause potential risk to humans who consume shellfish collected at HPS. Section 2.1 describes development of the specific remediation goals to meet the RAOs listed above. Section 2.2 summarizes the potential applicable or relevant and appropriate requirements (ARAR) identified for Parcel F.

Numerical remediation goals were not developed for the third RAO because the mobility of fish results in uncertainty in calculating the magnitude of PCB fish tissue loading that could be attributed to the COCs in Parcel F sediments. U.S. Department of the Navy (Navy) guidance, "Policy on Sediment Site Investigation and Response Action," states that all response actions for sediment must be directly linked and scientifically connected to Navy Comprehensive Environmental Response, Compensation, and Liability Act- (CERCLA) and Resource Conservation and Recovery Act (RCRA)-contaminated releases (Navy 2002). Although contamination at Parcel F may have contributed to PCB levels in fish tissue, it is difficult to

distinguish quantitatively the level from COCs contributed by Navy sources versus those contributed by non-Navy sources (from the surrounding San Francisco Bay).

In addition, EPA guidance states that "when developing RAOs, project managers should evaluate whether the RAO is achievable by remediation of the site or if it requires additional actions outside the control of the project manager. For example, complete biota recovery may depend on the cleanup of sources regulated by other authorities" (EPA 2005, pg 2-15). The entire San Francisco Bay is listed as a toxic hot spot under the Bay Protection and Toxic Cleanup Program because of the elevated PCBs concentrations in fish tissue caught in the bay in 1994. San Francisco Bay was subsequently placed on the Clean Water Act Section (§) 303(d) list based on the concentrations of PCBs in fish tissue.

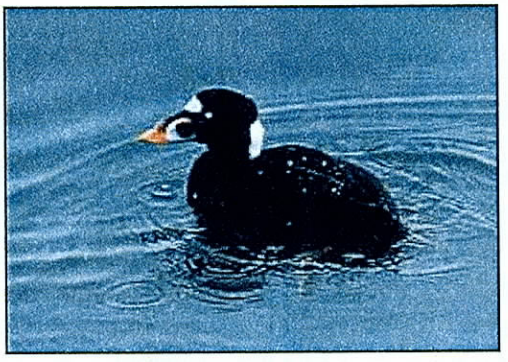
2.1 DEVELOPMENT OF REMEDIATION GOALS

This section presents the process used to develop remediation goals for sediment at Parcel F. The process included developing risk-based concentrations for the COCs before the final remediation goals were selected.

2.1.1 Risk-Based Concentrations

Development of preliminary remediation goals to address RAO 1: *Reduce the risk of benthic feeding and piscivorous birds, including surf scoters, to acceptable levels from exposure to copper, mercury, and PCBs through consumption of contaminated prey and incidental ingestion of sediment to an acceptable level.*

Preliminary remediation goals for copper, mercury, and PCBs in sediment were developed to address the first RAO (that is, protection of benthic feeding and piscivorous-eating birds). These goals were developed using the data from collocated sediment and laboratory-exposed *M. nasuta* tissue concentrations in a food chain model based on risk to the surf scoter (see picture to the right). The preliminary remediation goals were strongly influenced by the choice of site use factor (SUF), which is an estimate of the proportion of the surf scoter's daily diet that is obtained from the area under investigation. For example, assuming the surf scoter foraged exclusively at Parcel F (a SUF of 1.0), the preliminary remediation goals would be 135 milligram per kilogram (mg/kg) dry weight for copper, 0.94 mg/kg dry weight for mercury, and 620 micrograms per kilogram (µg/kg) dry weight for PCBs. However, assuming the surf scoter obtained only 10 percent of its daily intake from Parcel F (a SUF of 0.1), then the preliminary remediation goals would be 13,500 mg/kg dry weight for copper, 94 mg/kg dry weight for mercury, and 62,000 µg/kg dry weight for PCBs.



The analysis of ecological exposure and effect relies on several assumptions. Food chain models assume that the animal evaluated is actually exposed to conditions similar to those described by the model and that the effects in individual test animals reported in the literature have some ecological significance to populations of animals in the wild. The assumption of exposure is met because it is well known that the surf scoter ingests sediment and benthic invertebrates in San Francisco Bay. However, actual SUFs for the surf scoter at Parcel F are unknown. The surf scoter is common in San Francisco Bay from late September to early May; many individuals spend approximately 7 to 8 months in the area (Zeiner and others 1990). Large-scale tracking studies have been undertaken to document the movement of surf scoters between winter foraging areas and summer nesting areas. However, no studies of local habitat during winter foraging periods have been done. Surf scoters are numerous at Parcel F, but it is not known whether individuals spend time in a localized area or if the flocks move around throughout the day. Therefore, the actual SUF remains an uncertainty. The preliminary remediation goals were derived assuming that a substantial proportion of the surf scoter population that winters on San Francisco Bay obtains essentially all of their food from sediments in Areas III, IX, or X; a SUF of 1.0 is the most protective exposure assumption possible.

Along with exposure, the principal assumption concerning risk is that the effects recorded in laboratory studies are actually experienced by animals of interest at the site investigated. The preliminary remediation goals were derived using a standard food chain model that centers on a toxicity reference value (TRV), which is a daily dose of a chemical ingested by test organisms over a period of weeks or months that causes no adverse effect. The low TRVs were used to calculate the preliminary remediation goals presented in the Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005); these are conservative values that represent no observed adverse effects levels. The duration of exposure for chemicals that bioaccumulate, such as mercury and PCBs, can significantly affect the amount of the chemical retained by the animal.

Copper

Based on a SUF of 0.5 or greater, estimated ingested doses of copper exceeded the low TRV for surf scoters in Area III only. The exposure scenario for surf scoters is not well represented by the toxicity data used to derive the TRV, resulting in uncertainty about the actual probability of the effects of copper on the surf scoter. The low TRV for copper was derived from a study in which newly hatched chickens were fed copper for 8 weeks, starting on the day they hatched. The effect of interest in the study was weight gain; however, the surf scoters that forage on San Francisco Bay in the winter are adults. Nesting and chick-rearing occur far to the north during the summer. Although weight gain in chicks is of critical importance, this effect is of limited relevance to predicting effects of copper on adult surf scoters that forage at Parcel F.

A recent study of the effects of metals on diving ducks wintering in California showed that concentrations of several inorganic chemicals, including cadmium and mercury, in the tissues of scaup and canvasbacks are positively correlated with impaired body condition (Takekawa and others 2002). Concentrations of copper were slightly elevated in the diving duck samples

collected from San Francisco Bay when compared with other coastal California sites, but no effect of copper on body condition was indicated.

Assuming the surf scoter obtained 100 percent of its daily intake from clams taken from Area III, the preliminary remediation goal for copper would be 135 mg/kg. However, sampling showed that the benthic community in Area III is dominated by soft-bodied invertebrates rather than the clams and mussels that the surf scoter prefers, making it exceedingly unlikely that a SUF of 1.0 represents actual surf scoter foraging in Area III. Using a SUF of 0.5, meaning that the surf scoter obtains half of its daily intake from Area III, the preliminary remediation goal is about the same as the ER-M value (270 mg/kg).

Mercury

Potential risk to surf scoters ingesting *M. nasuta* exposed to sediment from Area III under laboratory conditions was modeled for Area III. The estimated dose to a surf scoter consuming a diet of nondepurated *M. nasuta* exclusively obtained from Area III (that is, SUF of 1.0) exceeded the low TRV, resulting in a hazard quotient of 4.15. Under these specific circumstances, mercury can be said to pose a risk to the surf scoter in Area III.

However, puzzling issues are raised by the data. For example, the mercury concentrations in depurated clams and in soft-bodied invertebrates collected from Area III were considerably lower than the mercury concentrations in the nondepurated clams. This result contrasts with what is seen for PCBs, where depuration had little effect on *M. nasuta* concentrations, and soft-bodied invertebrates were significantly more contaminated than *M. nasuta*. The small sample size precludes any additional analysis.

The low TRV for mercury was taken from the Great Lakes Water Quality Initiative (EPA 1995), which reviewed toxicological studies on birds. The TRV is based on a study in which mallards were fed methylmercury for three generations; the lowest observed adverse effect level, based on reproductive effects, was converted to a no observed adverse effect level of 0.039 mg/kg-day.

The preliminary remediation goal derived from the dose equation was 0.94 mg/kg, assuming a SUF for the surf scoter of 1.0. Field sampling results indicated mussels and clams consumed by the surf scoter are rare in the Area III sediments, which calls into question the SUF of 1.0.

Regarding risk to benthic invertebrates, sediments in Area III fall into two spatial groups. Mercury in 5 of the 19 samples collected during the Parcel F Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) exceeded the ER-M value, although the concentrations in 4 of those samples were less than twice the ER-M value. Only one sample contained mercury at concentrations five times the ER-M value. Mercury contamination is not widespread throughout Area III. Samples with mercury at concentrations that exceed the ER-M value were clustered near the tip of the pier. The highest concentration of mercury measured during the Validation Study was in the same sample that contained the maximum concentration of copper. However, this sample demonstrated no toxicity to either amphipods (survival was

89 percent) or to sea urchin larvae (normal development was 97 percent), raising questions about the actual toxicity of copper and mercury to invertebrates in Area III. The highest copper and mercury concentrations from the Feasibility Study Data Gaps (FSDG) Investigation found in Area III were in subsurface samples (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

PCBs

The low TRV for PCBs, which was used to derive the preliminary remediation goal, was based on a study by Platonow and Reinhart (1973) in which Aroclor-1254 was administered in feed to chickens for 39 weeks. A dose of 880 µg/kg-day resulted in reduced egg production. This study reported that PCBs accumulated in tissues were transferred to the egg during laying. Concentrations passed to the egg reached a maximum after several months of ingestion by the hen. This finding suggests that longer exposure durations may more accurately predict reproductive effects caused by PCBs. An uncertainty factor of 10 was applied to the dose to convert the effect level to a no-effect-level equivalent. The resulting bird low TRV is 90 µg/kg-day. Back-calculating a concentration in sediment that would result in a daily dose equal to the low TRV provides a preliminary remediation goal of 620 µg/kg dry weight for PCBs, averaged over the area of interest.

A single composite sample of hard-bodied invertebrates, composed of clams and mussels, was collected from each area in Parcel F except in Area III, where no clams were found. Despite the small sample size, the preliminary remediation goal was derived using the hard body invertebrate data in place of the laboratory *M. nasuta* data as an exploratory step toward validating the protectiveness of the preliminary remediation goal based on the *M. nasuta* data. When results for the field-collected clam samples were substituted in the dose equation as the prey of the surf scoter, assuming a SUF of 1.0, the preliminary remediation goal for PCBs was 27 percent higher (790,000 µg/kg) than the goal based on the laboratory-exposed *M. nasuta* as prey. This comparison supports the protectiveness of the preliminary remediation goal developed using laboratory *M. nasuta* data. Soft-bodied invertebrates collected from Parcel F generally contained more PCBs than clams or mussels. However, studies of foraging patterns in marine waters have shown that surf scoters eat stationary invertebrates, such as clams and mussels, and not burrowing worms (http://www.pwrc.usgs.gov/bioeco/SScoter.htm). As a result, the concentrations in soft-bodied invertebrates are not relevant to the dose model for the surf scoter.

The application of the TRV study on chickens to wild surf scoters requires several assumptions. It is assumed, for example, that a surf scoter that ingests the same amount of the chemical each day for the same period of time as the test animal will also suffer no ill effects. Again, this assumption has not been, and cannot be, tested at Parcel F. What has been shown is that birds such as the surf scoter take up chemicals on the wintering grounds in San Francisco Bay; however, neither the exposure pathways nor the exposure locations are well understood. Furthermore, the effects of chemicals accumulated during winter feeding may be expressed only during the reproductive events that occur thousands of miles away. In fact, circumstantial evidence indicated that surf scoter populations are stable in San Francisco Bay (SFEI 2005), suggesting that chemical risk may not be causing population-level effects.

The preliminary remediation goal for the surf scoter exposed to PCBs was compared with the preliminary remediation goal developed for the double-crested cormorant, which feeds predominantly on fish rather than clams. The preliminary remediation goal developed for surf scoters was lower than for the cormorant; thus, it was considered protective of both feeding guilds.

Development of preliminary remediation goals to address the RAO 2: *Limit or reduce the potential risk to human health from consumption of shellfish from Parcel F.*

Potential human health risks from shellfish consumption and direct contact with sediment during shellfish collection were evaluated using *M. nasuta* tissue data from the laboratory bioaccumulation test to address the second RAO. Future residents were assumed to harvest and consume shellfish from the intertidal areas of HPS and be incidentally exposed to sediment during harvesting. The direct contact exposure scenario associated with harvesting was also assumed to be representative of individuals wading in nearshore areas. Risks associated with direct contact were more than 100 times lower than risks associated with ingestion (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005).

Preliminary remediation goals were calculated using parameters specific to consumption of shellfish (see Attachment 1). Exposure point concentrations (EPC) were developed to model exposures under both a reasonable maximum exposure (RME) scenario and a central tendency exposure (CTE) scenario. The RME scenario relies on conservative exposure factors to estimate the reasonable maximum exposures anticipated for the site, whereas the CTE scenario describes a more typical or average exposure to an individual. EPCs for shellfish tissue were derived from the sediment EPC using the relationship between sediments and fish described below.

Using the risk model developed for the Parcel F Validation Study, a range of preliminary remediation goals for PCBs was calculated using assumptions appropriate for a shellfish ingestion scenario. Table 2-1 lists the parameters used to develop a preliminary remediation goal at a targeted risk level of 10^{-5}. Preliminary remediation goals were also calculated based on the upper and lower bounds of EPA's targeted risk management range for health protectiveness at Superfund sites (135 µg/kg to 13,500 µg/kg based on risk levels of 10^{-4} to 10^{-6}, respectively).

TABLE 2-1: INGESTION OF SHELLFISH SCENARIO
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Body Weight (kilogram)	70
Averaging Time Cancer (days)	25,550
Risk Level (unitless)	10^{-5}
Shellfish Ingestion Rate (kilograms per day)	0.00213
Fraction Ingested from Source (unitless)	0.1
Exposure Frequency (days per year)	365
Exposure Duration (years)	30
Oral Cancer Slope Factor (µg/kg-day)-1	5,000
Acceptable Shellfish Tissue Concentration (µg/kg)	1,540
Preliminary Remediation Goal for PCBs in Sediment (µg/kg)	**1,350**

This evaluation used the following equations:

$$\textit{Acceptable Shellfish Tissue Concentration} = (BW \times AT \times RL) / (IR_s \times FI \times EF \times ED \times CSF)$$

where:

BW	=	Body Weight
AT	=	Averaging Time
RL	=	Risk Level
IR_s	=	Shellfish Ingestion Rate
FI	=	Fraction Ingested from Source
EF	=	Exposure Frequency
ED	=	Exposure Duration
CSF	=	Cancer Slope Factor

$$\textit{Sediment Remediation Goal} = \%TOC \times FT / BAF \times \%lipid$$

where:

%TOC	=	Percent Total Organic Carbon (1.3 unitless)
FT	=	Acceptable Fish Tissue Concentration (µg/kg)
BAF	=	Bioaccumulation Factor (1.96 unitless [Tracey 1996])
%lipid	=	Percent lipids in fish tissue (3 unitless)

A summary of the assumptions used to derive each of the exposure parameters is provided below.

Body Weight, Averaging Time, and Exposure Frequency

These values represent standard, default exposure assumptions recommended by EPA (1989).

Risk Level

To calculate a remediation goal, it is necessary to define an appropriate risk level for site conditions. EPA guidance recommends an acceptable target risk range of 10^{-4} to 10^{-6} (EPA 1991).

Shellfish Ingestion Rate

The HPS Validation Study (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) used a seafood consumption study conducted by San Francisco Estuary Institute (SFEI) 2002) to estimate consumption rates for shellfish ingestion, resulting in a value of 48 grams per day (90th percentile) for the RME scenario. As noted in the Validation Study, this value was used to illustrate the potential risks associated with exposures at the site, but in fact provides a conservative estimate and reflects consumption rates appropriate for sport fish, and not shellfish. Wong (1997) reported that shellfish typically make up only 5 percent of total seafood consumption among San Francisco Bay anglers. Therefore, the 5 percent of the assumed fish consumption rates were used to estimate remediation goals, resulting in a shellfish ingestion rate of 0.00213 kilogram per day.

Fraction Ingested from the Source

The Validation Study assumed that the fraction ingested from the source was 1 for the RME scenario and 0.5 for the CTE scenario to evaluate risks (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005). These values assumed that 100 percent of the shellfish consumed under the RME scenario and 50 percent of the shellfish consumed under the CTE scenario would have been collected from Parcel F. However, because of the nature of the habitat along the shoreline, only limited mussel burrows actually exist at Parcel F and the mussel population may not be large enough to support that level of consumption. Given the abundance of other, more attractive, shellfish beds in the San Francisco Area, the fraction ingested was adjusted down to a value of 0.1 or 10 percent.

Exposure Duration

An exposure duration of 30 years was used based on recommendations by EPA (1989). This value represents the upper-bound residential tenure at a single location.

San Francisco Bay Watershed Concerns

The San Francisco Bay was included on the Clean Water Act § 303(d) list in 1998 for total PCBs as a result of an interim health advisory for fish consumption. The advisory was based on elevated concentrations of PCBs in fish tissue caught in the bay in 1994 that may cause harmful effects on people who consume fish caught in San Francisco Bay. Follow-up studies in 1997 and 2000 confirmed the presence of PCBs in bay fish tissue at concentrations that may be harmful to fish consumers (Water Board 2004).

The application of the human health remediation goals developed for the shellfish consumption pathway and the ecological remediation goals developed for the protection of benthic- and piscivorous-eating birds will help to address this sport fish pathway by lowering the average chemical concentrations in sediment throughout Parcel F.

2.1.2 Background Concentration for Each Chemical of Ecological Concern

Background concentrations or ambient concentrations are chemical concentrations that occur naturally in the environment and from human activities. Data for copper and mercury were compared with San Francisco Bay ambient sediment concentrations (68.1 mg/kg for copper and 0.43 mg/kg for mercury) (Water Board 1998). The estimated nearshore PCB ambient sediment concentration of 200 µg/kg was used as the ambient threshold value for total PCBs. The results of the sediment trap data collected in 2004 were also used in this Feasibility Study (FS) Report. Sediment traps were placed in Area X at four stations during three periods to characterize sediment deposition during winter, spring, and summer conditions. The data were used to estimate the concentration of sediment entering the South Basin, since the sediment traps capture suspended sediment that advects into South Basin from San Francisco Bay, as well as suspended sediment derived from runoff and local resuspension. Based on sediment trap data averaged over three deployment periods from the mouth of the South Basin, a PCB concentration of 121 µg/kg for incoming sediments was used for the ambient concentration of PCBs in sediment in the sediment transport model (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005) This result is consistent with the nearshore ambient concentration for PCBs in sediment (200 µg/kg), which is considered the upper bound value (Water Board 2003).

2.1.3 Range of Preliminary Remediation Goals for Sediment at Parcel F

As described in Section 2.1.1, the range of preliminary remediation goals for ecological receptors was calculated using results from 28-day bioaccumulation tests. Regulatory agency concerns remained that the field-collected tissue data should be incorporated into the development of the remediation goals. Preliminary remediation goals using the field-collected tissue data were not used alone because of the insufficient data set. Therefore, a risk management approach was taken by using the field-collected tissue data results to bound the range (or SUF to be considered) of preliminary remediation goals derived using the laboratory bioaccumulation. This resulted in a range of preliminary remediation goals that corresponded to a range of SUFs between 0.5 and 1.0. Similarly, the preliminary remediation goals for human consumption of shellfish were calculated based on EPA's acceptable target risk range between 10^{-4} and 10^{-6}. The range of preliminary remediation goals for Parcel F sediments is shown in Table 2-2.

TABLE 2-2: RANGE OF PRELIMINARY REMEDIATION GOALS FOR CHEMICALS OF CONCERN IN SEDIMENT AT PARCEL F
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Preliminary Remediation Goal	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (µg/kg)
Surf Scoter			
Based on a SUF of 1.0	135	0.94	620
Based on a SUF of 0.5	271	1.87	1,240
Human Consumption of Shellfish			
Based on a cancer risk 10^{-6}	Not applicable	Not applicable	135
Based on a cancer risk 10^{-4}	Not applicable	Not applicable	13,500

2.1.4 Application of Remediation Goals

This section discusses the approach for applying remediation goals in this FS Report. The application of site-specific remediation goals focused on achieving an area-weighted average concentration for each COC in sediment. The goal of the approach was to define remediation goals as a "Do Not Exceed" value that resulted in an area weighted average for the COCs representing the ecological preliminary remedial goal based upon a SUF of 1.0 and the human health target risk level of 10^{-6} or the upper bound near shore ambient concentration for PCBs.

Parcel F areas (I, III, VIII, IX, and X) were evaluated separately to apply remediation goals on a surface-weighted average basis in this FS Report. The size of each area was then calculated using the Thiessen polygon method of interpolation (Naval Facilities Engineering Services Center 2001). Thiessen polygons were constructed around individual sampling locations, so the sides of each polygon are equidistant from adjacent sampling locations.

Concentrations of COCs detected in sediment from a sampling location were assumed to represent all sediment within the polygon. The top 2-foot sediment depths were evaluated for each of the five areas. The highest chemical concentration detected at any depth within the interval evaluated (0 to 2 feet) was used to calculate the surface-weighted average concentrations. The area of each Thiessen polygon was calculated and mapped using a geographic information system (GIS). The offshore GIS model and Access™ database are included in Appendix A. Figure 2-1 shows the Thiessen polygons and related sampling locations at Parcel F evaluated as part of this FS Report. As illustrated on the table insert in the figure, the initial conditions show the area-weighted average for each COC within each subarea. Area-weighted average concentrations for PCBs in sediment exceeded the lower bound range for PCBs in Area X. Copper and mercury exceeded the lower bound range in Area III.

To determine the areas to be carried forward for remedial evaluation, preliminary remediation goals corresponding to a SUF of 0.5 were applied on a point-by-point (or polygon-by-polygon) basis in each area. The objective for using the GIS model was to develop a preliminary estimate of the area-weighted average concentration of each COC that would result from remediating sediment. The GIS model identified polygons that exceeded final remediation goals and removed the polygons and replaced the polygons with COCs in sediment at concentrations with San Francisco Bay sediment ambient concentrations. Finally, the area-weighted average was recalculated. The model also calculated the acreage and volume of sediments to be addressed in this FS Report. The areas of remediation, volumes, and average surface sediment concentration of COCs after remediation were modeled during the detailed remedial evaluation in Section 4.0. Table 2-3 shows the final remediation goals for sediment at Parcel F. Figure 2-2 shows the areas in Parcel F that exceeded the remediation goals (Area III and X). Figures 2-3 and 2-4 show Areas III and X, separately, and the areas to be addressed in this FS Report. The areas are further refined in Section 4.0 of this FS Report during the application of remedial alternatives.

2.1.5 Summary of Remediation Goal Approach

The area-weighted average approach, including selection of individual polygons for remediation, was developed to be protective of ecological and human receptors. The area-weighted average approach is protective of benthic-feeding and piscivorous birds with larger foraging ranges that would be exposed to a range of concentrations at Parcel F and areas addressed for ecological concerns included the areas that pose a potential risk to human health from the ingestion of shellfish.

	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (ug/kg)
Initial Weighted-Average	82.5	0.77	870
Oil Reclamation Area IX			
Maximum Initial	97.5	1.2	828
Initial Weighted-Average	68.7	0.49	278
South Basin Area X			
Maximum Initial	319	2.2	58,395
Initial Weighted-Average	99.5	0.78	3,720
Point Avisadero Area III			
Maximum Initial	6,550	252	2,463
Initial Weighted-Average	298	3.8	313
Eastern Wetland Area VIII			
Maximum Initial	58.7	0.8	545
Initial Weighted-Average	49	0.45	31.1
India Basin Area I			
Maximum Initial	117	0.55	111
Initial Weighted-Average	53.9	0.37	40.6

Barajas & Associates, Inc.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-1
TETRA TECH OFFSHORE MODEL MODELED SUBAREAS AND INITIAL CONDITIONS
Revised Parcel F Feasibility Study

2007-05-08 v:\hunters point\projects\parcel_f\offshore_modeling\subareas.mxd TtEMI-AL simon.cardinale

TABLE 2-3: FINAL REMEDIATION GOALS FOR CHEMICALS OF CONCERN IN SEDIMENT AT PARCEL F

Revised Feasibility Study for Parcel F, Hunters Point Shipyard, San Francisco, California

Remediation Goals	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (µg/kg)
Final Remediation Goals	271	1.87	1,240

	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (ug/kg)	Remediated	
Replacement Fill Values	68.1	0.43	143	140,357	cubic yards
Achieved Weighted-Average	61.3	0.47	173	44	acres
Do-Not-Exceed Criterion	270	2	1,200	14	% of area
Oil Reclamation Area IX				0	cubic yards
Maximum Remaining	97.5	1.2	828	0	acres
Achieved Weighted-Average	68.7	0.49	278	0	% of area
South Basin Area X				115,317	cubic yards
Maximum Remaining	138	1.4	1,134	36	acres
Achieved Weighted-Average	76.8	0.51	386	56	% of area
Point Avisadero Area III				25,040	cubic yards
Maximum Remaining	221	1.58	1,024	8	acres
Achieved Weighted-Average	68.5	0.5	123	35	% of area
Eastern Wetland Area VIII				0	cubic yards
Maximum Remaining	58.7	0.8	545	0	acres
Achieved Weighted-Average	49	0.45	31.1	0	% of area
India Basin Area I				0	cubic yards
Maximum Remaining	117	0.55	111	0	acres
Achieved Weighted-Average	53.9	0.37	40.6	0	% of area

Remediation Area
Polygon Area Included in Model
Road
Buildings
San Francisco Bay

Notes:
Model parameters include Sight-Use Factor = 0.5 and depth interval = 0-2 feet below sediment surface

N

400 0 400 800
Feet

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-2
TETRA TECH OFFSHORE MODEL
SITE-USE FACTOR 0.5
BASEWIDE REMEDIATION AREAS
Revised Parcel F Feasibility Study

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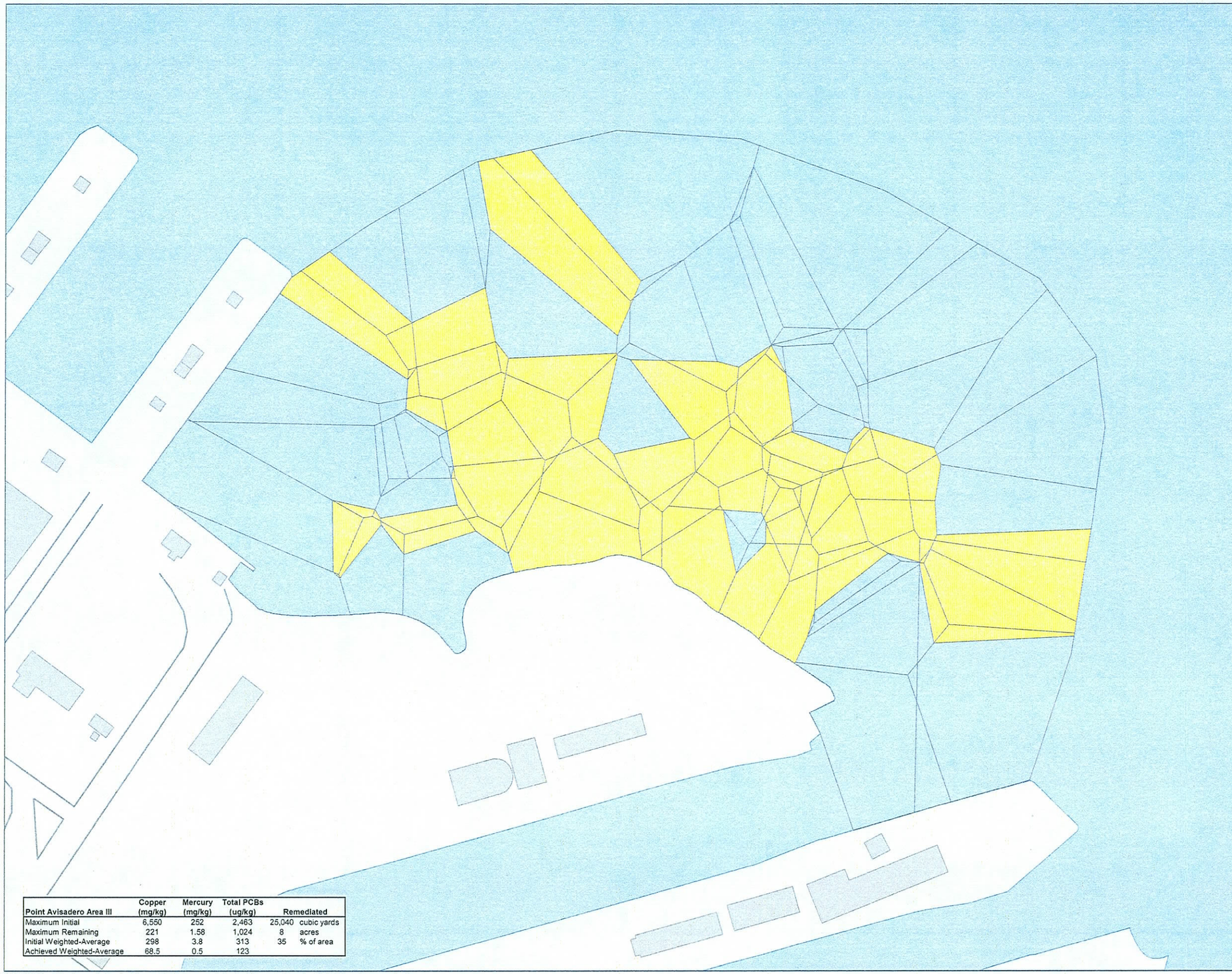

Point Avisadero Area III	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (ug/kg)	Remediated	
Maximum Initial	6,550	252	2,463	25,040	cubic yards
Maximum Remaining	221	1.58	1,024	8	acres
Initial Weighted-Average	298	3.8	313	35	% of area
Achieved Weighted-Average	68.5	0.5	123		

Remediation Area
Polygon Area Included in Model
Road
Buildings
San Francisco Bay

Notes:
Model parameters include Sight-Use Factor = 0.5 and depth interval = 0-2 feet below sediment surface

N

75 0 75 150
Feet

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-3
TETRA TECH OFFSHORE MODEL
SITE-USE FACTOR 0.5
AREA III REMEDIATION AREAS
Revised Parcel F Feasibility Study

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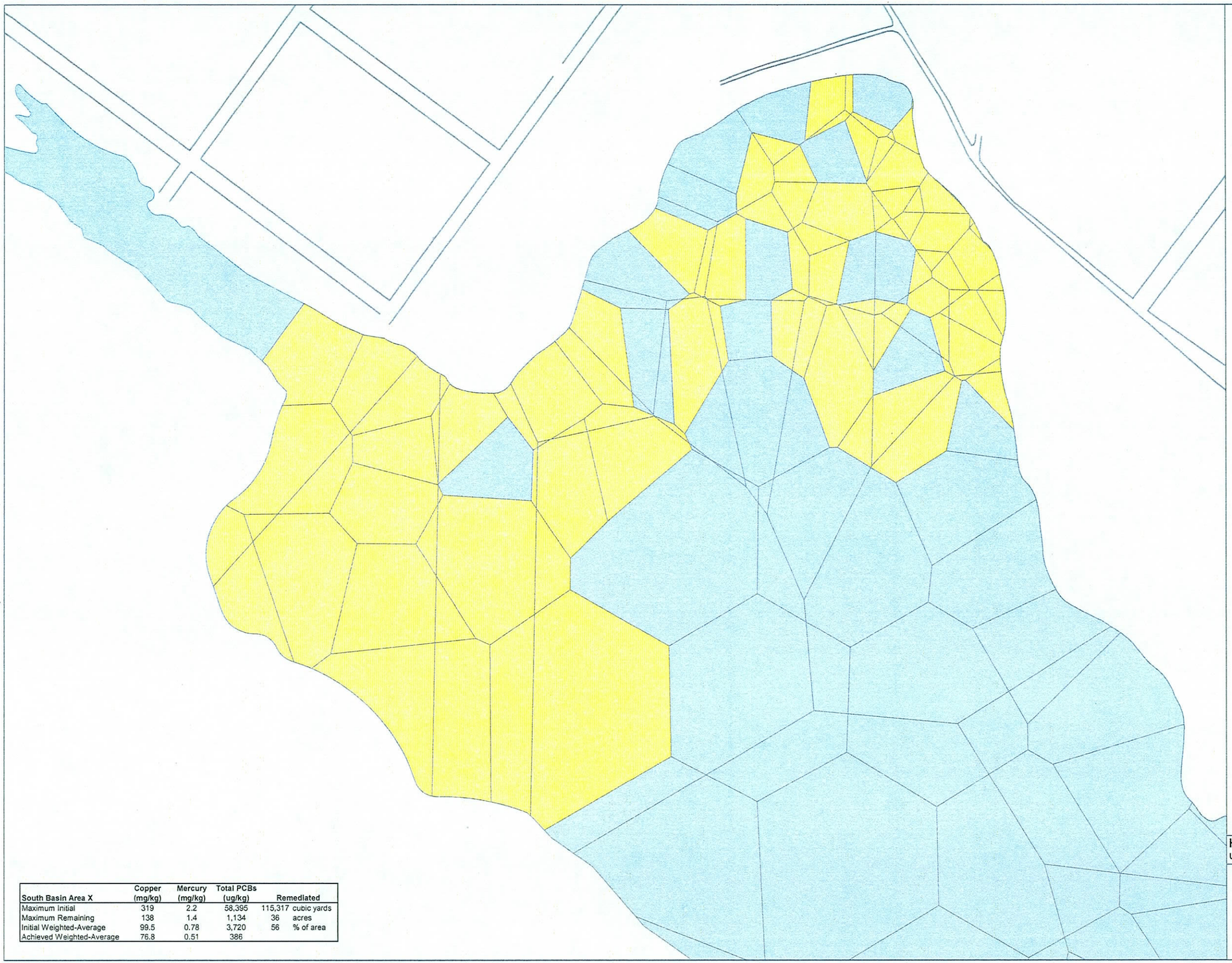

Remediation Area
Polygon Area Included in Model
Road
Buildings
San Francisco Bay

Notes:
Model parameters include Sight-Use Factor = 0.5 and depth interval = 0-2 feet below sediment surface

N

125 0 125 250
Feet

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

South Basin Area X	Copper (mg/kg)	Mercury (mg/kg)	Total PCBs (ug/kg)	Remediated	
Maximum Initial	319	2.2	58,395	115,317	cubic yards
Maximum Remaining	138	1.4	1,134	36	acres
Initial Weighted-Average	99.5	0.78	3,720	56	% of area
Achieved Weighted-Average	76.8	0.51	386		

FIGURE 2-4
TETRA TECH OFFSHORE MODEL
SITE-USE FACTOR 0.5
AREA X REMEDIATION AREAS
Revised Parcel F Feasibility Study

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2.2 POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act, requires that remedial alternatives attain ARARs unless they are waived in accordance with CERCLA. ARARs consist of regulations, standards, criteria, or limitations promulgated under federal or more stringent state laws. Appendix B provides a detailed discussion of the ARARs for this FS Report.

An ARAR may be either "applicable" or "relevant and appropriate," but not both. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 *Code of Federal Regulations* [40 CFR] Part 300) defines applicable and relevant and appropriate as follows:

- Applicable requirements are those cleanup standards; standards of control; and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically include a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

- Relevant and appropriate requirements are those cleanup standards; standards of control; and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site (relevant) that their use is well suited (and appropriate) to the particular site.

To qualify as a state ARAR under CERCLA and the NCP, a state requirement must be (1) a standard, requirement, criterion, or limitation under a state environmental or facility siting law; (2) promulgated (of general applicability and legally enforceable); (3) substantive (not procedural or administrative); (4) more stringent than the federal requirement; (5) identified by the state in a timely manner; and (6) consistently applied.

Section 121(e) of CERCLA exempts any response action conducted entirely on site from having to obtain a federal, state, or local permit, where the action is carried out in compliance with CERCLA § 121. In general, on-site actions need only comply with the substantive aspects of ARARs, but not with the corresponding administrative procedures, such as administrative reviews and recording and record-keeping requirements. Off-site actions must comply with all legally applicable requirements, both substantive and administrative.

In addition to ARARs, § 300.400(g)(3) of the NCP provides that regulatory agencies' advisories, criteria, or guidance may be considered for a particular release, as appropriate. To-be-considered (TBC) criteria consist of advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. TBC criteria are not automatically required as cleanup standards because they are by definition neither promulgated

nor enforceable. However, TBC criteria may be useful in identifying what is protective at a site or how to carry out an action.

ARARs and TBC criteria are usually divided into three categories: chemical-specific, location-specific, and action-specific.

A requirement is applicable if it specifically addresses or regulates the hazardous substance, pollutant, contaminant, action being taken, or other circumstance at the site. It is necessary to evaluate specific jurisdictional prerequisites of the statute or regulation to assess whether a particular requirement would be applicable. All pertinent jurisdictional prerequisites must be met for the requirement to be applicable, including the following:

- Who, as specified by the regulation, is subject to its authority;
- The types of substances and activities listed as falling under the authority of the regulation;
- The period during which the regulation is in effect; and
- The types of activities the regulation requires, limits, or prohibits.

If jurisdictional prerequisites are met, the requirement is applicable. If not, the next step is to consider whether the requirement is relevant and appropriate (EPA 1988a).

Evaluating whether a requirement is relevant and appropriate is site-specific and must be based on best professional judgment (EPA 1988b). A requirement may be relevant but not appropriate for a specific site. Only the requirements that are determined to be both relevant and appropriate are ARARs. Portions of a requirement may be relevant and appropriate even if a requirement in its entirety is not (EPA 1988b). The criteria for evaluating whether a requirement is relevant and appropriate are listed in § 300.400(g)(2) of the NCP and include the following:

- The purpose of the requirement and the purpose of the CERCLA action
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site
- The substances regulated by the requirement and the substances detected at the CERCLA site
- The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site

- The type of place regulated and the type of place affected by the release or CERCLA action
- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action
- Any considerations of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site

TBC criteria are evaluated either when ARARs do not exist (for example, as with remediation goals for soil and sediment) or when attaining ARARs is not protective. TBC criteria may be used to develop remediation goals or to guide how a remedy is implemented.

Section 121(d)(4) of CERCLA and § 300.430(f)(1)(ii)(C) of the NCP provide five specific waivers to ARARs that may be applied to remedial alternatives at a site. A remedial alternative for Parcel F that does not meet an ARAR may still be selected under the following conditions.

- The alternative is an interim measure and will become part of a total remedial alternative that will attain the ARAR when completed.
- Compliance with the requirement will result in greater risk to human health and the environment than other remedial alternatives.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- The remedial alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.
- For a state requirement, the state has not consistently applied or demonstrated the intention to consistently apply the promulgated requirement in similar circumstances at other remedial actions within the state.

A waiver determined to be appropriate would be documented in the ROD.

2.2.1 Potential Federal and State Chemical-Specific ARARs

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a remediation goal. Many potential ARARs associated with particular remedial alternatives (such as closure or discharge) can be characterized as action-specific but include numerical values or methodologies to establish them, so they fit in both the chemical- and action-specific categories. Contaminated sediment at Parcel F is the medium of interest in this FS Report. As discussed in Section 2.1, the

COCs for Parcel F are mercury, copper, and total PCBs. Appendix B provides a detailed discussion of the ARARs for this FS Report.

The following substantive requirements under RCRA Title 42 *United States Code* (USC) Chapter 82, §§ 6901-6991(i), were identified as potential chemical-specific ARARs.

- *California Code of Regulations* (Cal. Code Regs.) Title (tit.) 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), 66261.100, and 66268.1(f)

Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 contain the requirements for defining a hazardous waste. Any material excavated or generated from any response action will be characterized to determine if it is a hazardous waste.

Under the Toxic Substances Control Act (Title 15 USC, Chapter 53, §§ 2601-2692), 40 CFR § 761.61(a)(4)(i) was identified as a potential chemical-specific ARAR. This section sets forth cleanup levels for bulk PCB remediation waste. Based on the Toxic Substances Control Act, the remediation goal for sediment would be 25 mg/kg because Parcel F is a low-occupancy area. However, according to 40 CFR § 761.61(a)(4)(vi), more stringent cleanup levels may be required based on the proximity to areas such as endangered species habitats, estuaries, and wetlands. The level of 25 mg/kg is therefore not sufficiently protective of ecological receptors at Parcel F. In addition, the following state requirements are potential state chemical-specific ARARs.

- Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C), and 66261.3(a)(2)(F)

- Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20230

Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C), and 66261.3(a)(2)(F) contain requirements for determining if a waste is a non-RCRA hazardous waste under California regulations. Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20230 contain the state definitions of designated, nonhazardous and inert waste. Any material excavated or generated as a result of any response action will be characterized to determine if it is a waste based on these definitions.

Surface water is not a medium of concern in this FS Report. Chemical-specific water quality requirements are identified as ARARs in the event the remedial actions result in a release of chemicals into the surface water. The substantive provisions of the following requirements are potential ARARs:

- The California Toxics Rule (40 CFR § 131.38)

- Chapters 2 and 3 of the Comprehensive Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) including Table 3-3

The water quality standards at 40 CFR § 131.38 are potential applicable federal ARARs for discharges to the surface water during remediation.

The Navy will consider the substantive provisions of the Basin Plan, as it relates to surface water, including beneficial use, water quality objectives, and waste discharge requirements for potential ARAR status (Water Board 1995).

The Basin Plan for the San Francisco Bay basin was prepared and implemented by the Water Board, Region 2, to protect and enhance the quality of the waters in the San Francisco Bay Region. The Basin Plan establishes location-specific beneficial uses and water quality objectives for surface water and groundwater of the region and is the basis of the San Francisco Bay basin regulatory programs. The Basin Plan includes both numeric and narrative water quality objectives for specific groundwater subbasins. The water quality objectives are intended to protect the beneficial uses of the waters of the region and to prevent nuisance. In Chapter 3, Table 3-3, of the Basin Plan, the Water Board established water quality objectives for 12 chemicals in surface water with salinities greater than 5 parts per thousand. These standards apply to all estuarine waters within the region, except for the South Bay below Dumbarton Bridge. These standards apply to the Bay, which meets the salinity threshold.

2.2.2 Potential Federal and State Location-Specific ARARs

Location-specific ARARs are restrictions on the concentrations of hazardous substances or the conduct of activities because of the characteristics of the site or its immediate environment. Several conditions at Parcel F and several potential remedial alternatives are associated with location-specific ARARs. The following subsections summarize the location-specific ARARs, and Appendix B provides a detailed discussion of each location-specific ARAR.

2.2.2.1 ARARs for Biological Resources

The substantive provisions of the following federal and state requirements were identified as potential federal location-specific ARARs at Parcel F:

- **Migratory Bird Treaty Act (substantive provisions of 16 USC § 703):** Prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird.
- **Marine Mammal Protection Act (substantive provisions of 16 USC §§ 1361–1421h):** Prohibits the taking of a marine mammal on the high seas or in a harbor or other place under the jurisdiction of the United States.

The substantive provisions of the following are potential state ARARs:

- ***California Fish and Game Code* § 3503:** Prohibits the take, possession, or needless destruction of the nest or eggs of any bird,
- ***California Fish and Game Code* § 3800:** Prohibits the take of nongame birds.

- ***California Fish and Game Code* § 4150:** Prohibits the take or possession of nongame mammals.

- ***California Fish and Game Code* § 8500:** Prohibits the possessing or taking of mollusks, crustaceans, or other invertebrates.

2.2.2.2 *ARARs for Coastal Resources*

The Coastal Zone Management Act (16 USC §§ 1451 through 1464) was identified as a potential location-specific ARAR for Parcel F because sediments at the site are within the coastal zone. The Coastal Zone Management Act (16 USC § 1456(c)(1)(A)) requires each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource to conduct its activities in a manner that is consistent to the maximum extent practicable with enforceable policies of approved state management policies. The State of California's approved coastal management program includes the McAteer-Petris Act, the authorizing legislation for the San Francisco Bay Plan, developed by the Bay Conservation and Development Commission. Substantive provisions of this statute and plan are state ARARs. The remedial actions will be conducted in compliance with the substantive provisions of the San Francisco Bay Plan.

2.2.2.3 *ARARs for Hydrologic Resources*

The Rivers and Harbors Act (33 USC §§ 401 through 413) was identified as a potential location-specific ARAR for Parcel F. The River and Harbors Act prohibits the creation of any obstruction not authorized by Congress to the navigable capacity of any of the waters of the United States.

2.2.2.4 *ARARs for Wetlands Protection*

The following federal requirements were identified as potential location-specific ARARs at Parcel F.

- **Executive Order No. 11990:** Requires that federal agencies minimize the destruction, loss, or degradation of wetlands; preserve and enhance the natural and beneficial value of wetlands; and avoid support of new construction in wetlands if a practicable alternative exists. Executive Order 11990 is codified at Title 40 CFR § 6.302(a).

- **Clean Water Act (33 USC § 1344):** Section 404 of the Clean Water Act governs the discharge of dredged and fill material into the waters of the United States, including adjacent wetlands (33 CFR §§ 320.4 and 323; 40 CFR § 230.10; 230.11; 230.20 through 230.25; 230.31; 230.32; 230.41; 230.42; 230.53).

The Navy has identified the following provisions identified by the California Department of Fish and Game as potential state ARARs or TBCs:

- ***California Fish and Game Code* § 5650(a):** It is unlawful to deposit in, permit to pass into, or place in to the waters of the state any of the following including, but not limited to, petroleum, acid, coal or oil tar, lampblack, aniline, asphalt, bitumen, or residuary product of petroleum, or carbonaceous material or substance; or any substance or material harmful to fish, plant life, or bird life.

- The Fish and Game Commission's 1987 Wetlands Policy is a potential TBC criterion. This policy seeks to provide for the protection, preservation, restoration, enhancement, and expansion of wetland habitat in California.

2.2.3 Potential Federal and State Action-Specific ARARs

This section summarizes the potential action-specific ARARs identified for each proposed remedial alternative. Appendix B provides a detailed discussion of each potential action-specific ARAR for Parcel F.

2.2.3.1 ARARs for Sediment Removal

The following substantive requirements under RCRA, the Clean Water Act, and the Toxic Substances Control Act were identified as federal potential action-specific ARARs for dredging and excavation at Parcel F.

RCRA

- **Cal. Code Regs. tit. 22, §§ 66262.10(a) and 66262.11:** The requirements to determine if generated waste is hazardous waste.

- **Cal. Code Regs. tit. 22, §§ 66264.13(a) and (b):** The requirement to analyze generated waste to determine if it is hazardous.

- **40 CFR § 264.554(a), (d), (g), (h), (i), (j), and (k):** This requirement allows generators to accumulate solid remediation waste in an EPA-designated pile for storage only up to 2 years during remedial activities without triggering land disposal restrictions.

Clean Water Act

- **40 CFR § 122.44(k)(2) and (4):** Stormwater discharge requirements for construction that will disturb 1 or more acres.

- **40 CFR §122.44(i)(1)(i-iv):** Monitoring requirements for the discharge of dewatering effluent back to the Bay.

- **40 CFR § 125.3:** Technology-based treatment requirements for the dewatering effluent.

Toxic Substances Control Act

- **40 CFR § 761.61 (a)(5)(i)(B)(2)(ii) and (iii):** Requirement that PCB-remediated waste that contains more than 50 mg/kg is taken off site and disposed of in a landfill permitted under Section 3004 of RCRA (referred to as a Title C landfill) or a permitted PCB disposal facility such as an incinerator.

- **40 CFR §§ 761.65(c)(4) and (c)(9):** Requirements for managing PCB remediation waste.

- **40 CFR § 761.79(b)(1):** Requirement that decontamination water either will meet the standard or will be disposed of off site.

In addition, the following state potential action-specific ARARs and TBCs were identified:

- **State Water Resources Control Board Order No. 99-08-DWQ:** This order requires that best management practices will be used to prevent construction pollutants from contacting stormwater (TBC).

- **Cal. Code Regs. tit. 27, § 20090(d):** States that actions taken by public agencies to clean up unauthorized releases are exempt from tit. 27 and tit. 23, except that wastes removed from the immediate place of release and discharged to land must be managed in accordance with classification (Cal. Code Regs. tit. 27, § 20200 and Cal. Code Regs. tit. 23, § 2520) and siting requirements of tit. 27 or tit. 23 and wastes contained or left in place must comply with tit. 27 or tit. 23 to the extent feasible.

2.2.3.2 ARARs for In-Situ Treatment

The only potential action-specific ARARs associated with in-situ treatment are the RCRA action-specific ARARs identified for excavation.

2.2.3.3 ARARs for Off-Site Disposal

The only potential federal action-specific ARARs associated with off-site disposal are requirements of RCRA, the Toxic Substances Control Act, and the Federal Hazardous Materials Transportation Law discussed under Section B4.2.1 of Appendix B. These requirements are potential ARARs for on-site activities prior to off-site disposal.

2.2.3.4 ARARs for Subaqueous Caps

The only potential action-specific ARARs associated with the subaqueous caps are also location-specific ARARs and are as follows:

- Clean Water Act § 404
- Executive Order 11990
- Rivers and Harbors Act § 10

2.2.3.5 *ARARs for Institutional Controls*

There are no federal ARARs for institutional controls.

The Navy has identified the substantive provisions of the following requirements as potential state ARARs:

- The requirements that allow hazardous material covenants to run with the land under *California Civil Code* § 1471
- The authority for the Department of Toxic Substances Control (DTSC) to enter into an agreement to restrict land uses in *California Health and Safety Code* § 25202.5
- The requirements for obtaining variances from land use restrictions in *California Health and Safety Code* § 25233(c)
- The requirements for removing land use restrictions in *California Health and Safety Code* § 25234
- The requirement to execute and record a written instrument that restricts land uses in *California Health and Safety Code* § 25355.5(a)(1)(C)
- Cal. Code Regs. tit. 22, § 67391.1.

3.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

This section summarizes the identification and screening of remedial technologies and process options for Parcel F at Hunters Point Shipyard (HPS). The primary purpose of this phase of the feasibility study (FS) process is to identify and evaluate a range of potentially applicable general response actions (GRA), remedial technologies, and process options for sediments in Area III (Point Avisadero) and Area X (South Basin). Remedial technologies are general categories of technologies, such as in-situ stabilization or capping. The process options are specific processes within each technology family, such as carbon stabilization or use of a sand cap. A GRA may be accomplished by several types of remedial technologies; process options are specific methods within each technology type. The following screening process is intended to eliminate remedial action technologies and process options that are inappropriate or infeasible for the sediment at Parcel F. Process options that are retained after screening were combined into potential remedial alternatives for the site and described in Section 4.0.

The screening process evaluates the various technologies for effectiveness, implementability, and cost. This screening process eliminates the technologies that would not effectively address the contaminated sediment at HPS Parcel F. Effectiveness, implementability, and cost are described below.

- **Effectiveness:** Effectiveness is the ability of a technology to protect the environment and to meet the specific remedial action objectives (RAO) for a site. When effectiveness is evaluated, three primary factors are considered: (1) the ability to treat the estimated volume or area of contaminated media (in this case, sediment); (2) the protectiveness of the technology to the environment during implementation; and (3) the reliability of the technology to reduce the toxicity and mobility (movement) of contamination at the site and provide long-term protection. Remedial technologies that are not deemed effective are screened out and not retained for further consideration in this FS Report.

- **Implementability:** Implementability includes both technical and administrative feasibility. Technical implementability includes such factors as the ease of construction and operation at the site. Administrative feasibility includes such factors as the ability to obtain regulatory agency approval or the availability of materials and qualified operating staff. An example of a factor that can often affect implementability is the space available at a site for equipment and access during remediation. Waste treatment technologies, including dewatering, have minimum space requirements to be used. If the site does not have adequate space that is suitable for use, then these sorts of technologies would be considered not implementable. The remedial technologies that cannot be implemented at the site are eliminated from further consideration in this FS Report during screening of each technology and process option.

- **Cost:** The purpose of evaluating cost is to eliminate remedial technologies with costs that greatly exceed other technologies that would provide similar levels of protection. Therefore, the relative cost for each remedial technology is described as low, moderate, or high in this FS Report.

Sections 3.1 through 3.8 present the evaluation of remedial technologies considered for Parcel F for effectiveness, implementability, and cost. The remedial technologies are organized within the following GRAs:

- No Action
- Institutional Controls
- Monitoring
- In-Situ Treatment
- Ex-Situ Treatment
- Disposal Actions

The remedial technologies that pass the screening process and are retained for further evaluation are grouped together into process options (or "remedial alternatives") in Section 4.0 of this FS Report. Table 3-1 at the end of this section summarizes the screening results.

3.1 NO ACTION

As required in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [Title 40 *Code of Federal Regulations* Section (§) 300.430(e)], the no-action GRA is used as a baseline for comparison only. Under the no-action GRA, the site is considered unchanged, no remedial activities would be implemented, and there would be no short-term or long-term monitoring. The no-action response represents the existing site conditions at Parcel F

3.1.1 Effectiveness

The no-action general response action is evaluated based on the contamination in sediment at Parcel F assessed during the Validation Study and the Feasibility Study Data Gaps Investigation. This response action is not effective in reducing potential risk to human health or to the environment at Parcel F at HPS.

3.1.2 Implementability

No action is taken; thus, implementability does not apply.

3.1.3 Cost

No action is taken; thus, no costs apply to this option.

3.1.4 Screening Results

The no-action GRA will be retained for further evaluation and will serve as a baseline for comparison purposes as required under the NCP.

3.2 INSTITUTIONAL CONTROLS

Institutional controls are legal and administrative mechanisms used to implement land use and access restrictions that are used to limit the exposure of future landowner(s) and/or user(s) of the property to hazardous substances present on the property, to maintain the integrity of the remedial action until remediation is complete and remediation goals have been achieved, and to assure containment of hazardous substances remaining on the property in vapors, soils, sediments, or contaminated groundwater after remedial actions have been taken. Institutional controls may remain on a property even after remediation goals have been met in cases where those goals were selected at levels that accounted for the application of institutional controls. Institutional controls would likely remain in place unless the remedial action taken would allow for unrestricted use of the property. Monitoring and inspections are conducted to assure that the land use restrictions are being followed.

Legal mechanisms include proprietary controls such as restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions.

The U.S. Department of the Navy (Navy) has determined that it will rely upon proprietary controls in the form of environmental restrictive covenants as provided in the "Memorandum of Agreement Between the United States Department of the Navy and the California Department of Toxic Substances Control [DTSC]" and attached covenant models (Navy and DTSC 2000) (hereinafter referred to as "Navy/DTSC MOA"). Appendix C contains the Navy/DTSC MOA.

More specifically, land use restrictions will be incorporated into and implemented through two separate legal instruments as provided in the Navy/DTSC MOA:

1. Restrictive covenants included in one or more Quitclaim Deeds from the Navy to the property recipient.

2. Restrictive covenants included in one or more "Covenant to Restrict Use of Property" entered into by the Navy and DTSC as provided in the Navy/DTSC MOA and consistent with the substantive provisions of *California Code of Regulations* (Cal. Code Regs.) Title (tit.) 22 § 67391.1.

The "Covenant(s) to Restrict Use of Property" will incorporate the land use restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The Quitclaim Deed(s) will include the identical land use restrictions

in environmental restrictive covenants that run with the land and that will be enforceable by the Navy against future transferees.

The "Covenant(s) to Restrict Use of Property" and Deed(s) shall provide that a Parcel F Risk Management Plan ("Parcel F RMP") shall be prepared by the City of San Francisco and approved by the Navy and Federal Facility Agreement (FFA) Signatories. The Parcel F RMP shall be discussed in the Parcel F Record of Decision (ROD) and shall be attached to and incorporated by reference into the Covenant(s) to Restrict Use of Property and Deed(s) as an enforceable part thereof. It shall specify sediment management procedures for compliance with the remedy selected in the Parcel F ROD. The Parcel F RMP shall identify the roles of local, state, and federal government in administering the Parcel F RMP and shall include, but not be limited to, procedures for any necessary sampling and analysis requirements, worker health and safety requirements, and any necessary site-specific construction and/or use approvals that may be required.

Land use restrictions will be applied to the property and included in findings of suitability to transfer, findings of suitability for early transfer, "Covenant(s) to Restrict Use of Property" between the Navy and DTSC, and any Quitclaim Deed(s) conveying real property containing Parcel F at HPS.

Access

The Navy and FFA Signatories and their authorized agents, employees, contractors and subcontractors shall have the right to enter upon HPS Parcel F to conduct investigations, tests, or surveys; inspect field activities; or construct, operate, and maintain any response or remedial action as required or necessary under the cleanup program, including but not limited to cap/containment systems.

Implementation

The Navy shall address institutional control implementation and maintenance actions, including periodic inspections and reporting requirements in the preliminary and final remedial design reports to be developed and submitted to the FFA Signatories for review pursuant to the FFA (see "Navy Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions" attached to January 16, 2004, Department of Defense memorandum titled "Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Record of Decision (ROD) and Post-ROD Policy"). The preliminary and final remedial design reports are primary documents as provided in Section 7.3 of the FFA.

Land Use Restrictions

The following sections describe the institutional control objectives to be achieved through land use and activity restrictions for Parcel F in order to ensure that any necessary measures to protect human health and the environment and the integrity of the remedy have been undertaken.

Restricted Uses

The following uses will be restricted at Parcel F.

Limitations on water use such as boating, anchoring, swimming or clamming. The clamming restrictions would be implemented by posting warning signs and through physical barriers to restrict access. Physical barriers could include a perimeter fence to restrict access and limit exposure.

Restricted Activities

The following restricted activities throughout Parcel F must be conducted in accordance the "Covenant(s) to Restrict Use of Property," Quitclaim Deed(s), and the Parcel F RMP, which will be reviewed and approved by the FFA Signatories:

a. "Sediment disturbing activity" which includes but is not limited to (1) dredging of sediment, or (2) any other activity that involves movement of sediment.

b. Alteration, disturbance, or removal of any component of a response or cleanup action (including but not limited to cap/containment systems)

c. Removal of or damage to security features or signs

3.2.1 Effectiveness

Institutional controls can reduce unacceptable risks to ecological receptors and to humans by limiting the amount of direct contact with contaminated sediments (for example, by preventing negative effects to biota by prohibiting dredging and resuspension of sediments). The water use restrictions, physical barriers, and consumption advisory would all be effective in reducing exposure to humans. However, the effectiveness of institutional controls is uncertain because individuals may not follow the controls and warnings.

3.2.2 Implementability

Institutional controls are readily implementable.

3.2.3 Cost

Institutional controls would consist primarily of administrative actions; therefore, capital and operation and maintenance (O&M) costs would be very low or would not apply.

3.2.4 Screening Results

Institutional controls are not considered effective as a stand-alone remedial technology; however, they are further evaluated as a potential component of the remedial alternatives in Section 4.0.

3.3 MONITORING

This section summarizes the applicable monitoring activities applicable to remedial alternatives at Parcel F.

3.3.1 Monitoring

Short- and long-term monitoring are implemented at sites where contaminated sediments are left in place, such as in areas that are capped or stabilized in situ. Under CERCLA, long-term monitoring typically consists of sampling during the first 5 years of monitoring, followed by additional sampling events for 25 years. The type of monitoring depends on the remedial technology; for example, monitoring for capping technologies would include collecting samples along the cap's perimeter for analysis of the chemicals of concern (COC) (copper, mercury, and PCBs) and physical measurements to evaluate the integrity of the cap.

3.3.1.1 Effectiveness

Short-term monitoring is effective for evaluating the progress of remedial actions when the implementation timeframe could be extended or for remedial actions with greater uncertainty of success. In such cases, monitoring is an effective means to evaluate whether a contingency alternative is needed. Long-term monitoring is also an important means of assessing overall performance of the remedy.

3.3.1.2 Implementability

Monitoring would be readily implementable.

3.3.1.3 Cost

The costs of a monitoring program would depend on the type of monitoring, the size of the area monitored, and the duration of monitoring. Generally, the cost would be low to medium compared with other elements of an active remedy.

3.3.1.4 Screening Result

Monitoring is retained for evaluation as a component of the various remedial alternatives in Section 4.0.

3.3.2 Monitored Natural Recovery

Natural recovery of in-place contaminated sediments may occur over time by ongoing aquatic processes that contain, destroy, or reduce the bioavailability of chemicals (National Research Council 1997). This technology consists of monitoring the natural recovery process to assure compliance with the RAOs for Parcel F. The natural recovery process involves natural sedimentation that would create a clean layer of surface sediment, thereby burying contaminated sediments over time. In addition, other physical, chemical, and biological processes contribute to recovery by reducing chemical mobility through sorption or other binding processes, chemical or biological transformation to less toxic forms, and dispersion of particle-bound chemicals by erosion (Magar and Wenning 2005). Therefore, it is important that the monitoring methods used are designed to monitor the primary mechanism of recovery at the site. Figure 3-1 is a diagram showing the natural processes that take place in the sediment bed.

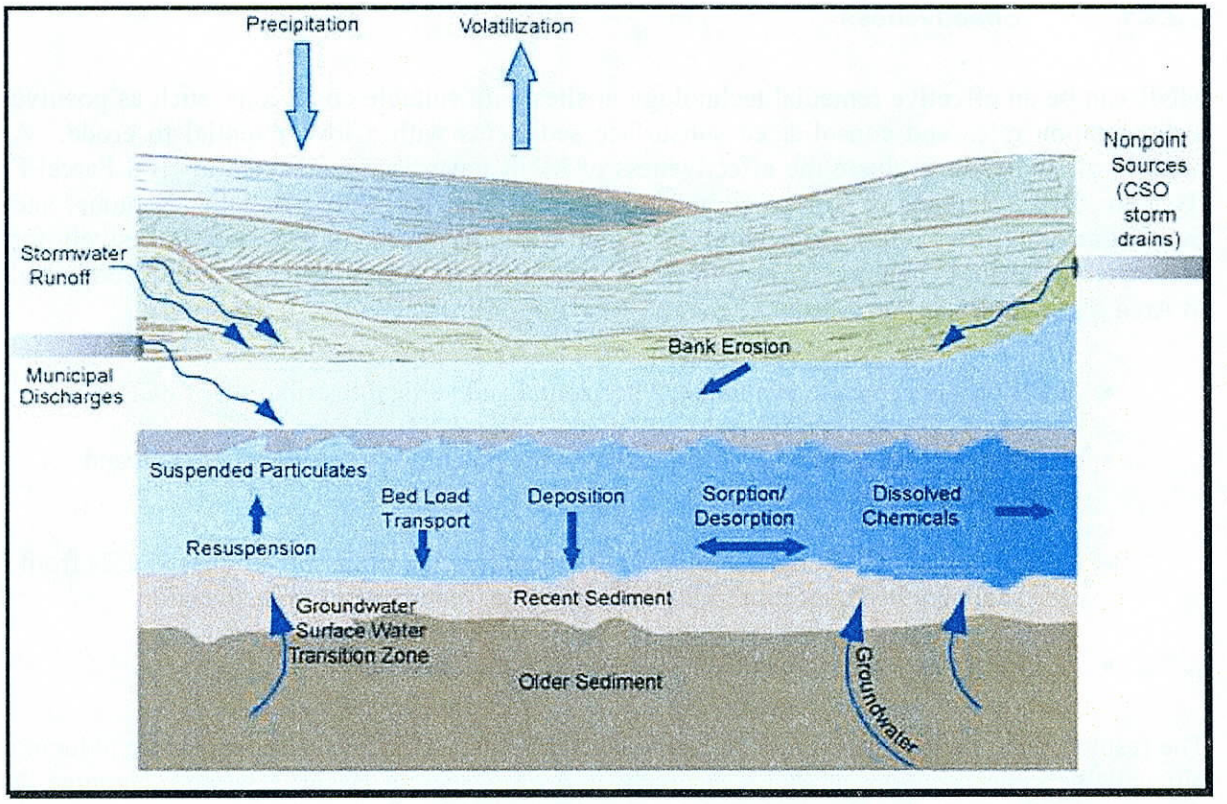


Figure 3-1. Diagram of Natural Processes in Sediment.

A framework for evaluating the effectiveness of MNR as a contaminated sediment management option was developed by the Remediation Technologies Development Forum (RTDF) sediment workgroup (Davis and others 2004). The framework is a weight-of-evidence approach to demonstrate that natural processes are reducing risks to an acceptable level within an acceptable timeframe. In general, the RTDF framework recommends a comprehensive approach that

includes characterization of sources, fate and transport, and vertical contamination, corroboration with biological endpoints, and developing predictive tools.

Distinguishing between chemical loads that are diffuse nonpoint upland sources from internal sources that are associated with resuspension of historical releases to the aquatic environment is important for predicting the success of MNR. These internal sources can act as reservoirs of chemicals that continuously cycle through the aquatic environment and therefore are important to characterize the nature and extent of these hotspot areas. It is important to assess the potential for these sources to affect the recovery at these sites. In addition, the long-term integrity and stability of the sediment bed under storm events should be assessed. Characterization of fate and transport processes—including the evaluation of potential for sediment bed erosion, deposition rates, and biological mixing—will also provide site-specific information that will indicate the potential effectiveness of natural recovery.

3.3.2.1 Effectiveness

MNR can be an effective remedial technology at sites with suitable conditions, such as positive sedimentation rates and consolidated subsurface sediments with a low potential to erode. A number of studies to evaluate the effectiveness of MNR have been conducted at HPS Parcel F (Battelle, BBL, Neptune & Company, and Sea Engineering, Inc. 2005; Battelle, Neptune, and Sea Engineering, Inc. 2005). In general, the South Basin has been studied more intensively for parameters relevant to natural recovery than has Area III (Point Avisadero). Sampling conducted in Area X (South Basin) included:

- PCB profiles cores to evaluate the horizontal and vertical distribution of PCBs
- Sedflume cores to provide information on the potential for sediment erosion and sediment stability with depth
- Fine-interval PCB congener cores to calculate the flux of dissolved-phase PCBs from the sediment bed over time caused by diffusion, bioturbation, and advection
- Radioisotope cores to evaluate sediment accumulation rates

The results of the South Basin evaluations indicated that natural recovery appears to be reducing bioavailable concentrations of PCBs in much of Area X (South Basin) (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005). The PCB concentration profiles indicated that peak PCB concentrations are found at depth and overlain by progressively lower concentrations.

The stability evaluation (predicting scour rates during extreme events) in the Area X indicated that less than 10 centimeters would be eroded during a 25-year storm. PCB flux modeling indicated that about 25 grams of PCBs would be released to the environment through diffusion, advection, and bioturbation of the next 100 years in the absence of remedial activities (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005).

Studies at Area III (Point Avisadero) relating to natural recovery processes are more limited, consisting of traditional site characterization and a chemical transport study to evaluate the effect of tidal currents and potential depositional scenarios, and mercury bioavailability studies. These results indicated that recovery is also occurring in Area III.

3.3.2.2 Implementability

MNR would be relatively easy to implement at Parcel F. Requirements for this option would include long-term monitoring to confirm recovery predictions and evaluate progress toward achieving the remediation goals.

3.3.2.3 Cost

Costs for MNR are low in comparison to other sediment remedial technologies. However, costs associated with MNR (such as long-term monitoring) can be significant, particularly if monitoring is required over a large area and for a long duration.

3.3.2.4 Screening Results

Significant data have been collected at HPS Parcel F in Area X (South Basin) to evaluate the effectiveness of MNR. MNR may also be combined with other remedial actions to enhance natural recovery, or combined with other active remedies. Natural recovery would be particularly effective in Area X (South Basin) of Parcel F because previous studies have indicated a low–energy, net depositional environment with a sedimentation rate of approximately 1 centimeter per year. MNR will be further evaluated in Section 4.0 for the South Basin.

3.4 IN-SITU TREATMENT

In-situ treatment involves technologies that are implemented in place. In-situ technologies involve treatment of contaminated sediments in place to contain chemical concentrations, mobility, or bioavailability. The in-situ technologies evaluated in this FS Report include capping and stabilization and treatment of contaminated sediments.

3.4.1 In-Situ Capping

Capping is a controlled placement of clean material (or cap) over contaminated sediments to contain the sediment in place. Isolation capping is the most common technology, where clean material is spread over contaminated sediment. Numerous process options are available that include varying types of cap materials and thicknesses, and placement of reactive materials to increase adsorption, chemical reaction with contaminants, or accelerate biological degradation.

Chemicals are then isolated from the aquatic environment and from ecological receptors and humans. Capping can be engineered for placement in subaqueous locations such as at Parcel F.

The advantage of this technology is that contaminated sediment is not remobilized or disrupted, so there is less chance for sediment resuspension and contamination of adjacent areas.

A wide variety of materials (inert, active, and sealing agents) can be used to cap contaminated sediments to minimized or reduce leaching, bioturbation, and erosive transport. Capping material typically consists of natural fine-grained materials such as clean Bay Muds, sand, and topsoil mixtures, including gravel. A low-permeability material such as Bay Mud or a clay mineral-based material such as AquaBlok prevents slows movement of contaminated pore water into the water column and provides for sorption and attenuation of chemicals. In addition, a thin layer of granular activated carbon and Bay Mud or sand at the base of the cap can significantly reduce the mobility of organic chemicals and increase the effectiveness of the cap. Armor stone and geosynthetic materials are also used as capping material (Hart Crowser 1996). Armor stone is normally used to further stabilize cap materials, especially in high-energy environments. Geosynthetic materials are often used for supporting and isolating as a base layer of the cap, especially at slope areas. However, naturally occurring capping materials, at least at the top layer of the cap, are preferred to aid active recolonization of the capped area by benthic organisms.

Thickness, consolidation, geometry of the sediment surface, and erosion need to be analyzed on a site-by-site basis to construct a successful cap. Optimum cap thickness is established on the basis of site-specific characterization information, natural recovery characteristics, and RAOs. Chemical fate and transfer models are available and can be used to design the cap thickness and evaluate the effectiveness of the cap.

Additional information is presented below for three types of capping systems: thin-layer, barrier, and armored caps.

Thin-Layer Caps – Thin-layer caps (10 to 15 centimeters thick) are sometimes referred to as assisted natural recovery. By placing a thin layer of sand or silt over the contaminated sediment, a thin-layer cap accelerates the natural sedimentation process, isolating the benthic organisms from the contaminated sediments. Design of thin-layer caps considers the depth of benthic activity and is generally limited to areas with relatively flat bathymetry, low-velocity currents, and low occurrence of ship traffic or other sources of sediment disturbance. Thin-layer caps can be placed from a barge or land.

Barrier Caps – Barrier caps generally include sand or clay mineral-based material, potentially consisting of multiply layers, and are usually 1 to 3 feet thick. Barriers caps are designed to prevent migration of the chemicals from sediments into the water, provide a barrier to burrowing benthic organisms, and stabilize the contaminated sediments (Hull and others 1999). Sand and fine-grained materials are commonly used for sediment capping because they are readily available. However, clay mineral-based materials, such as AquaBlok, are designed to provide a higher degree of resistance to erosive forces and a greater barrier to chemical migration. Barrier caps provide a greater degree of protection than thin-layer caps at sites with higher current velocities and more dynamic environments, with a corresponding increase in cost and complexity for design and placement.

Armored Caps – Armoring can be used to further stabilize cap materials in higher-energy environments where currents, waves, or mechanical disturbance could lift the cap material. Armor typically consists of stone or other riprap placed over the primary capping material or a clay-mineral based material such as AquaBlok. Capping design is typically based on a threshold event, such as a 100-year storm, as a conservative approach. A less conservative but still viable approach is to consider that the extreme event may erode some but not all of the conventional capping material, thus reducing the amount of capping material needed (Reible and others 2004). Capping can also be an effective alternative when natural attenuation processes are considered inadequate or too slow to minimize environmental risk.

Institutional and engineering controls are commonly implemented in conjunction with caps, such as physical access restrictions, deed notices, or future restrictions on dredging. These controls minimize the potential for cap disturbance and subsequent exposure to contamination by human or ecological receptors. A long-term monitoring program is commonly required to monitor the cap's integrity and effectiveness. Techniques such as sediment coring, bathymetric surveying, video profiling, and surface sediment sampling can be used to evaluate long-term effectiveness of the cap placement and shifting or erosion of the cap.

3.4.1.1 Effectiveness

Capping is considered an effective technology because it physically isolates or immobilizes contaminated sediment, preventing direct human contact and exposure of benthic organisms to contaminated material. Conditions in Area III are less favorable for barrier capping because the velocity of the current is faster in Area III than in Area X, with resulting higher scour rates and a steeper bathymetric gradient. Consequently, a more substantial cap, such as a multi-layered or armored cap, may be effective in this area. Area X (the South Basin) has relatively shallow water depth, a flat surface (bathymetric gradient), slow currents and, at present, no maintenance dredging. These conditions may favor use of thin-layer capping as an effective remedy but may require partial excavation to maintain the original bathymetry. Capping technologies also cause minimal sediment resuspension during the cap placement relative to dredging.

3.4.1.2 Implementability

Factors that influence implementability include the selection and availability of suitable capping material, the accessibility of the sites by barge or land, and environmental factors such as water depth and current velocities. Boat and ship traffic in the area of Parcel F is minimal; thus, cap placement is not likely to inhibit use of the waterways. The technical implementability of this process option is considered good because conventional construction techniques, materials, and equipment can be used. Implementability would be more difficult in Area III than Area X because of the steeper bathymetric gradient in that area. Initial monitoring would be required to evaluate the reduction of chemical concentrations in surface sediment to meet the RAOs for the site, while long-term monitoring would focus primarily on stability of the cap.

3.4.1.3 Cost

Capital costs for this process option are considered relatively low to moderate because capping generally costs less than excavation or dredging. Contaminated sediments would remain in the environment on site, handling would be limited, and transportation costs would be greatly reduced relative to removal technologies. The installation costs would vary depending on the capping design, ranging from low costs for a thin-layer cap to higher costs for multi-layered and armored caps. Costs for a monitoring program at Parcel F may be considerable, depending on the size of the area that would require capping.

3.4.1.4 Screening Results

Capping would be effective and implementable; thus, it is retained for further evaluation in Section 4.0 of this FS Report.

3.4.2 In-Situ Bioremediation and Stabilization

Two in-situ technologies are screened and discussed below: bioremediation and stabilization using activated carbon. The technologies are assessed for their ability to address both of the chemical types because Parcel F sediments contain both inorganic (copper and mercury) and organic (PCBs) COCs. Technologies that are effective for treating inorganic chemicals (metals) are evaluated primarily for application in Area III since metals are the primary risk driver in this area. Likewise, technologies potentially effective for addressing PCBs are evaluated for application in Area X (South Basin). The two in-situ technologies evaluated in this FS Report are summarized below. These summaries are followed by the evaluation of the technologies against the three evaluation criteria.

In-Situ Bioremediation. Bioremediation uses techniques directed toward stimulating existing microorganisms to grow and use chemicals as a source of food and energy. As a result, a combination of oxygen (for aerobic biodegradation), nutrients, and moisture must be provided, while the temperature and pH are controlled. In some cases, microorganisms adapted for degradation of specific chemicals are applied to enhance the process.

Bioremediation is not applicable for treatment of inorganic chemicals. Although not all organic chemicals are amenable to biodegradation, bioremediation techniques have been successfully used to remediate soils, sludges, and groundwater contaminated by petroleum hydrocarbons, solvents, some pesticides, PCBs, wood preservatives, and other organic chemicals. Higher chlorinated congeners, such as those most commonly found at Parcel F, are more readily treated under anaerobic conditions. In general, those with fewer chlorine atoms tend to be more readily biotransformed under aerobic conditions, and the higher chlorinated congeners are more readily biotransformed under anaerobic conditions. Since the PCBs detected in Area X (South Basin) are predominantly the high Aroclor PCBs (Aroclor-1254 and Aroclor-1260), anaerobic bioremediation would be most effective. Under anaerobic conditions, PCBs are transformed by reductive dehalogenation. Reductive dehalogenation is the process of chlorinated compounds being converted to another chemical by replacing the chlorine atoms with hydrogen atoms.

Reductive dehalogenation of organic molecules has become recognized in recent years as a general process that is effective for dehalogenating a variety of halogenated organic chemicals, such as pesticides and PCBs (Holliger and others 1998; Tiedje and others 1993).

However, complete anaerobic dehalogenation of PCBs in sediments has not been reported. Different organisms that can dehalogenate PCBs have different abilities to dehalogenate, and PCB dehalogenating patterns have been found to be different with different sediments (Tiedje and others 1993). Previous studies indicated that rates of reductive dehalogenation are optimal for PCB concentrations in the range of several hundred to thousands of parts per million (ppm) (or milligrams per kilogram [mg/kg]), but often are very slow or negligible for PCB concentrations below 50 ppm in sediments (Quensen and others 1988; Sokol and others 1998).

In-Situ Stabilization using Activated Carbon. In-situ stabilization of hydrophobic organic chemicals such as PCBs, polynuclear aromatic hydrocarbons (PAH), and DDT in sediment is an emerging technology. Laboratory studies using contaminated sediment from Area X (the South Basin) provided a basis for ongoing field testing at Parcel F in this area. Reduction in total PCBs was observed in bioaccumulation testing using *M. nasuta* clams, *Leptocheirus* amphipods, and *Neanthes* worms (Ghosh and others 2003; Luthy and others 2004; Zimmerman and others 2004). In addition, semipermeable membranes devices (SPMD) have been used to assess chemical and biological availability of PCBs and PAHs in sediment and water before and after treatment with activated carbon. One month treatment of activated carbon demonstrated a reduced SPMD uptake of up to 73 percent. Physical tests showed that the total PCB aqueous equilibrium concentration for sediment mixed with activated carbon decreased 87 percent for 1 month and 92 percent for 6 months.

The field application methods of most in-situ treatments, including activated carbon, are less proven, but preliminary results of a demonstration project under way at Parcel F by Stanford University are promising.

The primary objective of the demonstration project taking place at Parcel F is to evaluate an innovative treatment for in-situ stabilization of PCBs in sediment under field conditions found at Area X (South Basin) (see Attachment 3). Additional objectives are to evaluate if activated carbon treatment reduces PCB bioaccumulation in field tests and evaluate if no significant sediment resuspension and PCB release occurs as a result of the large-scale mixing technologies used to blend the carbon into the sediment. The technology involves mixing activated carbon into the contaminated sediment.

3.4.2.1 Effectiveness

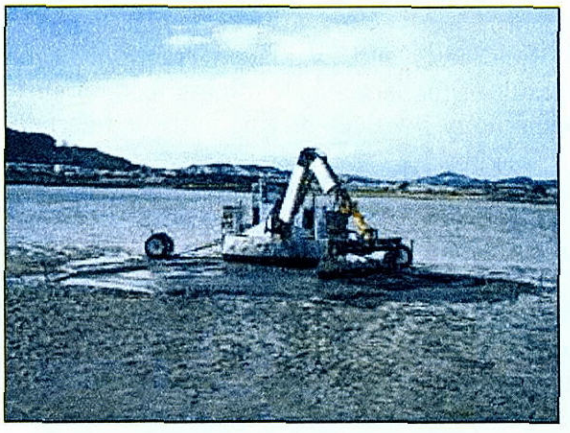
The effectiveness of in-situ bioremediation in addressing contaminated sediment at Parcel F is uncertain. In-situ bioremediation was evaluated on PCBs in the Hudson River to assess the technology's viability for treating contaminated sediments (Renholds 1998). Results of the study suggested that naturally occurring microorganisms were actively degrading PCBs; however, PCB degradation efficiencies were not high, and it was unclear whether the degradation that occurred was from bioremediation. Complete anaerobic dehalogenation of PCBs in sediments has not been reported, and different PCB dehalogenation organisms have different abilities to dehalogenate. PCB dehalogenating patterns have been found to be different with different

sediments (Tiedje and others 1993). Previous studies indicated that rates of reductive dehalogenation are optimal for PCB concentrations in the range of several hundred to thousands of ppm, but often are very slow or negligible for PCB concentrations below 50 ppm in sediments (Quensen and others 1988; Sokol and others 1998). Therefore, the effectiveness of this technology on sediments in Parcel F is less certain.

Although in-situ stabilization technologies are well developed, published data on the performance of in-situ stabilization on organic chemicals in sediment are limited. The field pilot study using activated carbon to stabilize PCBs in sediment at Parcel F, performed by Stanford University and its associates, should provide direct performance results and valuable information for the site remedial design. Preliminary results of the treatability test conducted at HPS indicated that the application of activated carbon to sediments was successful with minimal effects from disturbances to the water column via resuspension of material. Effectiveness of the activated carbon on bioavailability of chemicals is still under evaluation, but the preliminary results are promising (Luthy 2006).

3.4.2.2 Implementability

Implementation methods for in-situ bioremediation of sediments are not thoroughly developed. Implementation methods for application of granular activated carbon are being developed at Parcel F. Field demonstrations to test the ability to mix the activated carbon using large-scale equipment are under way by the Stanford team. This team is evaluating how the difference in homogeneity and amount of mixing could affect PCB bioaccumulation in benthic fauna found at Parcel F (see Attachment 3). Two types of large-scale equipment were evaluated: the Aquamog and the Compass Environmental, Inc. (CEI) injector system. The Aquamog is a barge-mounted machine with a "rotovator" attachment that mixes to a depth of about 1 foot; the arm is able to mix within a 6-foot swath (see photograph below). In addition to the Aquamog, an injector system was implemented at the South Basin. The system uses a rake injector that can be used from the shoreline with an injector arm to mix the activated carbon slurry (see photograph below).



Aquamog at Parcel F

Rake Injector Mixing Activated Carbon Slurry

3.4.2.3 Cost

In-situ treatment is generally expected to be less costly than removal and disposal technologies because the costs are lower than for removal and disposal of sediment in a classified landfill. Costs are saved by avoiding the construction of the sediment processing area and water treatment, as well as transportation and disposal costs. The costs for in-situ stabilization using activated carbon could be significantly reduced if regenerated activated carbon becomes available and is shown to be effective. A preliminary assessment by Stanford University showed that that the cost using regenerated activated carbon could lower the cost by 60 percent (see Attachment 3).

3.4.2.4 Screening Results

The effectiveness of biological in-situ treatment is not proven for sediments that contain PCBs at concentrations that are typical at Parcel F. Therefore, biological in-situ treatment is not retained for consideration as part of a remedial technology in this FS Report. The effectiveness and implementability of activated carbon as an in-situ treatment shows potential and is retained for consideration in Section 4.0 of this FS Report.

3.5 EX-SITU TREATMENT

Ex-situ treatments can be performed on site or at an off-site treatment facility. The treatments are usually applied to meet final disposal requirements or to reduce costs by generating material with less stringent disposal requirements. The ex-situ treatments considered for HPS Parcel F are biological, physical, chemical, and thermal.

The text below summarizes the ex-situ technologies evaluated in this FS Report. Each summary is followed by the evaluation of the technologies against the three criteria: effectiveness, implementability, and cost.

Biological Treatment – Landfarming. Landfarming (sometimes referred to as land treatment) was identified as the potential biological treatment for contaminated sediments at Parcel F. Landfarming involves mixing sediment contaminated by organic chemicals with nutrients, water, and other amendments and placing the combined material in an engineered treatment unit. Microorganisms can degrade certain organic chemicals with appropriate mixing of the sediment to introduce oxygen and proper moisture control. Landfarming units typically include leachate collection equipment to minimize the risk that chemicals would leach into uncontaminated soil and groundwater. Landfarming treatment requires prepared treatment beds, composting areas, or sediment piles. Landfarming would treat only organic chemicals at Parcel F (PCBs), and not inorganic chemicals (copper and mercury); therefore, it is evaluated for sediments from the South Basin.

Physical Treatment – Stabilization and Solidification. Stabilization treatments immobilize chemicals by mixing reagents into the sediments, thereby solidifying or fixing the chemicals through physical or chemical reactions. This binding of chemicals reduces their mobility and toxicity. Solidification involves binding metals into a low-permeability solid mass that resists leaching by immobilizing metals through precipitation. The actual binding mechanism depends on the type of solidification process. Cemented solidification processes are successful and effective for many situations because of the wide range of applicability for many sediment types and moisture contents. Some stabilization technologies for heavy metals use patented chemicals to convert soluble heavy metals such as copper and mercury to insoluble nonhazardous minerals. Inorganic chemicals, such as copper and mercury found at HPS Parcel F, can be chemically bound by a cement-based solidification process.

Chemical Treatment – Sediment Washing. Typically, sediment washing is a two-step process. Ex-situ physical separation is followed by chemical washing. During the first step, finer particles are separated out using mechanical screens or other methods. It is assumed that chemicals are sorbed onto finer particles, which generally contain high levels of total organic carbon. During the second step, chemical washing uses a solvent to remove chemicals from sediment, thus concentrating the chemicals in the washing stream.

The washing system typically consists of a reactor vessel to mix the sediment with washing fluids, and an adsorption unit to treat the wastewater generated. The washing fluid may be water, water mixed with surfactants, acids, or bases, depending on the chemicals to be removed. The process transfers chemicals to the washing fluid or concentrates chemicals in a fraction of the original volume. Sediment washing is generally considered effective for sediments affected by a wide range of chemicals, including fuel hydrocarbons, inorganic chemicals, and halogenated and nonhalogenated semivolatile organic compounds.

Thermal Treatment – Incineration. Incineration can treat most organic chemicals in both nonaqueous and aqueous media. Incinerators use controlled combustion with extremely high temperatures (1,400 °F to 3,000 °F) to destroy chemicals. Incineration can be implemented using mobile units or at off-site permitted facilities. Incineration is capable of destroying PCBs, PAHs, and dioxins (National Research Council 1997; Federal Remediation Technologies Roundtable 2002). Inorganic chemicals such as metals are typically concentrated in ash generated during the incineration process. The ash may require additional treatment, management, and disposal, depending on the chemical concentrations. The resulting residue can be disposed of off site or used beneficially under appropriate circumstances.

3.5.1 Effectiveness

Biological treatment would be effective for organic chemicals, such as the total PCBs found at Parcel F. However, it would not effectively treat sediments contaminated with inorganic chemicals such as copper and mercury. Because biological treatments are not field-proven, a treatability study would be required.

Stabilization and solidification technologies effectively reduce the mobility and toxicity of all three COCs (copper, mercury, and total PCBs) at Parcel F; however, these technologies are less proven for treatment of PCBs than for metals.

Sediment washing technology has been successfully implemented at sites contaminated with metals and PCBs. Sediment washing typically involves intensive treatment of the sediments and resultant fluids. Sediment washing would require testing to determine the most effective treatment methods for copper, mercury, and total PCBs at Parcel F.

Incineration would be effective and viable for treating mercury and total PCBs in sediments at Parcel F; however, they would not treat copper.

3.5.2 Implementability

All of the ex-situ technologies would be implementable in terms of equipment and personnel requirements. Sediment washing would be less implementable because of the difficulty of treating fine-grained sediments and potentially large volumes of liquid residual that would require treatment. Incineration is not implementable because of the off-gas treatment requirements and stringent Bay Area Air Quality Management regulations.

3.5.3 Cost

Capital and O&M costs for landfarming are low, although excavation costs to stockpile sediments are moderately expensive. Disposal of landfarmed waste may also be necessary. A minimal amount of relatively inexpensive capital equipment is required for landfarming stockpiles materials. Costs for implementing stabilization and solidification technologies include the stabilization effort and also disposal costs. The relative capital cost for stabilization is moderate, and no O&M cost is incurred. In general, sediment washing, incineration, and thermal desorption are expensive to implement. The per-unit cost for these technologies would likely be higher than off-site disposal of sediment at a permitted facility.

3.5.4 Screening Results

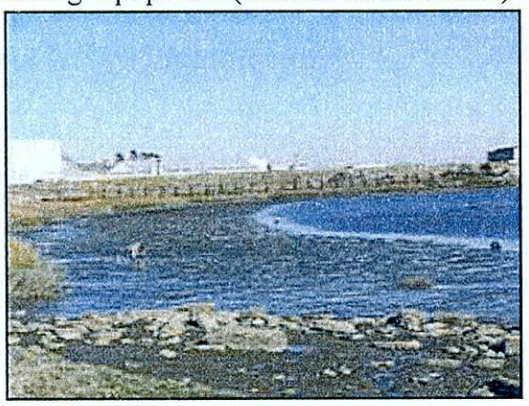
Ex-situ sediment stabilization and solidification technologies will be retained for further evaluation because they are both effective and implementable for treating the copper- and mercury-contaminated sediments at Parcel F. They also would reduce the hazardous waste disposal costs, if required. Landfarming would require treatability studies and is less proven for remediation of PCB-contaminated fine-grained sediments, so this technology is not retained. Sediment washing is not retained because of the impracticality of this technology with respect to its questionable implementability in fine-grained sediments.

3.6 REMOVAL

Well-proven technologies are available for removing contaminated sediments at Parcel F. Factors that influence removal of sediment include site conditions, water depth, sediment characteristics (including water content), volumes to be removed, and accessibility. Above-water excavation and two types of dredging (mechanical and hydraulic) are considered for the site and are evaluated below.

3.6.1 Above-Water Excavation

Above-water excavation is the process that uses earthmoving equipment (such as an excavator) to remove contaminated sediments. Excavation can be used to remove contaminated sediments from shallow nearshore areas where the work zone can be isolated and dewatered. A large mudflat is present in the South Basin (Area X) of Parcel F where it would be suitable to use excavation to remove the sediment at low tide (see photograph to the right). However, it would be difficult to access and reach this mudflat using dredging equipment. Cofferdams, an AquaDam, or other dewatering techniques could be used in wet or shallow submerged areas to keep water out of the excavation area.



3.6.1.1 Effectiveness

Greater control of material would be expected and chemicals would be less likely to spread to adjacent areas because excavation would be completed in a relatively dry environment as opposed to dredging. Excavation would be effective in the mudflat (Area X) of Parcel F.

3.6.1.2 Implementability

Excavation would likely involve the use of long-reach excavators, dump trucks, low-ground-pressure dozers, and other earthwork equipment. Crane mats would likely be required to support some of the heavy equipment on areas with soft subgrade. Cofferdams or other dewatering methods may be necessary to reduce or prevent dispersal of chemicals during excavation in wet or submerged areas.

3.6.1.3 Cost

The capital cost for excavation is expected to be comparable to the dredging technologies. However, costs for managing post-excavated sediment can be substantially lower than for dredging because excavation is conducted under relatively dry condition, the volumes of

removed contaminated sediment for rehandling are smaller, and costs for dewatering and water treatment efforts are much lower.

3.6.1.4 Screening Results

Removal of sediments is effective and implementable for certain areas of Parcel F; thus, it is retained for further evaluation in this FS Report.

3.6.2 Dredging

This technology involves removing contaminated sediments using either mechanical or hydraulic equipment. Both mechanical and hydraulic dredging have been used extensively to remove sediments. Mechanical dredging typically uses either a land-based or floating excavator, consisting of a crane or excavator arm with an excavation attachment such as a clamshell, drag line, or bucket. Specialty systems are required in the nearshore and extremely shallow areas. Hydraulic dredging typically involves a floating barge or platform with onboard pumping systems that remove water and sediment from inundated areas and pump it to another location for treatment or disposal.

After sediments are removed, they are transported from the dredging site to a rehandling or end-use site. Sediments can be transported by the dredging vessel itself, or by using additional equipment such as barges, scows, and pipelines. Three types of dredging (mechanical, hydraulic, and specialty dredging) were considered under this process option and are briefly evaluated in the following sections.

Site conditions conducive to dredging include:

- Suitable areas for staging and handling of dredged materials.
- Water depth that is adequate to support the dredging barges and where navigation is not impeded by pilings or other structures.
- Long-term risk reduction of removal outweighs sediment disturbance and habitat disruption.
- Contaminated sediment is underlain by clean sediment.
- Chemicals requiring remediation cover known and preferably discrete areas.

Mechanical Dredging

Mechanical dredging removes sediments through the direct application of mechanical force to dislodge and excavate the material. Excavator, clamshell, and dragline are common types of

mechanical dredges. Mechanically dredged sediments are typically placed in a barge or scow for transport to the rehandling or end-use site.

Mechanical dredging is an effective means of removing contaminated sediments from Parcel F. Mechanical dredging equipment can effectively remove hard, compacted sediments with little additional entrainment of water. Mechanical dredging, however, is slower than hydraulic dredging and typically creates more disturbance and resuspension of sediments at the dredging site. The standard clamshell dredge with a lid and rubber gaskets is somewhat effective in reducing resuspension during dredging operations.

Specialty environmental buckets are available and are designed to remove sediment in thin layers and to create a seal to reduce sediment loss, thus reducing resuspension of sediment during removal. The environmental buckets have been used at several remediation projects, including the Great Lakes (EPA 1994a, 1994b) and in the Pacific Northwest and New Bedford, Massachusetts. Although the environmental buckets may increase removal efficiency and minimize sediment resuspension, they may not be cost-effective at every site—for example, at sites with debris or in stiffer well-consolidated sediments may not be amenable to environmental buckets.

Other types of mechanical dredges include articulating mechanical dredges that incorporate a excavator design, clam-type enclosed buckets, or hydraulic closing mechanisms, all supported by an articulating fixed arm.

Hydraulic Dredging

Hydraulic dredging removes and transports sediment in a liquid slurry form. Hydraulic dredges are usually barge-mounted and carry diesel or electric pumps with intake and discharge pipes that range in diameter from 6 to 48 inches (U.S. Army Corps of Engineers 1991). Hydraulic dredging would be an effective means of reducing the resuspension of contaminated sediments in Parcel F. This type of dredging is effective for removing large volumes of loosely compacted sediment quickly with relatively little resuspension of sediments at the dredging site. Hydraulic dredging, however, typically removes a slurry that is only 20 percent sediment by weight, so substantial water handling is required. The water must be decanted, managed, and possibly treated before it can be discharged back into the bay or sewer system. Sediments are typically settled out in the settling basins or ponds or filtered out using geosynthetic filters such as a Geotube. Disposal at a landfill may require a greater degree of dewatering to reduce sediment moisture content to acceptable disposal limits.

Hydraulic dredges available for use at remediation sites include a conventional cutterhead, horizontal augers, plain suction (with no cutting action), pneumatic submersible pumps, specialty dredge heads, and diver–assisted, hand-held hydraulic suctions. Cutterhead dredges are most commonly used because they are effective in a wide range of sediment types. Suction dredges are generally used only in soft sediments with little debris, and sometimes employ a water jet to help loosen the sediments.

Specialty Dredging

Specialty dredging involves the use of specialized equipment such as high-solids, low-turbidity, or laser-surveyor type dredges. High-solids dredges are designed to minimize the amount of water that is taken up during dredging. Low-turbidity dredges minimize the localized resuspension of sediment that results from dredging. Laser-surveyor dredges are able to remove material in specific areas to exact depths. Dredging with specialized equipment is an effective means of reducing the risk of exposure to chemicals in Parcel F sediments. High-solids and low-turbidity dredges are effective when sediment dispersion is of primary concern. Laser-surveyor dredges are effective when disposal costs are high, and the possibility that design depths and volumes could be exceeded is of primary concern.

3.6.2.1 Effectiveness

Dredging would effectively remove contaminated sediments; however, the risk of leaving residual contamination in place should be considered. Mechanical dredging is most effective when dredging volumes are low, haul distances are high, and capacity at rehandling sites is limited. Accuracy for mechanical dredging is less than 2 feet. The vertical accuracy of hydraulic dredging techniques is less than 1 foot, but they require more on-site processing than does mechanical dredging. Hydraulic dredging removes a slurry that is only 20 percent sediment by weight. As a result, the added water must be decanted, managed, and possibly treated before it can be discharged. Specialty dredging in general is effective when resuspension, depth control, and treatment of decant water are key concerns.

3.6.2.2 Implementability

Dredging can be implemented easily at most sites. Mechanical and hydraulic dredging are easily implementable with standard equipment. Specialty dredging is relatively easy to implement, but requires specialized equipment and appropriately trained personnel. Because typical commercial dredging companies are not experienced in environmental remediation, special instruction is required to assure greater precision to minimize removal and handling of materials deeper than the contaminated zone. Production rates will be much slower than for typical maintenance dredging.

3.6.2.3 Cost

Capital costs are moderate to high, consisting mainly of equipment, personnel, and transportation. The capital cost for dredging technologies is expected to be higher than for any of the in-situ technologies. Post-dredging sediment and water management can substantially increase the overall costs of this remedial alternative.

3.6.2.4 *Screening Results*

Mechanical and specialty dredging technologies will be retained for further evaluation in this FS Report.

3.7 DISPOSAL

Disposal options for excavated sediments include off-site disposal at a Class I landfill or disposal at a Class II/III landfill. The excavated sediments would be evaluated before disposal to identify the type of landfill that will accept the material for disposal. Excavated sediments that qualify for disposal at a Class II or Class III landfill may also be beneficially reused as an alternative daily cover.

Following is a description of Class I and Class II/III landfills. Each description is followed by the screening evaluation against the three criteria: effectiveness, implementability and cost. The evaluation of landfill disposal is followed by the evaluation of sediment management.

3.7.1 Off-Site Landfill

Off-Site Class I, II, and III Landfills. A Class I landfill generally accepts hazardous waste as defined in Cal. Code Regs. tit. 22, Division (div.) 4.5, Chapter (ch.) 11, which lists characteristics of ignitability, corrosivity, reactivity, and toxicity. The characteristic of toxicity is evaluated using the following tests: (1) soluble threshold limit concentrations (STLC), (2) total threshold limit concentrations (TTLC), and (3) toxic characteristic leaching procedure (TCLP). A waste is considered hazardous if it exhibits ignitability, corrosivity, reactivity, and toxicity in comparison with established regulatory agency criteria. Therefore, samples collected from representative quantities of sediment would be analyzed for ignitability, corrosivity, reactivity, and, for initial characterization, using all three toxicity tests (STLC, TTLC, and TCLP). Before land disposal, RCRA hazardous waste (Cal. Code Regs. tit. 22 for criteria) and selected California-only hazardous waste must be treated to achieve the appropriate treatment standard specified in the requirements for land disposal restrictions in Cal. Code Regs. tit. 22, div. 4.5, ch. 18.

Removed material with PCB concentrations less than 50 mg/kg can legally be disposed of in a Class II municipal or solid waste landfill, while PCBs with concentrations that exceed 50 mg/kg requires disposal at a Toxic Substances Control Act-permitted landfill.

Under federal standards, PCBs are not regulated as a hazardous substance under RCRA, but mercury is. As a result, removed sediment must be managed as RCRA hazardous waste if the concentration of mercury exceeds the TCLP requirements when sediments from Parcel F are contaminated with both PCBs and mercury.

Off-Site Class II or Class III Landfill Disposal. Sediment waste that would not require Class I landfill disposal may be sent to either a Class II or a Class III landfill. Class II units are more rigorous than Class III because they are constructed to isolate hazardous waste from state waters. The Class II unit is a permitted Subtitle D cell designed with a synthetic liner and leachate collection system. Class III disposal facilities are constructed to separate nonhazardous solid waste and from waters of the State of California.

Designated wastes can be disposed of at Class II landfills that have been approved for containment of the type of waste stream to be disposed of (Cal. Code Regs. tit. 27, § 20210). Designated waste is defined as "nonhazardous waste that consists of, or contains, pollutants that, under ambient environmental conditions at a waste management unit, could be released in concentrations exceeding applicable water quality objectives or that could reasonably be expected to affect beneficial uses of the waters of the state as contained in the appropriate state water quality control plan" (*California Water Code* § 13173).

Nonhazardous and nondesignated wastes can be disposed of at Class III landfills that have been approved for the specific type of waste stream to be disposed of. Certain contaminated soils, sludge, and industrial wastes can also be disposed of at Class III landfills.

It is anticipated that most material removed from Parcel F would be considered designated waste for disposal at a Class II facility or as alternative daily cover, although some material may be designated as waste for a Class III facility.

3.7.1.1 Effectiveness

Landfill disposal would effectively reduce the risk of exposure to chemicals in sediment at Parcel F. Disposing of contaminated sediments at an off-site landfill removes the chemicals from the aquatic setting, where they could be a hazard to ecological receptors. The contaminated sediment is placed in a landfill, eliminating the pathway from sediment to the environment. Landfill sites are readily available, and costs are comparable to treatment technologies. Therefore, disposal at a Class I, Class II or III landfill would be an effective option.

3.7.1.2 Implementability

Implementability of landfill disposal depends on locating a landfill with adequate space for the contaminated sediments and with the appropriate permits and requirements to accept the contaminated sediments. Class I landfills identified for disposal of the contaminated sediments from Parcel F include the Laidlaw facility in Button Willow, California, and Chemical Waste Management's Kettleman Hills facility in Kettleman City, California. Class II landfills identified for disposal of the contaminated sediments from Parcel F include Altamont Landfill (Livermore, California), Hayroad Landfill (Vacaville, California), and Forward, Inc./Allied Waste (Manteca, California).

Disposal would be easily implemented once a landfill is found to meet the appropriate requirements. Dewatering, transportation, stabilization, and disposal of contaminated sediments in landfills have been widely conducted.

3.7.1.3 Cost

The cost of the off-site Class I landfill process option depends on several factors, such as (1) the trucking distance between HPS and the Class I landfill, and (2) the volume of waste that would require disposal. Out-of-state landfills may offer reduced disposal fees and taxes, as well as the use of rail transportation rather than trucking. Capital costs are high for Class I landfill disposal, but O&M costs are not associated with this process option.

The only treatment required for contaminated sediment to be disposed of in a Class II landfill is dewatering, so the total cost of disposal would vary, depending on the amount of dewatering required and the distance and type of transportation. Aside from dewatering, costs for disposal of contaminated sediments in a Class II landfill would be moderate.

3.7.1.4 Screening Results

Disposal at a Class I, II, or III landfill must be conducted in conjunction with other process options; thus, they will be considered with excavation and dredging and are retained for further evaluation in this FS Report.

3.7.2 Management of Removed Sediments

Dewatering and transportation options are evaluated in this section since these actions are part of all disposal methods. If a removal technology is selected, sediments would be stockpiled and may require dewatering before the waste could be transported to the off-site location. The dewatering process reduces the weight and volume of sediment and is necessary before transport. Depending on the removal technologies selected, the amount of water required to be removed varies greatly: extensive dewatering for hydraulic dredging, moderate for mechanical dredging, less for specialty dredging, and minimal or no dewatering for excavation. Three dewatering techniques were evaluated for Parcel F: dewatering beds, mechanical dewatering, and dewatering additives. Additionally, removal of sediments from Parcel F by barge, truck, and rail was evaluated.

Dewatering Beds. Dewatering beds use passive drainage and evaporation to dry sediment. A common approach is to place removed sediment into a skid-mounted bin or tank and allow the sediment particles to settle. After settling occurs, the overlying liquid will evaporate, slowly drain through a weir, or can be pumped out. If the liquid is drained or pumped, monitoring would be required and, depending on the presence of contamination, treatment may also be required. Another method is to spread sediment in thin layers over a large area and allow water to drain and evaporate over a period of time.

Mechanical Dewatering. Mechanical systems are used to accelerate the process when dewatering beds are insufficient. Mechanical dewatering technologies include belt presses, plate and frame and geotextile filtration, centrifugal dewatering, and heated and forced air.

For the belt press technique, removed material is placed between two conveyor belts, and water is squeezed out of the sediment by a series of rollers. For the plate and frame filtration technique, the material removed is pumped in between two plates lined with a permeable fabric, and water is squeezed out when the plates are pushed together under high pressure. The geotextile filtration technique uses flat or tube-shaped membranes (Geotube) that hold the material removed, and water is forced through the pores by gravity or a hydraulic pump. For the centrifugal dewatering technique, removed material is put in a chamber on the centrifuge, which quickly accelerates. The forces of the centrifuge drive the solids to the chamber wall, while the clarified liquid flows to an adjustable overflow weir. For heat and forced air systems, the material is placed in a confined area that can be adequately heated, with excess moisture given off through evaporation.

In all cases where mechanical dewatering processes create excess water, the water must be analyzed and treated as necessary before it can be disposed of to a sewer or discharged back to the site.

Dewatering Additives. Dewatering additives (such as polymers, hydrated lime, ferric sulfate, and fly ash) would be added to the sediment removed to increase sediment solidification. The dewatering additives process requires mechanical equipment to mix the sediment and additives. Although the additive materials assist in the dewatering and shorten the dewatering time, they may increase the overall sediment volume and weight by 10 to 30 percent, resulting in increased disposal costs.

3.7.2.1 Effectiveness

The dewatering time varies depending on temperature and weather. Warm, dry weather makes the dewatering process much faster than cooler, wetter weather. Use of dewatering beds, mechanical dewatering, and dewatering additives are field-proven methods for dewatering sediments. Mechanical dewatering would be much quicker than relying on the natural means of the dewatering bed. The use of additives would be effective, but would require a bench-scale test to identify the type of chemical additives and mixing equipment and methods to be used.

3.7.2.2 Implementability

A passive dewatering system (an on-site dewatering bed) would require a large tract of land, ranging from 1 to 2 acres for mechanically dredged material to a larger area for hydraulically dredged material. The dredged material would be placed in up to 1-foot layers. A platform and skid-mounted bin would be required to move sediments to and from the dewatering site. The time required to settle fine sediment would depend on the particle analysis of the dredged

material. If a large amount of fine Bay Mud is included in the material, a considerable amount of time may be required to achieve turbidity levels appropriate for discharge.

Most types of mechanical dewatering would be moderately difficult to implement, requiring a major mobilization of heavy equipment and experienced personnel to the site, in addition to wastewater treatment (either on site or off site). The exception is the use of Geotubes, which are fairly easy to implement.

The use of dewatering additives would require a large area of land and use of heavy machinery to properly mix the material removed. Although not as labor intensive as mechanical dewatering, the use of chemical additives is considered relatively difficult to implement.

3.7.2.3 Cost

The use of on-site dewatering beds is a cost-effective method to dewater sediments at Parcel F. The cost of using a dewatering bed is typically low because dewatering occurs over time and relies on evaporation and drainage without electrical costs. Only a tank, platform, heavy equipment, and a drainage system would be required. Mechanical dewatering techniques greatly increase dewatering costs compared with the dewatering bed techniques, depending on the type of dewatering equipment used, the method of dredging, and the resulting difference in composition of the dredged material. The additional costs for dewatering additives may be offset by a reduction in the amount of time required for settling, resulting in lower costs for equipment and labor on site

3.7.2.4 Screening Results

The effectiveness of dewatering beds would depend on the type of dredging and the resulting amount of fine clay particles, consistent with the level of Bay Mud entrained in the dredged materials. Dewatering beds are more likely to be effective if mechanical dredging is used. Mechanical dewatering would be effective and implementable, but at a much greater cost than dewatering beds. The exception is the use of Geotubes, which are more easily implemented with lower costs than are the other mechanical dewatering techniques. Dewatering additives would be effective and implementable and may be necessary for sediment handling at Parcel F. Because of the conditions at Parcel F, large volumes of sediments that would require dewatering would be expected. As a result, all of these process options are retained for further evaluation in this FS Report.

3.7.3 Transportation

Dredged sediments are typically placed in a barge or scow for transport to a rehandling or end-use site. After dredged sediment has been processed (through dewatering or treatment), trucks would be used to transport material to an off-site disposal facility. When this method is used, trucks would be required to meet waste specifications for transportation of the material. Transportation by rail can be used to move excavated or dredged material to an off-site disposal

facility. This method of transport requires an existing railroad that connects Parcel F with a disposal facility. Not all disposal facilities are serviced by rail spurs, so the selection of this transportation method depends on the disposal facility selected. The rail containers would be required to meet specifications for waste transportation.

3.7.3.1 Effectiveness

Barges and trucks have been successfully used to transport contaminated sediments and would be considered effective for removing sediments from Parcel F. Transportation by rail has been successfully used to transport contaminated sediments from a similar project at Parcel E, so it would be considered effective for removing sediments at Parcel F.

3.7.3.2 Implementability

Transport by barge and truck would be readily implementable at Parcel F, which has sufficient access, turnaround, and staging areas. Implementability of rail transport depends on the existence of rail facilities at or near the site for loading and at or near the selected landfill for unloading. A rail spur used by Allied Waste is located at Pier 96, within 2 miles of HPS. Allied Waste has used this rail spur for transporting sediments from Parcel E at HPS. Trucks would be used to haul the material from Parcel F and then loaded on the train. The train would take the material directly to the Allied Waste disposal facilities in Utah. Rail transport would be easily implemented if the Utah disposal facilities are selected (based on the type of waste generated).

3.7.2.3 Cost

Barge and truck transportation costs are high but standard for moving contaminated sediments from a dredging site to an off-site facility. Costs may vary depending on the waste classification and distance to the disposal facility. Costs for rail transportation are high but standard for moving contaminated sediments to an off-site facility.

3.7.2.4 Screening Results

Transportation by barge and truck would be effective and easily implementable; thus, it is retained for further evaluation in this FS Report. Rail transportation depends on the disposal facility that is to be used. It is also retained for further evaluation in this FS Report.

3.8 SUMMARY OF INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

The initial screening process evaluated the various technologies for effectiveness, implementability, and cost. This screening process eliminated technologies that would not effectively address sediment contamination at Parcel F. Table 3-1 summarizes the results of the initial screening of remedial technologies and process options and identifies the technologies that were eliminated from consideration in this FS Report.

TABLE 3-1: SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

General Response Action	Remedial Technology Type	Process Option	Retained for Further Evaluation	Description	Screening Comments
No Action	None	Not Applicable	Yes	No Action	Required by NCP as a baseline for comparison.
Institutional Controls	None	Deed and Recreational Use Restrictions	Yes	Institutional controls include land use and site access restrictions. Institutional controls and monitoring can be implemented as part of a natural recovery option or a remedial alternative with active remediation.	Institutional controls are further evaluated as a potential component of other remedial alternatives. Institutional controls are considered to be limited action alternatives, which would be used with MNR, capping, and removal alternatives.
Monitoring	Long-Term Monitoring	Long-Term Monitoring	Yes	Long-term monitoring is implemented at sites where contaminated sediments are left in place, such as in areas that are capped or stabilized in situ. The type of monitoring depends on the remedial technology.	Long-term monitoring is an important means of assessing overall performance of the remedy.
	MNR	MNR	Yes	This technology consists of monitoring the natural recovery process to assure compliance with the RAOs for the site. The natural recovery process involves natural sedimentation that would create a clean layer of surface sediment, thereby burying contaminated sediments over time. In addition, other physical, chemical, and biological processes contribute to recovery.	Significant data have been collected for the evaluation of MNR at Area X in Parcel F.
In Situ	Capping	Thin-Layer Caps	Yes	Thin-layer caps (10 to 15 cm thick) are sometimes referred to as assisted natural recovery. By placing a thin layer of sand or silt over the contaminated sediment, a thin-layer cap accelerates the recovery process.	A thin-layer cap would be effective in parts of Area X. However, a thin-layer cap would be less effective in Area III.
	Capping	Barrier Caps	Yes	Barrier caps generally include sand or clay mineral-based material, potentially consisting of multiple layers, and are usually 1 to 3 feet thick. Barriers caps are designed to prevent the migration of chemicals from sediments into the water, provide a barrier to burrowing benthic organisms, and stabilize the contaminated sediments (Hull and others 1999).	A barrier cap in combination with armoring would be effective in Area III. The barrier cap would be too thick for Area X because of the shallow water depths in Area X.

TABLE 3-1: SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS (CONTINUED)
Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

General Response Action	Remedial Technology Type	Process Option	Retained for Further Evaluation	Description	Screening Comments
In Situ (Continued)	Capping	Armored Caps	Yes	Armoring can be used to further stabilize cap materials in higher-energy environments where currents, waves, or mechanical disturbance could lift the cap material. Armor typically consists of stone or other riprap placed over the primary capping material or a clay-mineral based material such as AquaBlok.	An armored cap design would be required in Area III because of the relatively steep bathymetric gradient.
	Stabilization	Bioremediation	No	Bioremediation uses techniques directed toward stimulating existing microorganisms to grow and use chemicals as a source of food and energy. As a result, a combination of oxygen (for aerobic biodegradation), nutrients, and moisture must be provided, while the temperature and pH are controlled.	The effectiveness of bioremediation in addressing contaminated sediment at Parcel F is uncertain. Complete anaerobic dehalogenation of PCBs in sediments has not been reported, and different PCB dehalogenation organisms have different abilities to dehalogenate.
		Activated Carbon	Yes	Hydrophobic organic chemicals such as PCBs in sediment tend to strongly bond with activated carbon. Mixing granular activated carbon with sediment reduces the bioavailability of PCBs.	The field application methods of most in-situ treatments, including activated carbon, are less proven, but preliminary results of a demonstration project under way at Parcel F by Stanford University are promising.
Ex Situ	Biological Treatment	Landfarming	No	Landfarming (sometimes referred to as land treatment) was identified as the potential biological treatment for contaminated sediments at Parcel F. Landfarming involves mixing sediment contaminated by organic chemicals with nutrients, water, and other amendments and placing the combined material in an engineered treatment unit.	Landfarming is not retained since it is less proven for metals and PCBs treatment compared with other technologies.
	Stabilization and Solidification	Physical Stabilization Using Reagents	Yes	Stabilization treatments immobilize chemicals by mixing reagents into the sediments, thereby solidifying or fixing the chemicals through physical or chemical reactions.	Sediment stabilization technologies are both effective and implementable for treating the mercury- and copper-contaminated sediments at Area III in Parcel F. The technology could reduce the hazardous waste disposal costs, if required.

TABLE 3-1: SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS (CONTINUED)
Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

General Response Action	Remedial Technology Type	Process Option	Retained for Further Evaluation	Description	Screening Comments
Ex Situ (Continued)	Stabilization and Solidification	Cemented Solidification	Yes	Solidification involves binding metals into a low-permeability solid mass that resists leaching by immobilizing metals through precipitation.	Solidification technologies are both effective and implementable for treating the mercury- and copper-contaminated sediments at Parcel F. The technology could reduce the hazardous waste disposal costs, if required.
	Physical Treatment	Sediment Washing	No	Typically, sediment washing is a two-step process. Ex-situ physical separation is followed by chemical washing. It is assumed that chemicals are sorbed onto finer particles, which generally contain high levels of total organic carbon.	Application of this technology requires a large space and large volumes of secondary waste to be treated.
	Thermal Treatment	Incineration	No	Incineration can treat most organic chemicals in both nonaqueous and aqueous media. Incinerators use controlled combustion with extremely high temperatures (1,400 °F to 3,000 °F) to destroy chemicals.	Implementability problems due to permitting restrictions, air quality regulations, and cost.
Removal	Excavation	Excavation	Yes	Excavation is the process that uses earthmoving equipment (excavator or backhoe, for example) to remove contaminated sediments. Excavation can be used to remove contaminated sediments from shallow nearshore areas	Could be implemented in Area X.
	Dredging	Mechanical dredging	Yes	Mechanical dredging is an effective means of removing contaminated sediments from Parcel F.	Dredging would effectively remove contaminated sediments however risk of leaving residual contamination in place should be considered
		Hydraulic dredging	No	Hydraulic dredging removes and transports sediment in a liquid slurry form. Hydraulic dredges are usually barge-mounted and carry diesel or electric pumps with intake and discharge pipes that range in diameter from 6 to 48 inches (LTMS 1996).	The vertical accuracy of hydraulic dredging techniques is less than 1 foot, but they require more on-site processing than does mechanical dredging.

TABLE 3-1: SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS (CONTINUED)
Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

General Response Action	Remedial Technology Type	Process Option	Retained for Further Evaluation	Description	Screening Comments
Removal (Continued)	Dredging	Specialty Dredge	Yes	Specialty dredging involves the use of specialized equipment such as high-solids, low-turbidity, or laser-surveyor type dredges. High-solids dredges are designed to minimize the amount of water that is taken up during dredging. Low-turbidity dredges minimize the localized resuspension of sediment that results from dredging.	Specialty dredging in general is effective when resuspension, depth control
Disposal	Off-Site Disposal	Treatment/ Disposal Facility	Yes	Disposal at an off-site landfill would effectively reduce the risk of exposure to contaminated sediment at Parcel F. Disposing of contaminated sediment at an off-site landfill removes the chemicals of concern from the aquatic setting.	Disposal at a Class I, II, or III landfill must be conducted in conjunction with other process options; thus, they will be considered with excavation and dredging and are retained for further evaluation in this FS Report.

Notes: Shaded general response actions are evaluated further in Section 4.0 of this FS Report

cm Centimeter
FS Feasibility Study
MNR Monitored natural recovery
NCP National Oil and Hazardous Substances Pollution Contingency Plan
PCB Polychlorinated biphenyl

4.0 DEVELOPMENT AND EVALUATION OF REMEDIAL ALTERNATIVES

This section develops and evaluates remedial alternatives designed to address offshore contaminated sediments in Area III (Point Avisadero) and in Area X (South Basin) at Parcel F. The areas to be addressed in this Feasibility Study (FS) Report are adjacent to potential sources of contaminated soil and sediment along the shoreline at Parcels B and E-2 and Yosemite Creek. Numerous source control measures have already been implemented as described in Section 1.6.2; however, three areas will need to be further addressed before work begins on Parcel F to prevent recontamination. The additional source control measures include remediation of soil contamination at Parcel B, further removal in the polychlorinated biphenyl (PCB) hotspot area along the shoreline in Parcel E-2, and an evaluation of Yosemite Creek as a potential ongoing source of contamination to Area X (South Basin). The proposed source control measures are discussed in Section 4.1. Section 4.2 summarizes the modeling methods used to evaluate the effectiveness of the remedies presented in the detailed evaluation of alternatives. Development and evaluation of the remedial alternatives are presented in Sections 4.3 and 4.4.

4.1 SOURCE CONTROL MEASURES

According to U.S. Department of the Navy (Navy) policy and U.S. Environmental Protection Agency (EPA) guidance, site managers should identify all direct and indirect continuing sources of significant contamination to sediments as early as possible and before a remedial action is implemented (Navy 2002; EPA 2002, 2005). The evaluation of the remedial alternatives in this FS Report assumes that the ongoing sources are controlled or have been reduced.

Source Control for Area III. Potential sources of metals contamination in Parcel B could migrate and act as a future source of contamination to Area III if these sources are not controlled. A Technical Memorandum in Support of a Record of Decision (ROD) Amendment (TMSRA) (SulTech 2006a) is being prepared to evaluate remediation alternatives and includes addressing the shoreline contamination in Parcel B. All soil remediation alternatives in the TMSRA include placement of a revetment along the shoreline for protection and to prevent erosion. In addition, excavation of mercury-bearing soil at Installation Restoration (IR)-26 (below 10 feet at Excavation EE-05) is also proposed to reduce the potential affect of this soil on groundwater located near the shoreline. These remedial actions should effectively control the off-site source of chemicals. These actions should be completed before or concurrently with any remedial actions in Area III of Parcel F.

Source Control for Area X. An FS is currently being conducted to evaluate remedial alternatives to address existing contamination presented in Parcel E-2, including the contaminated shoreline areas adjacent to Area X in Parcel F. Alternatives for source control in Parcel E-2 include complete removal and consolidation and capping with shoreline protection. Either of these alternatives should effectively prevent future contamination to the bay from Parcel E-2, and this remediation work should be completed before or simultaneously with any remediation work in Area X. Additionally, the Navy intends to continue the removal action of the PCB-contaminated sediments along the PCB hotspot area in the intertidal area of Parcel E-2.

This action was suspended in 2006 due to administrative constraints. The Navy plans future response actions in Parcel E-2 to address this area.

As described in Section 1.4.1, Yosemite Creek enters Area X (South Basin) and is characterized as a shallow, tidally influenced channel with no permanent flow (Battelle, Blasland, Bouck & Lee, Inc. [BBL], Neptune & Company, and Sea Engineering, Inc. 2005). While contaminant loadings from this source have been greatly reduced in recent decades, the potential for ongoing contamination of sediments in Area X must be addressed simultaneously or before implementation of any remedial alternative in Area X. The Navy does not own Yosemite Creek.

Groundwater effects to the Parcel F sediments are considered a minor pathway in comparison with the effects from erosion and surface water runoff. While the magnitude of metals and PCBs released by this pathway is not likely to be significant because of the very low aqueous solubility of PCBs, the groundwater pathway is being evaluated as part of the groundwater investigation in Parcel B (SulTech 2006a), the Parcel E-2 remedial investigation (RI)/FS (pending release), and Parcel E RI (pending release). Removal of potential mercury source material beneath former Excavation EE-05 is being evaluated at Parcel B (Pt. Avisadero area). In addition, two new groundwater monitoring wells have been installed downgradient from the former excavation and one proposed well will be installed within the excavation footprint after the removal is completed to monitor the possible migration of mercury.

4.2 MODELING METHODS USED TO EVALUATE LONG-TERM EFFECTIVENESS IN DETAILED EVALUATION OF ALTERNATIVES

To evaluate the long-term effectiveness of each remedial alternative under consideration in this FS Report, Sea Engineering, Inc. developed and applied a model to predict residual PCB concentrations in surface sediment in Areas III and X, and to estimate the amount of dissolved-phase PCB transport from the sediment bed into the water column over time in Area X. Due to the heterogeneity of contamination patterns in Area III, the total amount of dissolved-phase PCB transport to the water column could not be readily calculated and is not included here. The model considered the following processes: (1) sediment accumulation (such as burial), and (2) dissolved-phase PCB transport due to diffusion (such as transport in response to a concentration gradient), bioturbation (such as physical mixing due to biological activity), and porewater advection (such as fluid transport) in the sediment bed (see Attachment 3). These parameters are modeled to estimate the recovery of the affected sediments through burial while considering the potential effects of PCB transport within the sediment bed. As described in Section 3.3.2, these are the key recovery processes that contribute to natural recovery of sediments.

The total transport of PCBs through the sediment bed and to the water column was quantified with modeling to allow a comparison of long-term effectiveness between the alternatives. A hydrophobic contaminant flux model (Lick and others 2002) was used to provide quantitative information on the long-term evolution of surface sediment PCB concentrations and release of dissolved-phase PCBs into San Francisco Bay. Attachment 3 contains a detailed discussion of the modeling framework used in the alternatives analysis and in the Feasibility Study Data Gaps (FSDG) Technical Memorandum (Battelle, Neptune & Company, and Sea Engineering, Inc.

2005). The reduction in the amount of PCBs released to the water column as a result of each alternative is presented but is not directly linked to a remedial action objective (RAO); rather, it is used to compare the effectiveness of the remedial alternatives developed in Section 4.0.

The model simulated conditions at representative locations in Areas III and X. In Area III, two locations were chosen to represent the areas of highest PCB concentrations: PA-135 and PA-162. Figure 4-1 developed by Battelle during the FSDG (Battelle, Neptune & Company, and Sea Engineering, Inc. 2005) shows the locations of PA-135 and PA-162. Location PA-135 had the highest concentration of total PCBs (2,179 micrograms per kilogram [µg/kg]) in the surface interval, and location PA-162 had the highest overall total PCB concentration (5,327 µg/kg) in the 60-to-90 centimeter (2 to 3 feet) sampling interval.

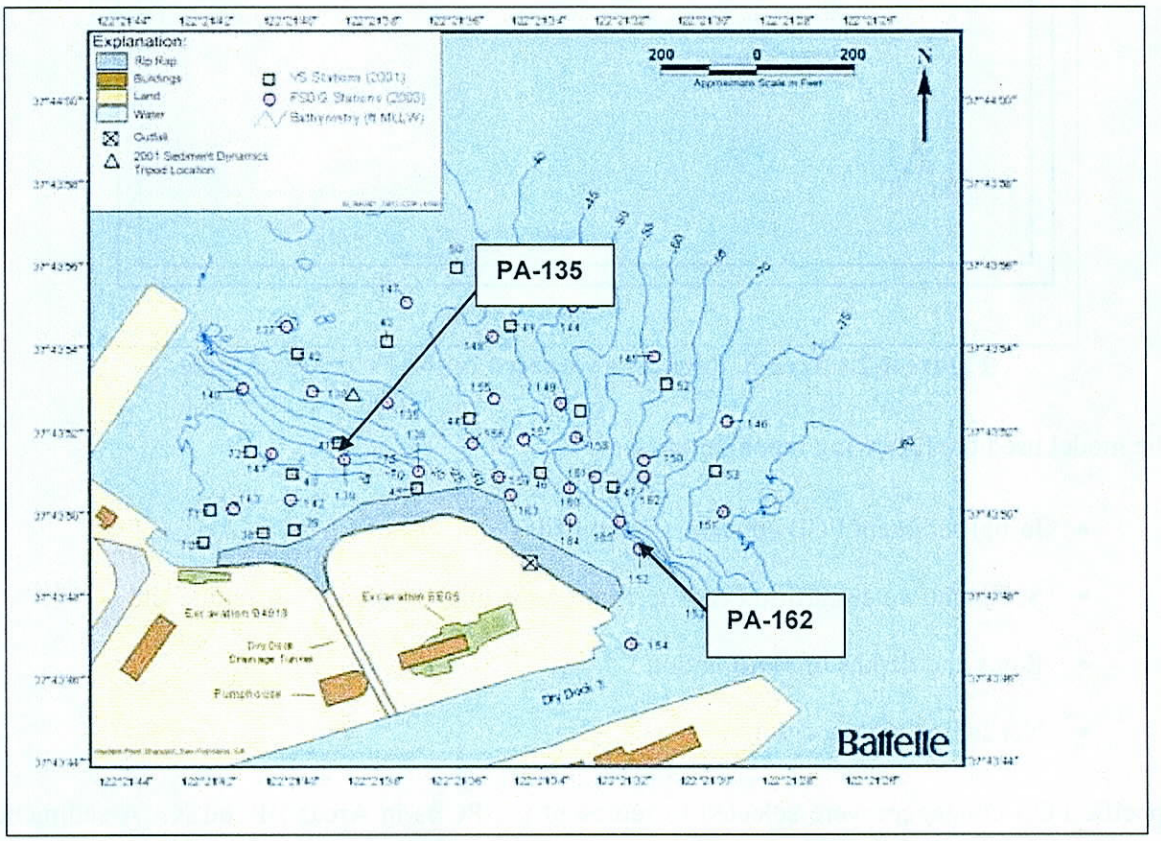


Figure 4-1. Area III Locations Evaluated in the PCB Flux Model

Area X was represented by six regions (see Figure 4-2). Data for the fine interval cores from the FSDG investigation were used to represent the first four regions. Fine interval cores were not collected in regions 5 and 6; therefore, representative cores in each region were selected from the PCB rapid sediment characterization (RSC) cores as being the closest to the average PCB concentrations.

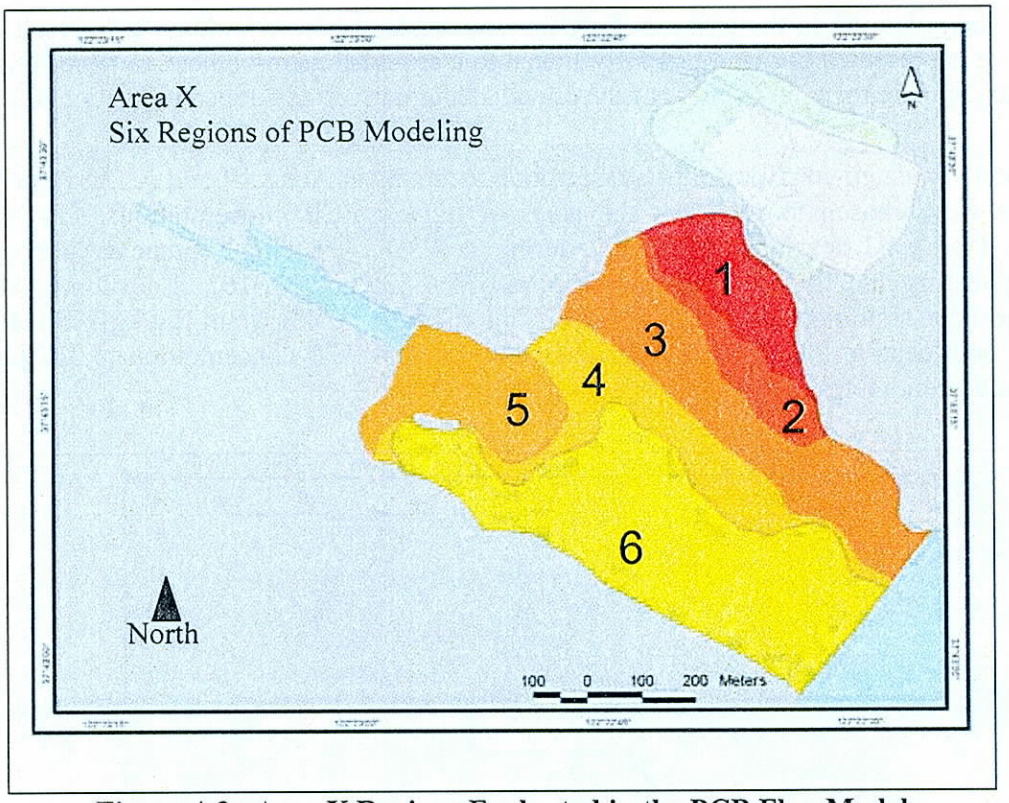


Figure 4-2. Area X Regions Evaluated in the PCB Flux Model

The model used the following input parameters:

- Initial sediment PCB concentration profiles
- Sediment-water partition coefficients representative of the PCBs at the site
- Rates and depths of bioturbation
- Net sediment deposition rates

Specific PCB congeners were selected to represent the PCBs in Areas III and X. A sediment-water partition coefficient of 2.4×10^{-5} liters per kilogram (L/kg) was used for Area III and was developed from the PCB octanol-water partition coefficient (Karickhoff and others 1979) and the total organic carbon (TOC) measurements in the FSDG confirmatory cores. Studies previously conducted by Zimmerman and others (2004) established site-specific sediment-water partition coefficients for PCBs in Area X sediments. The sediment-water partition coefficient reflects the tendency of hydrophobic organic compounds to associate and sorb to sediment particles. The average partition coefficient for the three highest-concentration PCB congeners observed in the fine interval cores was used for regions 1 through 4. The congener distributions from RSC core data from regions 5 and 6 were used to define the sediment-partition coefficients for these areas.

See Attachment 3 for a detailed discussion of model sensitivity to the sediment-partition coefficient.

The U.S. Army Corps' Engineer Research and Development Center evaluation of bioturbation rates and depths were used for the bioturbation assumptions (Clarke and others 2001). The PCB flux model assumed that the degree of bioturbation decreased with increasing depth.

Net sediment deposition rates were calculated from the radioisotope data collected in Area X, which showed an average net sediment deposition rate of 0.93 centimeter per year (cm/yr) with a lower bound of 0.7 cm/yr. A deposition rate of 0.5 cm/yr was used in this modeling effort as a conservative estimate based on potential unforeseen reductions in the San Francisco Bay sediment loading in the next 100 years. The PCB concentration of the depositing San Francisco Bay sediments was assumed to be 121 µg/kg, which is a conservative estimate based on sediment trap data collected as part of the FSDG Investigation.

Using these values, the dissolved-phase PCB transport at the two locations in Area III and six regions in Area X were simulated for a 30-year period for each remedial alternative.

4.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Eight remedial alternatives were developed from the remedial technologies retained in Section 3.0 as the most suitable to address the site-specific RAOs at Parcel F. The alternatives represent a range of options in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 *Code of Federal Regulations* [40 CFR] Section (§) 300.430[e]), including (1) the no-action alternative; (2) one or more alternatives that involve little or no treatment but that protect human health and the environment by preventing or controlling exposure; (3) a treatment alternative that reduces the toxicity, mobility, or volume of chemicals; and (4) an alternative that includes an innovative technology. These alternatives were developed in accordance with EPA recommendations that remedial alternatives pertaining to sediment sites should represent a range of options including monitored natural recovery (MNR), in-situ capping, and removal options or combinations of approaches (EPA 2005).

The eight remedial alternatives evaluated in detail are:

- Alternative 1: No Action
- Alternative 2: Removal and Off-Site Disposal
- Alternative 3A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls
- Alternative 3B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls

- Alternative 4A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 4B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 5A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 5B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls

4.4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Each remedial alternative is evaluated against nine criteria that are based on the statutory requirements of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (EPA 1988b). The first two criteria are considered threshold criteria and must be met for an alternative to be selected. The next five balancing criteria are used to evaluate the alternatives against each other. The final two modifying criteria are used to incorporate regulatory and public concerns and comments. The nine criteria are discussed below.

- **Overall protection of human health and the environment**: This criterion is considered a threshold that is used to evaluate how the alternative achieves and maintains protection of human health and the environment. This evaluation determines whether the alternative achieves adequate protection and describes how site risks are eliminated, reduced, or controlled through treatment, engineering, or controls. All alternatives must achieve this criterion to be considered viable.

- **Compliance with ARARs**: Compliance with applicable or relevant and appropriate requirements (ARAR) is a threshold criterion that is used to evaluate whether the alternative complies with chemical-specific, action-specific, and location-specific ARARs. It includes the determination of whether each alternative meets all federal, sate, and local ARARs.

- **Long-term effectiveness**: Long –term effectiveness is considered a balancing criterion that includes an evaluation of the long-term effectiveness and permanence the alternatives afford, including the degree of certainty that the alternative will be successful. This criterion also includes the residual risk from untreated contaminated material or treated residuals after the remedial action and the reliability of controls to manage the risk. Residual risk from alternatives for contaminated sediment may be considered the risk that would remain after dredging, capping, or MNR is complete. Numerical modeling methods are used to compare long-term effectiveness in this FS Report.

- **Reduction of toxicity, mobility, or volume:** This balancing criterion is used to evaluate the amount of hazardous material treated; the magnitude of the reductions in toxicity, mobility, of volume of chemicals; the degree the treatment is irreversible; and the nature and quantity of treatment residuals.

- **Short-term effectiveness**: Short-term effectiveness is a balancing criterion that describes the short-term effects of alternatives that could be posed to the community during implementation, effects to workers during the remedial action, and the potential environmental effects of the remedial action. This criterion also includes an evaluation of the time until protection is achieved. The time needed until protection is achieved can be difficult to assess at sediment sites. Short-term risks that involve bioaccumulative chemicals may include the risks posed by continued human or ecological exposure to chemicals in the food chain.

- **Implementability**: Implementability is a balancing criterion that is used to evaluate the technical and administrative feasibility of the alternative. The evaluation also includes the ease of undertaking an additional remedial action if the remedy fails.

- **Cost**: This balancing criterion includes an evaluation of the direct and indirect capital costs required to complete the alternative. This criterion can also include the relative cost of achieving different cleanup levels. The costs of each alternative are expected to be accurate to within +50 to -30 percent.

- **State acceptance:** This criterion is defined as a modifying criterion that includes an evaluation of the technical and administrative concerns that federal, state, or other agencies may have for each alternative. This criterion will be evaluated in detail once agency comments on the FS Report and Proposed Plan are received.

- **Community acceptance**: Community acceptance is a modifying criterion that is used to evaluate the concerns and issues the public may have about each alternative. Community acceptance will be addressed in detail in the ROD, once comments on the FS Report and Proposed Plan are received.

Each of the alternatives is evaluated in the following sections using the nine NCP criteria.

4.4.1 Alternative 1: No Action

Pursuant to the requirements of the NCP (40 CFR §3 00.430(e)), the no-action alternative must be carried through the entire FS to serve as the baseline condition. The no-action alternative is used as a baseline for comparison only and should reflect the site conditions described in the risk assessments.

4.4.1.1 Overall Protection of Human Health and the Environment – Alternative 1

Alternative 1 would not actively manage the risks; however, general improvement in sediment quality would be expected over time based on natural sedimentation and potential chemical or biological degradation. However, monitoring is not included under this alternative; therefore, the effect of these natural processes could not be quantitatively assessed.

4.4.1.2 Compliance with ARARs –Alternative 1

There is no need to identify ARARs for the no-action alternative because ARARs apply to "any removal or remedial action conducted entirely on site" and "no action" is not a removal or remedial action. CERCLA § 121 (42 *United States Code* § 9621) cleanup standards for selection of a Superfund remedy, including the requirement to meet ARARs, are not triggered by the no-action alternative (EPA 1991). Therefore, a discussion of compliance with ARARs is not appropriate for this alternative.

4.4.1.3 Long-Term Effectiveness – Alternative 1

Alternative 1 cannot be evaluated for effectiveness in the long term because the alternative would not include monitoring.

4.4.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 1

The effects of natural process such as chemical and biological degradation could reduce the toxicity and mobility of chemicals over time, and sedimentation could reduce the mobility of chemicals. Treatment would not occur, so the toxicity, mobility, and volume of contaminated sediment at Parcel F would not be actively reduced through treatment under the no-action alternative.

4.4.1.5 Short-Term Effectiveness – Alternative 1

Implementation of Alternative 1 would impose no additional short-term risks to the community, the environment, or site workers beyond any that already exist at the site.

4.4.1.6 Implementability – Alternative 1

Alternative 1 can be easily implemented. No equipment, manpower, or other resources would be required. No operations would be conducted, and no permits or institutional controls would be required.

4.4.1.7 Cost – Alternative 1

No capital, permitting, monitoring, or operation and maintenance (O&M) costs are associated with Alternative 1.

4.4.1.8 State Acceptance – Alternative 1

State acceptance will be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD. However, regulatory acceptance of Alternative 1 is unlikely because this alternative does not actively manage the risks associated with contaminated sediment at Parcel F.

4.4.1.9 Community Acceptance – Alternative 1

Community acceptance will be evaluated during the review and comment period on the FS Report and during the assembly of the Proposed Plan, and will be thoroughly addressed in the ROD. Community acceptance of Alternative 1 is unlikely because this alternative does not actively manage the risks associated with contaminated sediment at Parcel F.

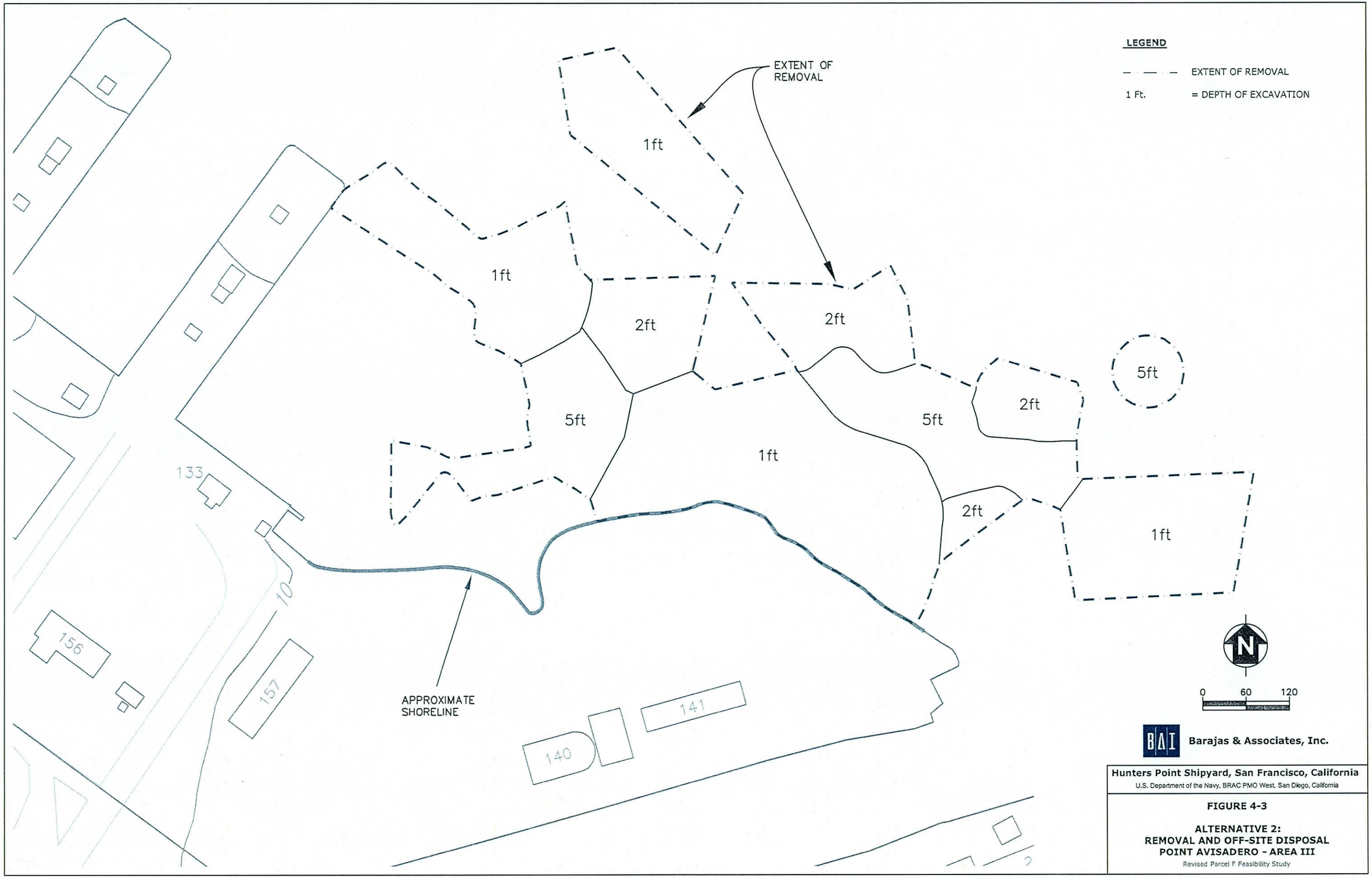
4.4.2 Alternative 2: Removal and Off-Site Disposal

Alternative 2 would combine (1) excavation or dredging of contaminated sediment with copper, mercury, and PCBs at concentrations that exceed the site-specific remediation goals in Areas III and X; and (2) disposal of the dewatered material at an off-site landfill. Additional components of excavation or dredging would include backfilling excavated or dredged areas with clean sediment to pre-removal elevations, dewatering dredged material, and discharging dredge water into the bay or sanitary sewer. Treatment of dredge water before discharge may also be necessary under Alternative 2.

Removal in Area III

The approximate areas and depths of excavation or dredging for Area III are shown on Figure 4-3. The depths selected would remove all chemicals of concern (COC) and achieve the site-specific RAOs. The removal depths selected are based on analytical data for copper, mercury, and PCBs from the core samples collected during the 2003 FSDG investigation.

A barge-mounted environmental clamshell dredge would likely be required for much of Area III because of water depths over 65 feet. Clamshell dredges can be used to depths up to 100 feet, while other types of dredges are generally limited to depths less than 65 feet. The environmental clamshell dredge is watertight to limit turbidity in the water when the sediments are extracted, but some turbidity and contaminant transport would still be expected. A double-walled silt curtain potentially could be used to encircle the excavation in areas close to shore to reduce sediment transport to adjacent areas. However, the feasibility of these control measures is uncertain because of the deep water depths and high currents. Construction monitoring for turbidity and suspended solids would be conducted around the perimeter of the dredge areas to verify that excessive sediment is not escaping the silt curtains. Sediments would be placed into an adjacent barge, and the free water that is extracted along with the sediment would be pumped back to the bay inside of the silt curtain. If necessary, this water could also be pumped through geotube filters and a sedimentation basin could be located onshore to further limit sediment discharge; however, these measures are not expected to be necessary and have not been included in this cost estimate.


LEGEND
EXTENT OF REMOVAL
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EXTENT OF REMOVAL
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156
157
140
141
APPROXIMATE SHORELINE
N
0 60 120
Barajas & Associates, Inc.
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California
FIGURE 4-3
ALTERNATIVE 2:
REMOVAL AND OFF-SITE DISPOSAL
POINT AVISADERO - AREA III
Revised Parcel F Feasibility Study

Approximately 27,300 cubic yards (yd^3) of contaminated sediment would be removed from Area III. Dredging with an environmental clamshell bucket is anticipated to progress at a rate of about 1,500 yd^3 per day, based on 24-hour per day operation which is often necessary in the San Francisco Bay due to the extensive number of dredging operations. The dredging would be completed in 18 days.

Bathymetric survey methods would be used during construction to ensure that the required removal depths are achieved.

A staging and dewatering facility would be constructed on site at or near the docks to dewater the dredge material from Area III to reduce the weight and volume of the material before off-site transportation and disposal. Sediment from the barges would be placed into the dewatering area and allowed to drain before it is transported by truck to an approved disposal facility.

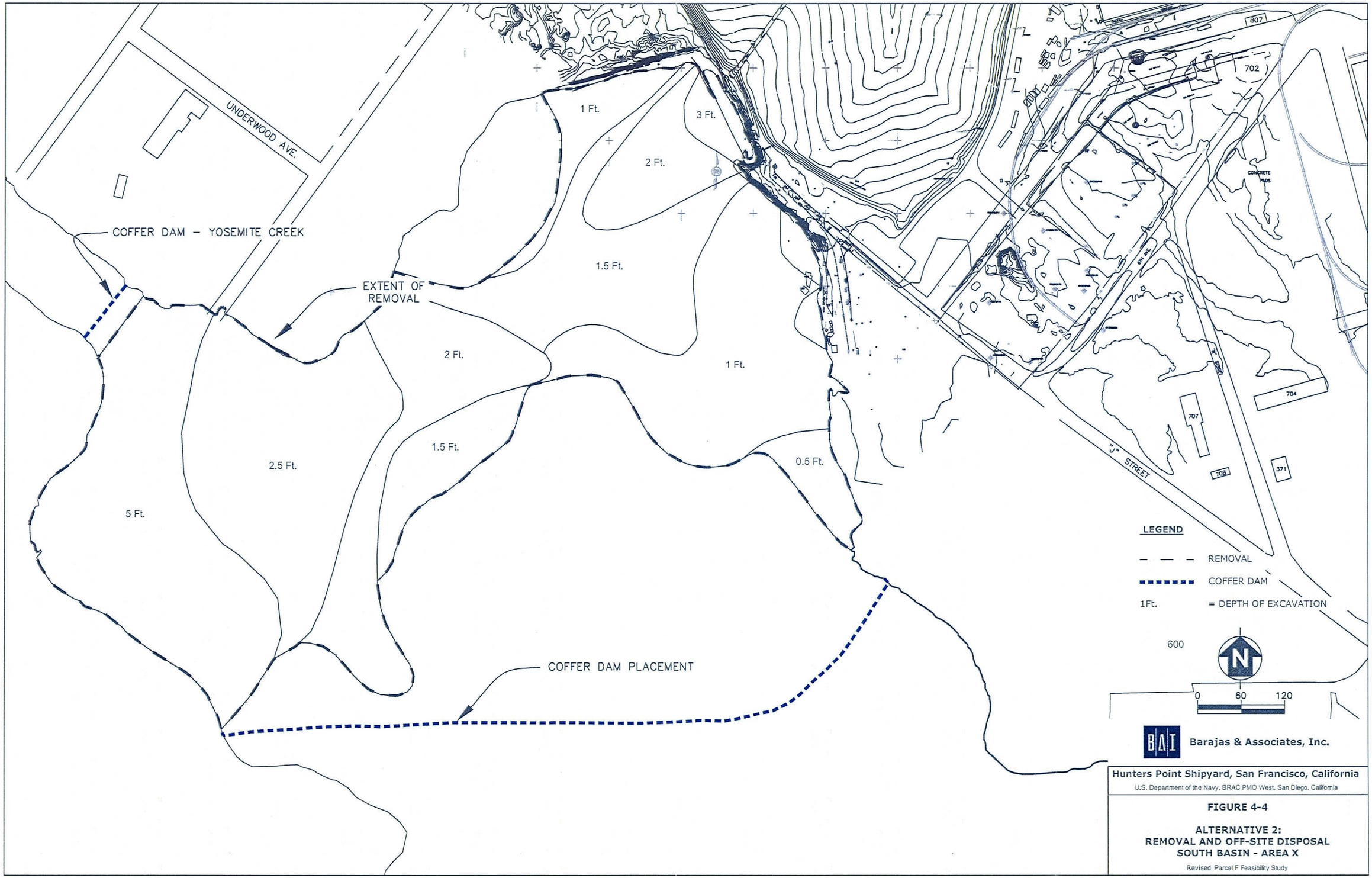
Both solid and liquid wastes would be generated by this alternative. Liquid wastes would include wastewater produced by sediment dewatering and decontamination of equipment. (This category does not include the free water removed from the barge within the excavation curtain before the sediment is off-loaded.) This water would be stored in an on-site storage tank until it could be tested for compliance with sanitary sewer discharge criteria. Depending on chemical concentrations, the water would either be sent to a licensed treatment facility or discharged into the bay or sanitary sewer. Approximately 344,000 gallons of water would be generated from the dewatering process. If the concentrations of dissolved metals are too high for discharge to the sanitary sewer after dewatering, then treatment for this water could raise the cost of this alternative; however, treatment is not expected. Treatment has not been included in the estimated cost for this alternative. The estimated cost of this alternative is presented in Appendix D.

Excavated and dewatered dredge sediment would be tested for hazardous characteristics and disposed of at a Class 1 or Class 2 off-site landfill as appropriate. However, based on the available data, hazardous levels of chemicals are not expected, so the costs shown include disposal at a Class 2 landfill.

Removal in Area X

The approximate areas and depths of excavation for Area X are shown on Figure 4-4. The depths selected should remove all COCs and meet the site-specific RAOs. Remaining chemicals at levels below the remediation goals would not require additional remedial action.

The removal depths selected are based on analytical data from the RSC core samples, laboratory verification core samples, and fine-interval PCB congener core samples collected during the 2003 FSDG investigation. The removal area selected contains copper, mercury, and total PCBs in sediment at concentrations that exceed the remediation goals, as described in Section 2.1.4.



Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 4-4

ALTERNATIVE 2:
REMOVAL AND OFF-SITE DISPOSAL
SOUTH BASIN - AREA X

Revised Parcel F Feasibility Study

The isoconcentration contours shown on Figure 2-4a through 2-4f from the FSDG Investigation Report (see Attachment 1) were used to identify areas and depths of sediment PCB concentrations for focused removal. Additional areas and depths were added based on analytical data from the fine-interval PCB congener core samples. The vertical extent of PCB concentrations above remediation goals near the mouth of the Yosemite Creek has not been defined. Therefore, an additional 2 feet of excavation in this area was assumed to estimate cost in this FS Report.

Cofferdams would be placed as shown on Figure 4-4 to isolate the remedial area from the remainder of the bay. The area would then be dewatered before excavation begins so that conventional excavation equipment operating on crane mats could be used. Centrifugal pumps would be used to pump water from the removal area and over the water barriers to the bay. Treatment for this water is not expected to be necessary because no excavation would occur until after it is dewatered. Sediment would be removed in the dewatered area using conventional excavation methods and equipment. Crane mats would likely be required to support heavy equipment on areas with soft subgrade.

The sediment must pass the paint filter test before it could be accepted at a landfill. As a result, staging and dewatering facility would be constructed on site in an upland area to allow dewatering of the wet sediment for transportation and off-site disposal. The facility would be approximately 50 feet by 200 feet and would be sloped to allow drainage away from the sediment. Sediment would be placed and allowed to drain before it is loaded onto trucks for transportation to an approved disposal facility. The water from the dewatered sediment would be pumped to the on-site sanitary sewer system. Approximately 161,000 yd^3 of sediment would be removed from Area X, and approximately 434,000 gallons of water would be removed from the sediment at the dewatering pad. Construction in Area X would take approximately 6 months, and would be scheduled to occur during the dry season between April and October, to the extent possible, to limit the amount of rainwater that would require handling.

Bathymetric survey methods would be used during construction to ensure that the removal depths required are achieved and to calculate the necessary amount of backfill. Clean backfill with similar gradation to native sediments would be placed over the excavation areas to restore the sediment surface to pre-removal elevations. The backfill material would be dewatered before it is placed to minimize settling and erosion transport. In addition, the removal area would be backfilled to slightly above the natural elevation to allow for natural erosion processes to restore the sediment surface to the natural pre-removal grade. After backfilling is complete, the cofferdams would be removed and the area would again be inundated.

Solid wastes generated under this alternative, including dewatered excavated sediment would be tested for hazardous characteristics and disposed of at a Class 1 or Class 2 off-site landfill as appropriate. However, based on the available data, hazardous levels of chemicals are not expected, so the costs shown include disposal at a Class 2 landfill.

4.4.2.1 Overall Protection of Human Health and the Environment – Alternative 2

Excavation or dredging of the remediation areas shown on Figures 4-3 and 4-4 would be protective of human health and the environment because they would remove most of the contaminated sediments that exceed the remediation goals for Parcel F. However, complete removal of contaminated sediments through dredging is not possible, but the residual contamination would be reduced by the backfilling operation. Therefore, the surface-weighted average of contamination is expected to meet the remediation goals after the short-term effects and equilibrium occur. Short-term effects would include the effect to the aquatic habitat from the resuspension and disruption of the sediment bed during removal of sediments. Chemicals removed from the site would be isolated in an off-site Class I or II landfill, as appropriate.

4.4.2.2 Compliance with ARARs – Alternative 2

Alternative 2 would comply with all chemical-, action-, and location-specific ARARs. Excavation would consider the substantive requirements of the Rivers and Harbors Act and the Coastal Zone Management Act. Results from sampling and analysis of excavated sediment would be used to evaluate whether the contaminated sediment should be managed as a hazardous waste pursuant to the requirements of Resource Conservation and Recovery Act (RCRA) identified as chemical-specific ARARs.

Waste would also be characterized to determine if it is California non-RCRA waste pursuant to *California Code of Regulations* (Cal. Code Regs.) Title (tit.) 22, Sections (§§) 66261.22(a)(3) and (4), 66261.24(a)(2)-(a)(8), 66261.101, 66261.3(a)(2)(C), or 66261.3(a)(2)(F), or a designated nonhazardous or inert waste as defined in Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20320. Sediment would be held in a laydown area that would comply with storage requirements for PCBs in 40 CFR § 761.65 and the additional requirements of the Toxic Substances Control Act that have been identified as ARARs. An appropriate off-site disposal facility would be selected based on the results of the analysis.

4.4.2.3 Long-Term Effectiveness – Alternative 2

As described in Section 4.2, numerical modeling was used to evaluate the long-term effectiveness of Alternative 2. The modeling estimated both the residual PCB concentrations in the sediment bed and the amount of PCBs released from the sediment bed into the water column due to bioturbation, diffusion, and porewater advection. Results of this modeling for Areas III and X are described below.

Area III

Alternative 2 combines excavating or dredging of contaminated sediment with chemical concentrations that exceed the remediation goals for copper, mercury, and total PCBs and backfilling these areas with clean sediments to pre-removal elevations. The two locations in

Area III, as described in Section 4.2, were used to model the long-term effectiveness of this alternative.

The sediment core data used in the model to represent Area III were modified to reflect the removal scenario. The PCB concentrations in the core profiles that represent removal areas were replaced with clean, PCB-free sediments with identical geotechnical properties. The sediment-water partition coefficients, rate and depth of bioturbation, and net sediment deposition rate for the fill sediment were assumed to be the same as the native sediments.

Using these values, the PCB transport at the two locations was simulated for a 30-year period. Figure 4-5 shows a summary of the average surface sediment PCB concentrations for each location. The surface sediment PCB concentrations were averaged over the top 10 centimeters of the sediment bed to represent the PCBs that are readily bioavailable. Each location shows a slow increase in PCB concentration that eventually reaches the background concentration for the sediments coming in from San Francisco Bay.

While PCBs were used to model the effect of removal, backfilling and return to the San Francisco Bay sediment ambient concentrations, similar trends can be assumed for copper and mercury concentrations in these two locations within Area III.

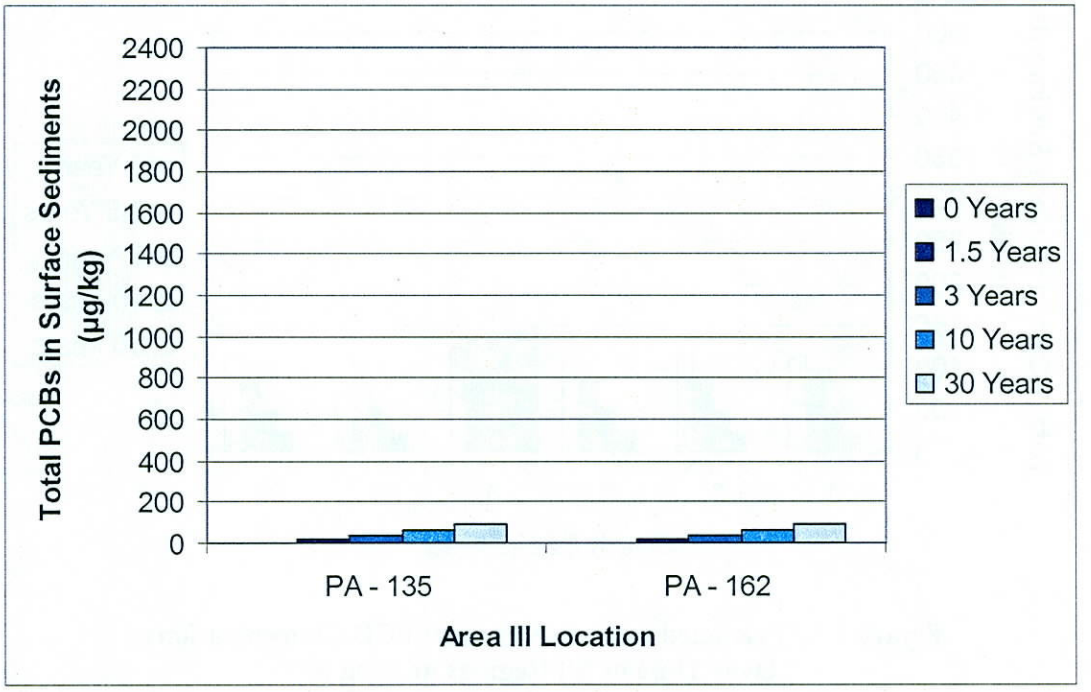


Figure 4-5. Predicted Surface Sediment PCB Concentrations Over Time at Each Location at Area III

Area X

Alternative 2 combines excavating or dredging of contaminated sediment with chemical concentrations that exceed the remediation goals for copper, mercury, and PCBs in Area X and backfilling these areas with clean sediments to pre-removal elevations.

As in the case of modeling for Area III, each of the cores used to represent these areas was modified to reflect the removal scenario. The PCB core profiles that represent the areas removed were replaced with clean, PCB-free sediments with identical geotechnical properties. The sediment-water partition coefficients, rate and depth of bioturbation, and net sediment deposition rate for the fill sediment were assumed to be the same as the native sediments.

The PCB fluxes in the six Area X regions were simulated for a 30-year period. Figure 4-6 shows a summary of the average surface sediment PCB concentrations for all six regions. The surface sediment PCB concentrations are averaged over the top 10 centimeters of the sediment bed to represent the PCBs that are readily bioavailable. The surface sediment PCB concentrations show a slow recontamination of the clean fill material to the background concentration equal to the sediments coming in from San Francisco Bay for all areas except area 4, where minimal removal occurred.

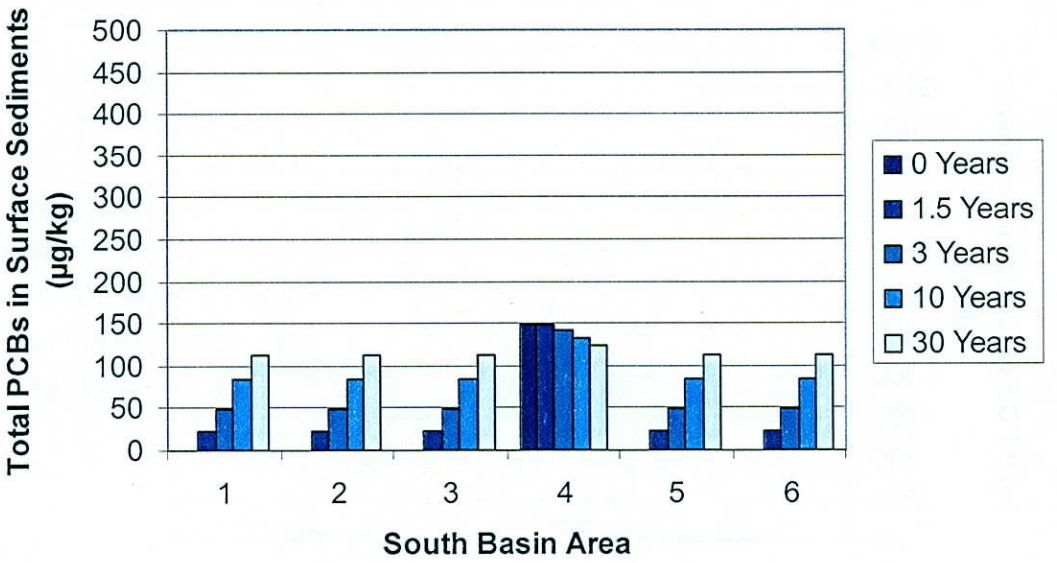


Figure 4-6. Predicted Surface Sediment PCB Concentrations Over Time in All Regions at Area X

Figure 4-7 shows the total mass of dissolved-phase PCBs released into the water column as a function of time for each area. The flux starts low from the clean fill material and slowly increases to a constant slope based on the assumption that the depositing sediments have a PCB concentration of 121 µg/kg. If the San Francisco Bay-wide levels of PCBs are reduced such that

concentrations in the depositing sediment decrease, this flux will decrease as well. These predictions indicate that approximately less than 5 grams of PCBs would be released to the bay from Area X (South Basin) over the next 30 years.

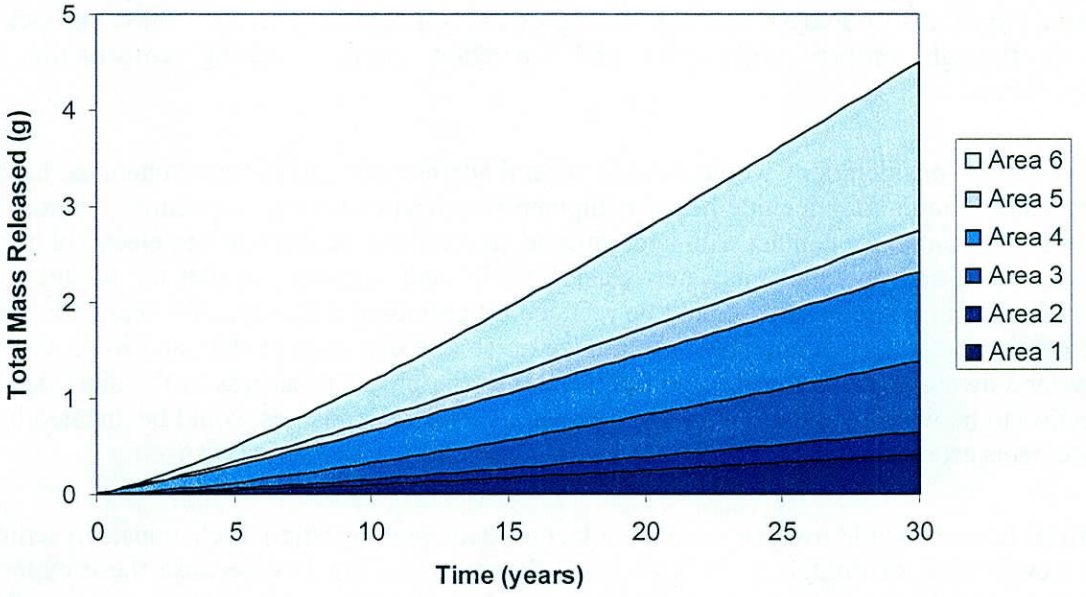


Figure 4-7. Mass of Dissolved-Phase PCBs Released into the Water Column Over Time at Area X

Conclusions for Long-Term Effectiveness

Under this alternative, sediment with chemicals at concentrations exceeding the remediation goals would be removed and placed in an off-site disposal unit, and clean sediment would be used as backfill over the removal area. The residual contamination from dredging would be reduced by the backfilling component of this alternative. As shown in the modeling results above, the residual PCBs are expected to release less than 5 grams of PCBs to the bay over the next 30 years. This alternative would provide long-term effectiveness in Areas III and X as long as off-site sources do not recontaminate the area to concentrations above the remediation goals.

4.4.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 2

The toxicity, mobility, or volume of chemicals in Parcel F would not be reduced through treatment in this alternative. EPA's preference for treatment would not be satisfied because treatment (other than dewatering) is not expected to be required.

4.4.2.5 *Short-Term Effectiveness – Alternative 2*

The local community and excavation or dredging contractors would face limited short-term risks during remediation, including construction noise, physical hazards such as traffic and heavy equipment associated with excavation or dredging and material transport operations, and potential exposures to dredged material during ex-situ solids management. These risks can be reduced through proper engineering and operation controls during construction and transportation.

Worker safety considerations would include general site hazards and potential chemical hazards. General site hazards may include heavy equipment; occupational noise exposure; potential slip, trip, or fall; potential for contact with underground or overhead mechanical and electrical hazards or utility lines; and potential for water-related injuries and drowning or that the dredge vessel may sink. General site hazards would be reduced by providing a site-specific health and safety plan; appropriate safety equipment to minimize noise and exposure to dust and improve water safety; and awareness training to orient personnel to the physical hazards at the site. Specific protection to be worn by on-site workers to prevent chemical exposures would be dictated by the requirements established in the contractor's site-specific health and safety plan.

Chemical hazards would involve dermal contact or incidental ingestion to chemicals in sediment during excavation or dredging. It is assumed that the risks are low because these exposures would be of limited duration and would likely involve minimal contact with sediments. These exposures could occur as a result of spills or poorly managed field practices. Workers would be required to wear appropriate personal protective equipment and use best management practices to minimize exposures.

Environmental effects during excavation or dredging will likely include suspension of contaminated sediments and redeposition on the excavated or dredged surface or adjacent areas. Contaminated sediments suspended in the water column may affect fish and other aquatic species in Parcel F during excavation or dredging; however, these exposures would be expected to be temporary and localized and partially reduced through engineering controls. Control measures would include using careful and appropriate excavation or dredging methods to minimize these effects within the remediation area and cofferdams and silt curtains to reduce the risk of contaminating adjacent areas. Safe routes and loading areas would be established to minimize risk during transportation. It is anticipated that sediments would be loaded for transportation at the docks near Parcel B; however, alternative loading facilities could be evaluated if the traffic load from the Hunters Point Shipyard (HPS) area is not acceptable.

4.4.2.6 *Implementability – Alternative 2*

Alternative 2 can be implemented. Dredging, backfilling, and off-site disposal have been successfully implemented at multiple sites, and it is a proven alternative for sites with conditions comparable to Parcel F. Construction equipment and personnel would be available from several commercial companies in the San Francisco Bay area.

Implementation in Area III will pose engineering challenges because of the greater water depths and currents and potential for concrete debris. The difficulties associated with Alternative 2 in Area X are likely related to the intended temporary cofferdams and dewatering. This use of cofferdams and dewatering operation may be more difficult and costly than is anticipated. The water cannot be removed if silt curtains must be used instead of cofferdams. In that case, this alternative would become more difficult because of the necessity of dredging rather than excavating in these large, shallow areas. It is unlikely that floating or shore-based dredges could access all areas that would require excavation. Tracked excavators capable of traversing shallow inundated areas (such as marsh buggies) could be used, but would increase the risk of contaminating adjacent areas, including areas that have previously been excavated and sampled. A detailed bathymetric survey of Area X should be conducted before the remedial design is initiated. Another difficulty is the necessity of rerouting any water that enters Yosemite Creek during excavation so that it can continue to drain during construction.

4.4.2.7 Cost – Alternative 2

The detailed cost analysis for Alternative 2 includes mobilization, dewatering and loading facilities, surface water control, excavation or dredging, backfilling, implementing construction quality control and confirmation sampling, dewatering dredged material, and disposal of dredged material in an off-site landfill. No O&M costs are included for Alternative 2.

The estimated total present value for Alternative 2 is $42,630,000. The basis for this cost estimate is presented in Appendix D (see Table D-2)

4.4.2.8 State Acceptance – Alternative 2

State acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan and would be thoroughly addressed in the ROD.

4.4.2.9 Community Acceptance – Alternative 2

Community acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan and would be thoroughly addressed in the ROD.

4.4.3 Alternatives 3A and 3B: Focused Removal, Off-Site Disposal, and Armored Cap (3A) or AquaBlok Cap (3B) in Area III; In-Situ Stabilization in Area X; and Institutional Controls

Alternative 3A would combine focused removal of nearshore contaminated sediments in Area III, placement of an armored cap over deeper off-shore contaminated sediments in Area III, in-situ stabilization of contaminated sediments in Area X, and institutional controls.

Alternative 3B, which substitutes an AquaBlok clay cap for the armored cap in Area III, was also evaluated. All other aspects of Alternative 3B are identical to Alternative 3A. Differences between the two are discussed below.

Focused Removal in Area III

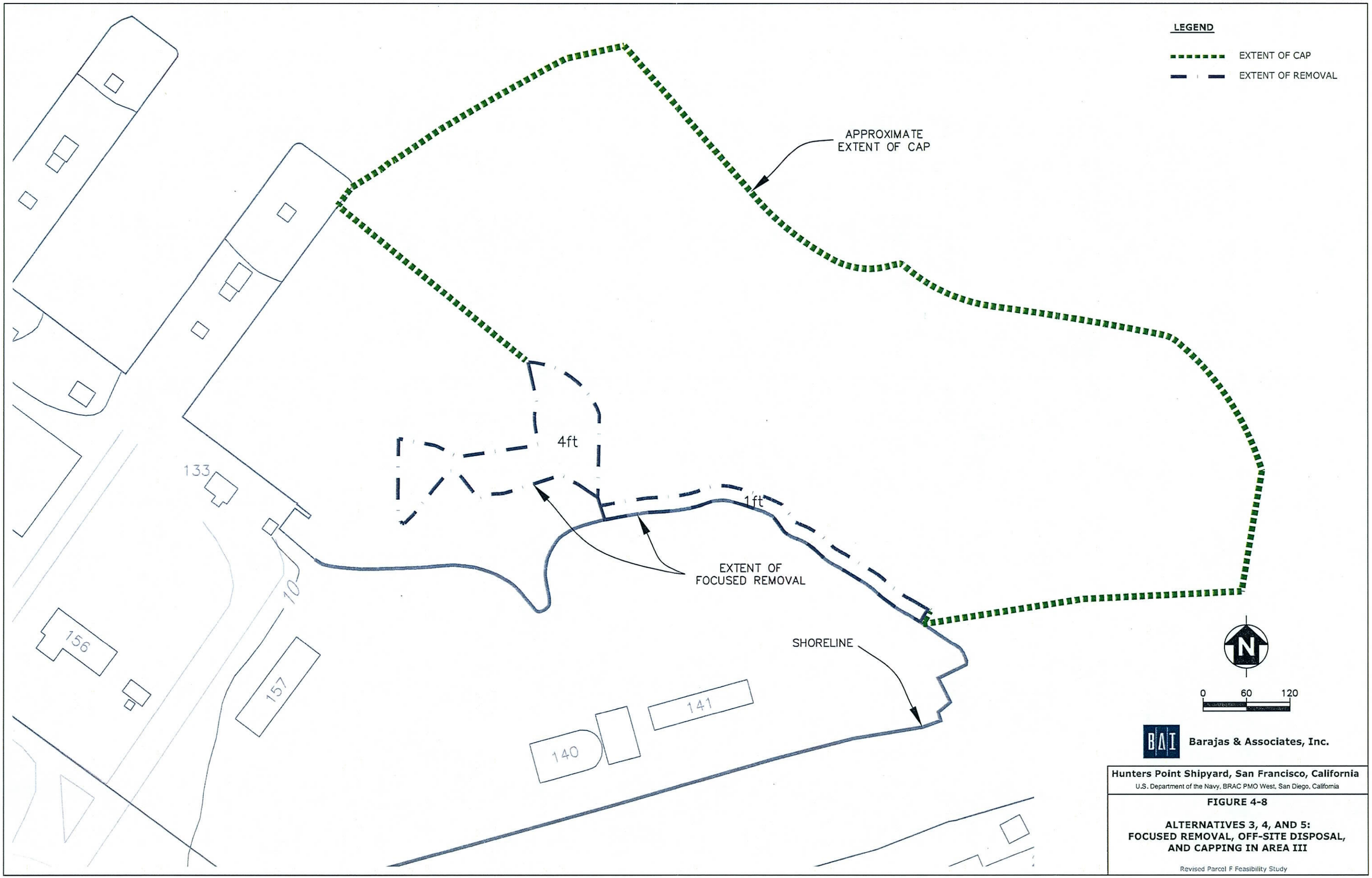
Focused removal would include (1) excavation of sediment with copper, mercury, and PCB concentrations that exceed the site-specific remediation goals; (2) backfilling the excavation area with clean sediment to pre-excavation elevations except as noted otherwise below; (3) dewatering the excavation material; (4) discharge of excavation water into the bay or sanitary sewer; and (5) disposal of the dewatered material at an off-site landfill. The focused removal differs from the complete removal in Alternative 2 because only areas too shallow to be capped would be excavated. Areas too shallow to be capped are assumed to be about 20 feet from shore in Area III. Sediment would be removed and processed by methods similar to those described in Alternative 2. The approximate areas and depths for excavation in Area III are shown on Figure 4-8.

The selected depths of excavation would remove all contamination above the site-specific remediation goals in the focused removal area and to the depth of contamination with a predetermined maximum depth since backfilling would occur. The selected removal depths are based on analytical data for copper, mercury, and PCBs from the core samples collected during the 2003 FSDG investigation.

Approximately 4,920 yd^3 of contaminated sediment would be removed from the focused removal area, and approximately 62,000 gallons of water would be generated from dewatering.

Dredging with an environmental clamshell bucket is anticipated to progress at a rate of about 1,500 yd^3 per day, based on 24-hour per day operation, which is often necessary in the San Francisco Bay because of the extensive number of dredging operations. Dredging would be completed in 4 days in Area III.

Baseline bathymetric surveys, construction quality control monitoring, and confirmation samples would be conducted under the focused removal portion of Alternative 3A, as described for Alternative 2. The dewatering facility, dewatering methods, and solid and liquid disposal for the focused removal portion of Alternative 3A are identical to Alternative 2.


LEGEND
EXTENT OF CAP
EXTENT OF REMOVAL
APPROXIMATE EXTENT OF CAP
4ft
1ft
EXTENT OF FOCUSED REMOVAL
SHORELINE
133
10
156
157
141
140
N
0
60
120
Barajas & Associates, Inc.
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California
FIGURE 4-8
ALTERNATIVES 3, 4, AND 5:
FOCUSED REMOVAL, OFF-SITE DISPOSAL,
AND CAPPING IN AREA III
Revised Parcel F Feasibility Study

Armored Capping in Area III

Contaminated areas that are not addressed by focused removal would be capped with a subaqueous armored cap after the focused removal and backfilling is completed in the nearshore areas. The cap would be 2 feet thick and would be installed by controlled placement of granular material over contaminated areas. The proposed area for capping is shown on Figure 4-8. Near the shoreline, the armored cap would extend 10 feet over the focused removal area identified for Alternative 3A.

As discussed in the EPA subaqueous capping guidance (EPA 1996), both fine-grained and sandy materials can be effective for capping. There are several advantages and disadvantages to each material. Fine-grained material can provide a more effective barrier against contaminant flux to the surface, particularly for organic chemicals. However, fine-grained materials are more difficult to place in water even with low currents. Fine-grained materials will also generally require a thicker cap that covers a larger area because of the combination of erosion potential (even with armoring) and consolidation, which would further limit the area available for capping in shallow areas. Fine-grained materials are much more susceptible to resuspension of particles and to deeper penetration by bioturbators. Sandy caps are much easier to place, especially in deeper areas. Sandy materials provide less protection against contaminant flux, but are much less susceptible to erosion, bioturbators, and consolidation. The cap in Area III would be installed primarily to prevent direct contact, as contaminant flux is not expected to be sufficient to cause unacceptable risk (see long-term effectiveness below). Therefore, sandy materials (less than 50 percent passing the #200 sieve) would provide a superior cap material in this situation. Areas with greater sloping bathymetry may require additional armoring.

The armored cap would consist of a 1.5-foot-thick layer of clean sandy material covered by 6 inches of armor stone for erosion protection. The armor stone would provide erosion protection against tidal currents, which are expected to reach a velocity of 5 feet per second in some areas. The sand layer would be sufficiently thick to protect most bioturbators, which are expected to be located primarily in the top 10 centimeters. Locally dredged sediment would be the most cost-effective capping material. However, material with the correct gradation may not be readily available. As a result, this FS Report assumes that the capping material is obtained from onshore sources.

The cap would extend approximately 10 feet laterally beyond the boundary of the contaminated sediments to ensure complete coverage and allow for a shallow slope along the edge of the cap. The cap would taper from 2.0 feet thick at the edge of contamination to 6 inches (gravel only) at the outer edge.

The cap would require the import of approximately 26,500 yd^3 of sandy soil and 8,800 yd^3 of armor stone. Clean cap material would be transported to the site by truck or barge. Cap material would be spread over contaminated sediment by controlled release from a pipeline with a diffuser to allow more accurate placement in the deeper areas. A capping rate of 0.5 acre per day, the duration of the capping operation would be about 25 days was assumed for cost estimating purposes.

The cap would be constructed by placing the material in three separate installments. A period of 1 to 2 weeks would be allowed between installation of the soil and the armor stone to allow for any settlement of the cap material. Control measures would be used during cap placement to minimize disturbance or any potential resuspension of contaminated sediment. In-situ water quality monitoring would be conducted during capping to monitor chemical resuspension and turbidity.

Placement of an armored cap in Area III would require institutional controls and long-term monitoring. This FS Report uses the following institutional controls and monitoring plan for cost comparison.

Institutional Controls

As described in Section 3.2, institutional controls would be implemented for Area III and Area X.

Monitoring

The monitoring program associated with Alternatives 3A and 3B would have three primary components, including baseline monitoring, construction quality control monitoring, and long-term monitoring.

Baseline Monitoring. A baseline bathymetric survey would be conducted to characterize the contours of the sediment surface in Area III before the cap is installed.

Construction Quality Control Monitoring. Construction control testing would include in-situ water quality monitoring for turbidity and suspended solids to assess the potential for contaminant suspension during capping. Cap material would be tested before it is placed to ensure the quality of the cap material, and placement methods would be monitored visually and using standard bathymetric survey methods to ensure accuracy and quality of placement. Confirmation sampling after the cap is placed would consist of bathymetric surveys to model the surface contours of the new cap on the bay bottom in the remediation areas and for comparison with the baseline bathymetric survey.

Long-Term Monitoring. After the cap is complete, annual post-construction monitoring would be conducted for 5 years. The annual monitoring would consist of subsurface bathymetric surveys to monitor the cap surface depths. Some movement and settling of the cap would be expected because the sediment would consolidate under the cap. Large variations in cap elevation (substantially greater than that anticipated as a result of consolidation) would be investigated further using coring. The goal would be to ensure long-term cap coverage and stability. Cap repair would be required in the event that monitoring demonstrates a loss of cap integrity.

A 5-year review would evaluate the data generated during capping and subsequent monitoring to assess the overall performance of the remedy. After the first 5-year review, it is assumed that monitoring would be implemented every 5 years for years 10 to 30; monitoring would consist of the same elements as annual monitoring during the first 5 years.

It is assumed that the cap would be stable after 30 years. Assuming that the 0.5 cm/year deposition rate continues for another 30 years, portions of the cap would be buried by up to another 15 centimeters (or 6 inches) of clean material.

AquaBlok Capping in Area III

Alternative 3B is identical to Alternative 3A except that a 1-foot-thick AquaBlok cap, instead of an armored cap, would be placed over the contaminated sediments in Area III. This section describes only the new cap. Items that are the same as Alternative 3A are not reiterated.

The 1-foot-thick layer cap of AquaBlok material would be placed over the contaminated off-shore sediment in Area III in the same area as the armored cap (see Figure 4-8). AquaBlok is a patented material that acts as an effective physical, hydraulic, and chemical environmental barrier when installed over contaminated sediments. AquaBlok consists of composite-aggregates composed of a central core, clay or clay-size materials, and polymer. The thickness of the AquaBlok cap is based on the maximum depth (6 inches) of most of the biological activity at Parcel F, plus 6 inches for additional protection.

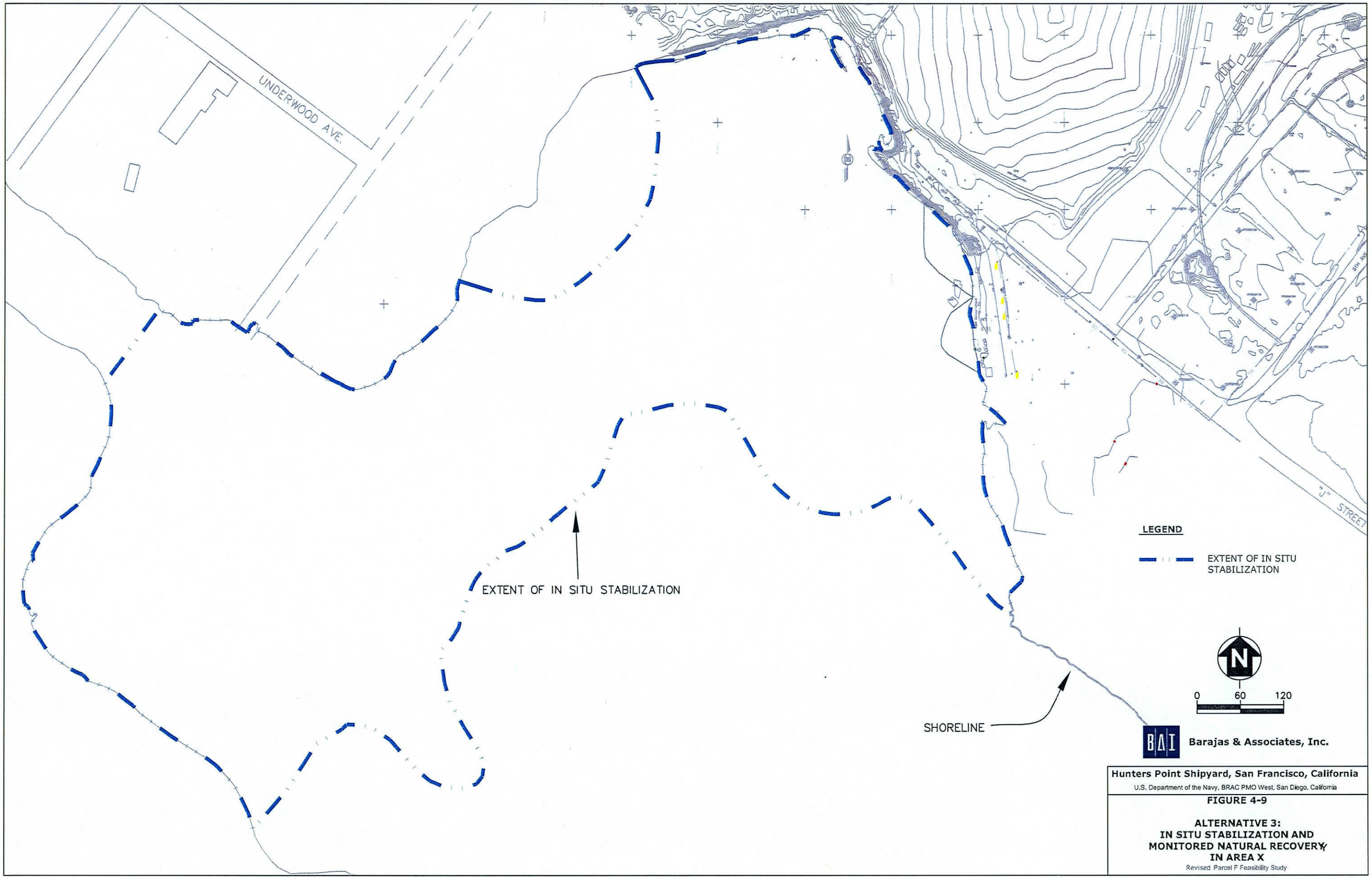
The cap would extend approximately 10 feet laterally beyond the mapped sediment remediation areas to allow for proper grading. The precise thickness, material types, layering requirements, and reinforcement would be decided in the detailed design.

The AquaBlok cap would be applied using a pipeline with a diffuser. The quantity and spatial uniformity would be monitored using standard bathymetric surveying techniques during placement of the raw material over the sediment surface. Once they have been placed on the sediment surface underwater, the AquaBlok particles hydrate and coalesce, and the AquaBlok product mass transforms into a continuous and relatively soft body of material.

The required institutional controls and long-term monitoring for the capping portion of Alternative 3B are identical to the armored cap under Alternative 3A.

In-Situ Stabilization and Monitored Natural Recovery in Area X

PCB contamination in Area X would be stabilized in situ with activated carbon. Figure 4-9 shows the proposed area for in-situ stabilization in Area X. Granular activated carbon would be applied by mixing the carbon within the top 1 foot of contaminated surface sediment using equipment such as an Aquamog or other device that would ensure complete mixing.



Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 4-9

ALTERNATIVE 3:
IN SITU STABILIZATION AND
MONITORED NATURAL RECOVERY
IN AREA X

Revised Parcel F Feasibility Study

Approximately 3.4 percent by volume of carbon will be required. The sediments would be expected to swell, raising the elevations of this area slightly. The remediation area of Area X (South Basin) would be dewatered before stabilization so that conventional mixing equipment operating on crane mats could be used. Cofferdams would be used to isolate the remediation area from the remainder of the bay. Centrifugal pumps would pump water from the remediation area, over the water barriers, and to the bay. Treatment for this water is not expected to be necessary because no mixing equipment would be operated until after dewatering is complete.

A treatment thickness of 1 foot was selected based on the maximum depth (6 inches) of most of the biological activity at Parcel F, plus 6 inches for additional protection. Sediments below 1 foot would be expected to remain stable in the environment and not be impaired by bioturbation, tidal waves, or erosion from storm events. The well–defined, smooth vertical profiles of PCBs in sediment cores support the conclusion that the sediment in Area X is relatively stable. Little evidence exists of past erosion in the sediment cores, and sediment stability analysis predicts that scour depths of less than 10 centimeters will occur during storm events. In addition, a stiff layer of clay is present at 30 centimeters below the sediment surface in Area X that is expected to resist erosion even under high shear stress conditions.

4.4.3.1 Overall Protection of Human Health and the Environment – Alternatives 3A and 3B

Area III. Alternatives 3A and 3B would be protective of human health and the environment in Area III by effectively removing nearshore sediments contaminated by copper, mercury, and PCBs; and by isolating, stabilizing, and containing areas offshore affected by copper, mercury, and PCBs. Under these alternatives, most sediments with chemical concentrations that exceed the site-specific remediation goals would be either removed and disposed of off site or would be isolated from the water column and potential exposure pathways by a cap. The thickness of the cap would minimize the potential for contaminated sediment to resurface and would minimize the potential for burrowing organisms to contact contaminated sediment. As discussed in Section 4.1, the chemicals are not expected to migrate through the cap to the surface.

The sources of contamination at HPS Parcel F are being controlled, resulting in a low risk of future cap contamination in Area III from Parcel B.

Area X. In-situ stabilization of contaminated sediments in Area X would be protective of human health and the environment by effectively reducing the bioavailable concentration of PCBs in the top 1 foot of sediment to concentrations less than the site-specific remediation goals. PCBs bond strongly with activated carbon, thus reducing the bioavailability of the chemicals. Based on results from a treatability study conducted for Parcel F, activated carbon is anticipated to reduce tissue bioaccumulation of PCBs by 90 percent (see Attachment 3). As discussed in Section 4.1, the chemicals are not expected to migrate through the stabilized section of bed sediments to the sediment surface.

4.4.3.2 Compliance with ARARs – Alternatives 3A and 3B

Alternatives 3A and 3B would comply with all chemical-, action-, and location-specific ARARs. Excavation would consider the substantive requirements of the Rivers and Harbors Act and the Coastal Zone Management Act. Results of sampling and analysis of the excavated sediment would be used to evaluate whether contaminated sediment should be managed as a hazardous waste pursuant to the requirements of RCRA that have been identified as chemical-specific ARARs.

Waste would also be characterized to determine if it is California non-RCRA waste pursuant to Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C) or 66261.3(a)(2)(F), or a designated nonhazardous or inert waste as defined in Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20320. Sediment would be held in a laydown area that would comply with storage requirements for PCBs in 40 CFR § 761.65 and the additional requirements of the Toxic Substances Control Act that have been identified as ARARs. An appropriate off-site disposal facility would be selected based on the results of the analysis. The placement of the thin-layer cap would consider Clean Water Act § 404, Executive Order 11990, and Rivers and Harbors Act § 10.

4.4.3.3 Long-Term Effectiveness – Alternatives 3A and 3B

Numerical modeling was used to evaluate the long-term effectiveness of Alternatives 3A and 3B. The modeling estimated both the residual PCB concentrations in the sediment bed, and the amount of PCBs released from the sediment bed into the water column due to bioturbation, diffusion, and porewater advection. Results of this modeling for Areas III and X are described below.

Area III

Each of the cores used to represent Area III was modified to reflect the capping scenario. A 2-foot-thick layer of sand material with a zero PCB concentration was placed on top of the contaminated sediment. A porosity of 0.5, which is typical for sandy sediment, was assumed for the sand cap. The sediment-water partition coefficients for the cap material were calculated by assuming that a minimal amount of organic material was present in the sand that would adsorb the PCBs. An organic fraction of 0.01 was assumed as a minimal level for the sand cap. Using the Karickhoff and others (1979) formulation, an average sediment-water partition coefficient for the cap was determined to be 2×10^4 L/kg, which should be conservative. The rate and depth of bioturbation would be expected to decrease in sandy sediments where less organic material is available for uptake.

The PCB transport at the two locations in Area III was simulated for a 30-year period based on the assumptions described above. Figure 4-10 shows a summary of the average surface sediment PCB concentrations for the two locations in Area III. The surface sediment concentrations were averaged over the top 10 centimeters of the sediment bed to represent the PCBs that are readily bioavailable. Both locations show a slow increase in PCB concentrations because the PCB concentration in the depositing sediment from San Francisco Bay is assumed to be 121 µg/kg. No significant PCB transport from deeper sediments into the top 10 centimeters is predicted.

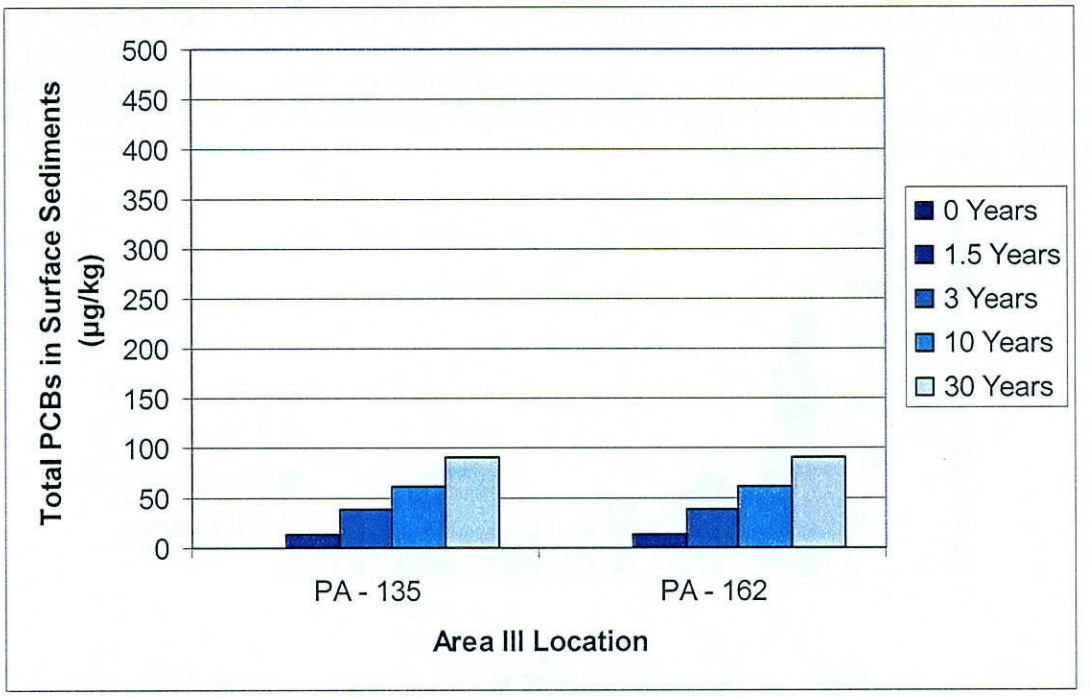


Figure 4-10. Predicted Surface Sediment PCB Concentrations Over Time at Each Location

Area III

Alternative 3B combines focused removal and AquaBlok capping of contaminated sediment. The two locations modeled in Alternative 1 were used for this case, and the results are the same as for Alternative 3A.

Area X

Alternative 3 combines stabilization of contaminated sediments with activated carbon in the top 1 foot in the nearshore areas of Area X, and MNR for deeper regions. For this case, the same six regions modeled in Alternative 2 were evaluated.

Each of the cores in the stabilization area was modified to reflect the addition of 3.4 percent activated carbon in the top 30.48 centimeter (1 foot) of the sediment. The PCB concentrations remain the same as in Alternative 2, because no removal takes place. The sediment-water partition coefficients for the amended sediment were calculated from the Zimmerman and others (2004) laboratory studies on the Area X sediments assuming 3.4 percent granular activated carbon (1.20×10^{6} L/kg). The rate and depth of bioturbation and the net sediment deposition rate were assumed to be the same as for Alternative 2.

The PCB fluxes in the six Area X regions were simulated for a 30-year period. Figure 4-11 shows a summary of the average surface sediment PCB concentrations for all six regions. The surface sediment PCB concentrations are averaged over the top 10 centimeters of the sediment bed to represent the PCBs that are readily bioavailable. Most bioturbation in Area X (South Basin) was observed above this depth.

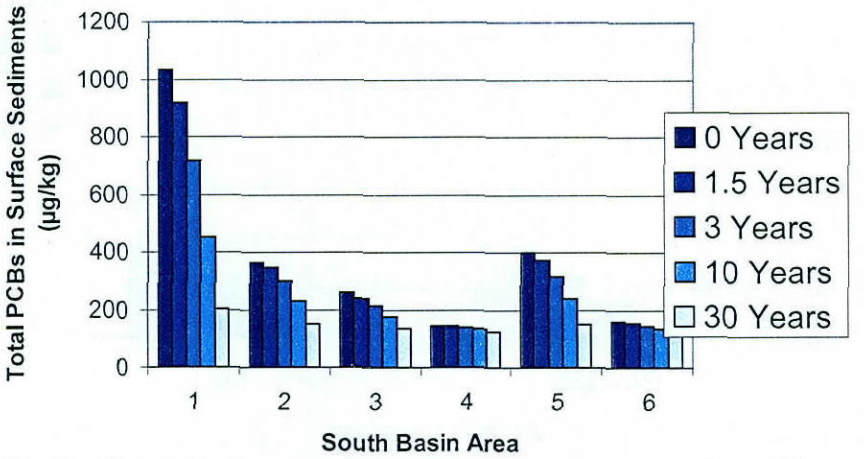


Figure 4-11. Predicted Surface Sediment PCB Concentrations Over Time at Area X

Figure 4-12 shows the total mass of dissolved-phase PCBs released into the water column as a function of time for each area. The flux slowly increases to a constant slope based on the assumption that the concentration of PCBs in the depositing sediments is approximately 121 µg/kg. If the San Francisco Bay-wide levels of PCBs are reduced such that concentrations in the depositing sediment decrease, this flux will decrease as well. These predictions indicate that a little over 5.0 grams of PCBs will be released to the bay from Area X (South Basin) over the next 30 years. The flux here is much lower than under the no-action alternative. The addition of activated carbon increases the sediment-water partition coefficient to the point where the PCB release is slowed considerably.

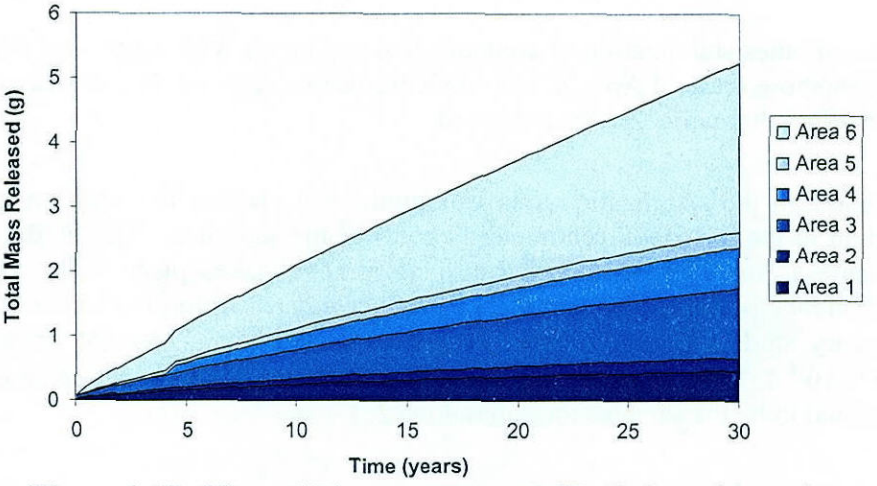


Figure 4-12. Mass of Dissolved-Phase PCBs Released into the Water Column over Time in Area X

Conclusions for Long-Term Effectiveness

Under Alternatives 3A and 3B, nearshore sediment with chemicals at concentrations above the remediation goals in Area III would be removed and placed in an off-site disposal unit, and clean sediment will be used as backfill over the removal area. Long-term effectiveness in these areas would be the same as was described in Alternative 2.

The magnitude of the residual risk posed if contaminated sediments are in place under a cap in Areas III would be minimal. If properly designed and maintained, a cap would immediately and effectively isolate and confine the contamination, and the sediments would remain in a saturated, reducing environment where mobilization and leaching are unlikely. As shown in the modeling results above (see Figure 4-10), almost no flux is expected through the cap, but sedimentation will eventually lead to a higher concentration of PCBs in surface sediment because of the background PCB concentrations in the off-site bay sediments. In Area X, the stabilized and residual PCBs, along with any deposited, are expected to release a little over 5 grams of PCBs to the bay over the next 30 years. This estimate of flux is the lowest for any alternative developed in this FS Report. Alternatives 3A and 3B would provide long-term effectiveness in Areas III and X as long as off-site sources do not recontaminate the area to concentrations above the remediation goals. The thickness of the cap would minimize the potential for contaminated sediment to resurface and would likewise minimize the potential for burrowing organisms to contact contaminated sediment. In addition, on-site sources of contamination at Parcel F are being controlled, resulting in low risk of future contamination to concentrations above the remediation goals. Based on modeling results, Alternative 3B (AquaBlok cap) provides no additional effectiveness over Alternative 3A (armored sand cap) in Area III.

The monitoring program, which would have a duration of 30 years, would verify the long-term effectiveness of the cap isolation and containment in Area III. Institutional controls implemented as part of Alternatives 3A and 3B would protect the cap in Area III from being harmed by excavation, dredging, or other construction in the area.

4.4.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment – Alternatives 3A and 3B

Area III. No treatment would occur in Area III other than any required to transport and dispose of removed sediments at an off-site disposal facility. The toxicity or volume of chemicals would not be reduced. EPA's preference for treatment would not be satisfied in Area III.

Area X. In-situ stabilization of contaminated sediments using granulated activated carbon would reduce the mobility and toxicity of mercury and PCBs in Area X. Chemicals would bind strongly onto the surface of the activated carbon, thereby removing the chemicals from the aqueous phase and reducing the bioavailability of the chemicals to ecological receptors. The application of 3.4 percent activated carbon to the contaminated sediments would result in an increase in the sediment volume. EPA's preference for a reduction in toxicity and mobility through treatment would be met in Area X by Alternatives 3A or 3B.

4.4.3.5 Short-Term Effectiveness – Alternatives 3A and 3B

The community would be exposed to minimal risk during cap installation and in-situ carbon placement and mixing. Risks to the community would be limited to potential elevated noise levels associated with implementation and increased vehicle or vessel traffic around the bay when the capping material is transported to the site. The site would be closely controlled during implementation of the remedy to minimize the potential for community exposure to contamination or physical hazards associated with construction.

Workers engaged in implementing Alternatives 3A and 3B could be exposed to general hazards associated with heavy equipment, such as noise, slip, trip, and fall incidents, utilities, and water-related accidents. Implementation of the remedy would be controlled by a project health and safety plan that would specify potential site hazards, as well as protective equipment and mitigation measures to minimize hazards and risks.

Area III. The short-term effectiveness provided by excavation in Area III would be similar to Alternative 2, but to a lesser extent because of the smaller area to be excavated. Alternative 3A would have some limited short-term effect on the environment by altering the sediment surface and the native benthic community. Placing an armored or AquaBlok cap over the contaminated sediments in Area III would effectively bury benthic communities. Benthic communities typically recover to pre-capping diversity and population. However, because of the change in surface sediment type, the types of species that populate the cap may vary from the pre-capping populations.

In addition, sediment is likely to be resuspended in the water column during excavation of the nearshore sediments in Area III, and to a lesser extent during placement of the cap over the contaminated offshore sediments. Excavation and cap placement may temporarily increase surface water turbidity, lower dissolved oxygen concentrations, and potentially affect the ecological community. Effects to the environment during excavation and placement of the cap are expected to be temporary, and the ecosystem would be expected to recover over time.

Area X. Stabilization would temporarily disrupt the benthic community in the affected sediment through the mixing process. The surface elevations are not expected to be significantly altered by stabilization, although some expansion is expected because of the mixing and carbon addition. After the sediments have settled, the surface elevations are expected to be similar to current levels.

4.4.3.6 Implementability – Alternatives 3A and 3B

Area III. The removal activities under Alternatives 3A and 3B are similar to Alternative 2, except that sediments would likely be dredged entirely from the shore access, so implementation would be easier. Construction equipment and personnel would be available from several commercial companies in the region.

Capping is a mature technology, and the equipment, materials, and contractors needed to implement the remedial alternative are considered readily available and reliable, although it is potentially more challenging to implement in areas in Area III with a steeper bathymetric gradient. Implementation in Area III will also pose engineering challenges because of the greater water depths and currents. The monitoring program is considered readily implementable and is based on proven and reliable equipment and methods.

Area X. In-situ stabilization is an emerging technology. Implementation methods specifically for in-situ sediment treatment using granulated activated carbon have not been thoroughly developed. However, numerous proven methods are available for mixing in-situ stabilization admixes in dry areas, including injection augers, augers, and rotary mixers. The difficulties with removing the water from Area X for mixing are the same as were described in Alternative 2 for excavation.

4.4.3.7 Cost – Alternatives 3A and 3B

The detailed cost analysis for Alternatives 3A and 3B include excavation, backfilling, dewatering of excavated material, disposal of dewatered material in an off-site landfill, capping, applying and mixing activated carbon, implementing institutional controls, implementing construction quality control and confirmation sampling, and long-term monitoring.

The estimated total present value is $23,190,000 for Alternative 3A and $25,280,000 for Alternative 3B. The cost estimate is presented in Appendix D (see Tables D-3 and D-4).

4.4.3.8 State Acceptance – Alternatives 3A and 3B

State acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

4.4.3.9 Community Acceptance – Alternatives 3A and 3B

Community acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

4.4.4 Alternatives 4A and 4B – Focused Removal, Off-Site Disposal, and Armored Cap (4A) or AquaBlok Cap (4B) in Area III; Monitored Natural Recovery in Area X; and Institutional Controls

Alternative 4A would combine focused removal and off-site disposal of nearshore contaminated sediments in Area III, placement of an armored cap over deeper offshore contaminated sediments in Area III, monitored natural recovery of sediments in Area X, and institutional controls.

Alternative 4B, which substitutes an AquaBlok clay cap for the armored cap in Area III, was also evaluated. All other aspects of Alternative 4B are identical to Alternative 4A. Differences between the two are discussed below.

Focused Removal and Armored Cap in Area III

The focused removal of contaminated nearshore sediments in Area III and armored capping over contaminated offshore sediments in Area III are identical to Alternative 3A described in Section 4.4.3. Excavation areas, depths, and volumes are described in Section 4.4.3 and are shown on Figure 4-8. Construction, dewatering, disposal, and monitoring for focused removal, and construction, monitoring, and institutional controls for armored capping are also described under Alternative 3A.

Focused Removal and AquaBlok Cap in Area III

Alternative 4B is identical to Alternative 4A except that an AquaBlok rather than an armored cap would be used in Area III. The focused removal of nearshore sediments in Area III and AquaBlok capping over offshore contaminated sediments in Area III are identical Alternative 3A, described in Section 4.4.3. Excavation areas, depths, and volumes are described in Section 4.4.3 and are shown on Figure 4-8. Construction, dewatering, disposal, and monitoring for focused removal, and construction, monitoring, and institutional controls for AquaBlok capping are identical to Alternative 3B.

Monitored Natural Recovery in Area X

MNR does not include any active removal, containment, or treatment of contaminated sediments in Area X. MNR would rely on natural processes to reduce or contain chemicals in sediment at Area X and would include long-term monitoring and institutional controls. In general, natural recovery would rely primarily on long-term natural sedimentation and burial of contaminated sediments to reduce chemical concentrations in surface sediment over time. Previous investigations indicated that Area X is a low-energy, net depositional environment with a sedimentation rate of approximately 1 cm/yr (Battelle, BBL, Neptune & Company, and Sea Engineering Inc. 2005).

Evidence indicates that natural recovery processes already appear to be reducing bioavailable concentrations of PCBs in Area X. Sediment cores show well-defined subsurface peaks in PCB concentration overlain by sediment with progressively lower PCB concentrations. In addition, results from the Validation Study Report demonstrated that vertical chemical distribution of copper and mercury is similar to PCBs in Area X.

The well–defined, smooth vertical profiles of PCB in sediment cores support the conclusion that the sediment in Area X is relatively stable. Little evidence exists of past erosion in the sediment cores, and sediment stability analysis predicts that scour depths of less than 10 centimeters will occur during storm events. Over time, natural sedimentation would continue to form a protective

barrier that would inhibit diffusion of chemicals into the water column, minimize the potential for resuspension of contaminated sediment, and further isolate contamination from potential contact with ecological and human receptors.

Baseline and long-term monitoring would be required under Alternative 4B. The existing data used for the modeling included in this FS Report would be included as part of the baseline for sediment contamination at the site. Long-term monitoring would be used to evaluate the extent that the surface sediments recover and meet the remediation goals over time. A formal monitoring plan would be selected during the remedial design phase; however, the following monitoring program is assumed for the cost comparison.

Baseline Monitoring. The existing sediment data would be supplemented in areas where insufficient data are available. Additionally, a bathymetric survey would be conducted to establish baseline conditions before the MNR remedial strategy is implemented. Fine-interval sediment cores would be collected as necessary to supplement the existing data.

Long-Term Monitoring. Long-term monitoring would consist of sediment sampling for copper, mercury, and PCBs. Grain size distribution and TOC would also be evaluated to characterize the surface sediments. Bathymetric surveys would be conducted once every 5 years to evaluate potential changes in the morphological configuration of the sediment surface over time, including potential erosion or redistribution.

Institutional Controls

As described in Section 3.2, institutional controls would be implemented for Area III and Area X.

4.4.4.1 Overall Protection of Human Health and the Environment – Alternatives 4A and 4B

Area III. Alternatives 4A and 4B would be protective of human health and the environment in an identical manner as under Alternatives 3A and 3B.

Area X. No active removal or treatment would be implemented for contaminated sediments in Area X under this alternative. Therefore, the short-term effectiveness of MNR in providing protection to human health and the environment would be low. The effectiveness of MNR to provide protection of human health and the environment at Area X in the short term depends on enforcement of restrictions on shellfish consumption and access restrictions implemented under the institutional controls. The sources of contamination at Area X (South Basin) are being addressed through a time-critical removal action.

The long-term effectiveness of MNR to effectively reduce the risks associated with chemicals in Area X depends on natural sedimentation. Model results indicated that it would take approximately 10 years to achieve the remediation goals at Parcel F (approximately 2013).

4.4.4.2 Compliance with ARARs – Alternatives 4A and 4B

Alternatives 4A and 4B comply with all chemical-, action-, and location-specific ARARs. Excavation would consider the substantive requirements of the Rivers and Harbors Act and the Coastal Zone Management Act. Results of sampling and analysis of excavated sediment would be used to evaluate whether contaminated sediment should be managed as a hazardous waste pursuant to the requirements of RCRA that have been identified as chemical-specific ARARs. Waste would also be characterized to determine if it is California non-RCRA waste pursuant to Cal Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C) or 66261.3(a)(2)(F), or a designated nonhazardous or inert waste as defined in Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20320. Sediment would be held in a laydown area that would comply with storage requirements for PCBs in 40 CFR § 761.65 and the additional requirements of Toxic Substances Control Act identified as ARARs. An off-site disposal facility would be selected based on the results of the analysis. The placement of the thin-layer cap would be designed to comply with the provisions of the Clean Water Act § 404, Executive Order 11990, and Rivers and Harbors Act § 10.

4.4.4.3 Long-Term Effectiveness – Alternatives 4A and 4B

Numerical modeling was used to evaluate the long-term effectiveness of Alternatives 4A and 4B. The modeling estimated both the residual PCB concentrations in the sediment bed, and the amount of PCBs released from the sediment bed into the water column due to bioturbation, diffusion, and porewater advection. Results of this modeling for Areas III and X are described below.

Area III. The long-term effectiveness of Alternatives 4A and 4B for Area III is identical to that described for Area III in Alternatives 3A and 3B in Section 4.4.3. Alternatives 4A and 4B would provide long-term effectiveness. For a detailed description of the long-term effectiveness of these alternatives, see Section 4.4.3.3.

Area X. Alternatives 4A and 4B would provide long-term effectiveness for Area X. The effects of sediment deposition and natural chemical and biological degradation in Area X will improve sediment quality over time. As shown in the modeling results below, sedimentation will improve the sediment quality near the surface, where the most biological activity occurs in depositional areas, and is expected to meet the remediation goals for PCBs in approximately 10 years. Human health and ecological risks will likely be effectively reduced by natural processes. The long-term effectiveness of this alternative on the highest portions of the mudflat where sediment is located above the mean lower low water (MLLW) elevation is less certain.

The initial PCB concentrations for each area were derived from the core data described in Section 4.2. The average sediment-water partition coefficients described in Section 4.2 were also used.

The PCB fluxes in the six Area X regions were simulated for a 30-year period using these values. Figure 4-13 shows a summary of the average surface sediment PCB concentrations for all six regions. The surface sediment PCB concentrations are averaged over the top 10 centimeters of the sediment bed to represent the PCBs that are readily bioavailable. Figure 4-14 shows the total mass of dissolved-phase PCBs released into the water column as a function of time for each area. The model indicates that less than 8 grams of PCBs would be released to the bay from South Basin over the next 30 years.

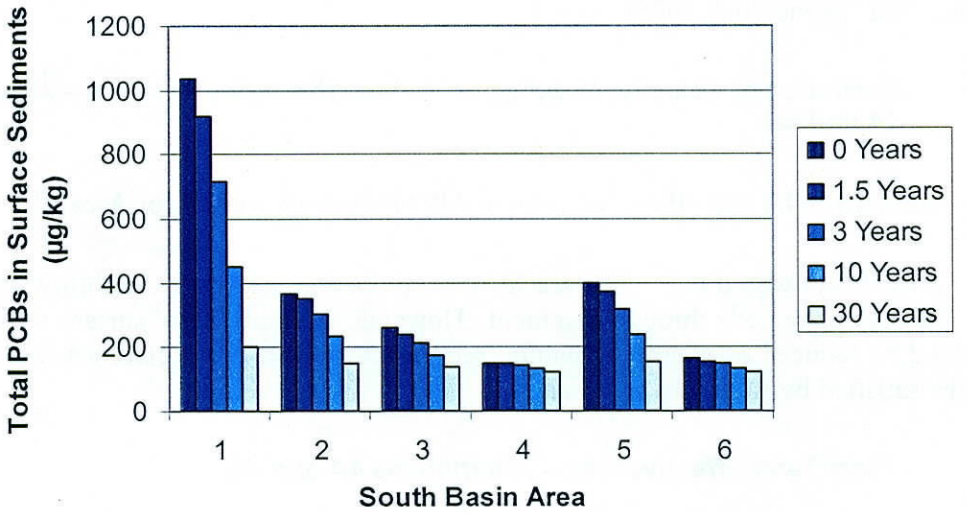


Figure 4-13. Predicted Surface Sediment PCB Concentrations Over Time in Each Region under the Alternatives 4A and 4B

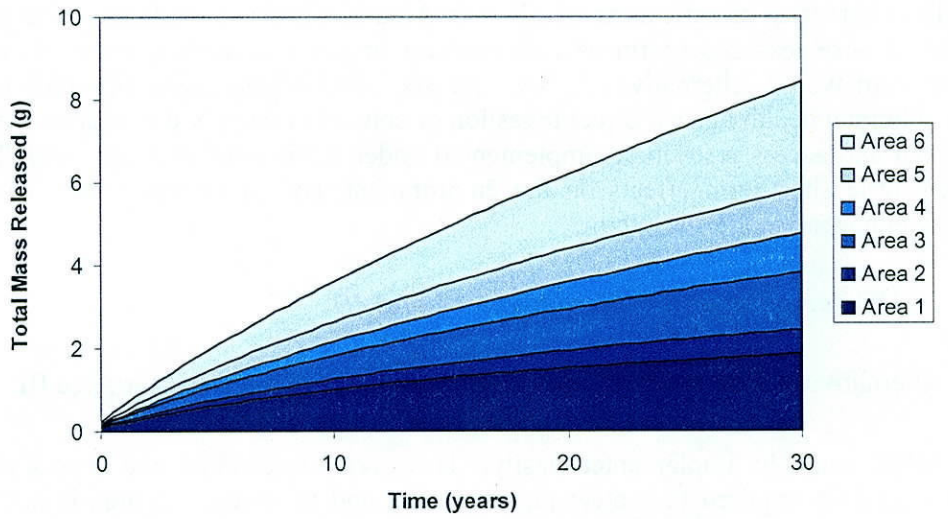


Figure 4-14. Mass of Dissolved-Phase PCBs Released into the Water Column Over Time in Area X

The primary exposure pathway of sediment contamination at Area X is ingestion of contaminated sediment and prey by microinvertebrates, bioaccumulation in upper-trophic-level receptors, and human consumption of shellfish. MNR would be an effective remedy if natural sedimentation continues at the current rate of 1 cm/year and the conditions in Area X (South Basin) remain stable, and long-term effectiveness would increase over time. Regions above MLLW are only submerged a portion of the time. This may result in a reduction of the gross sediment deposition, although it will also result in a reduction in erosion due to wave activity. Therefore, net deposition is likely to be comparable in the nearshore and offshore areas (Battelle, Neptune Inc., Sea Engineering, 2005).

4.4.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment – Alternatives 4A and 4B

Area III. Alternatives 4A and 4B are identical to Alternatives 3A and 3B for Area III.

Area X. No treatment would occur in Area X, so no reduction in toxicity, mobility, or volume would result from this remedy through treatment. However, the mobility of surface sediments in Area X would be reduced over time by natural sedimentation. EPA's preference for treatment would not be satisfied by Alternatives 4A and 4B.

4.4.4.5 Short-Term Effectiveness – Alternatives 4A and 4B

Area III. Alternatives 4A and 4B are identical to Alternatives 3A and 3B for Area III.

Area X. The short-term effectiveness of MNR in Area X would be medium. Alternatives 4A and 4B would pose less short-term risk to workers or the surrounding residents caused by construction than would Alternatives 2, 3A, and 3B. The effectiveness of MNR to provide protection of human health against direct ingestion or contact in Area X depends on enforcement of recreational and access restrictions implemented under the institutional controls. There will be relatively little short-term effects on the environment, and protection of the environment would not be enhanced in the short term.

4.4.4.6 Implementability – Alternatives 4A and 4B

Area III. Alternatives 4A and 4B are identical to Alternatives 3A and 3B for Area III.

Area X. MNR could be implemented easily. However, recreational and access restrictions potentially would be required to protect human health and to ensure the area is not disturbed during the natural recovery process, which could be difficult to enforce in public access areas such as Area X (South Basin).

4.4.4.7 *Cost – Alternatives 4A and 4B*

The detailed cost analysis for Alternatives 4A and 4B includes excavation, backfilling, dewatering excavated material, disposing of dewatered material in an off-site landfill, capping, implementing institutional controls, implementing construction quality control and confirmation sampling, and long-term monitoring.

The estimated total present value is $13,060,000 for Alternative 4A and $15,150,000 for Alternative 4B. The basis for this cost estimate is presented in Appendix D (see Tables D-5 and D6).

4.4.4.8 *State Acceptance – Alternatives 4A and 4B*

State acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

4.4.4.9 *Community Acceptance – Alternatives 4A and 4B*

Community acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

4.4.5 Alternatives 5A and 5B – Focused Removal, Off-Site Disposal, and Armored Cap (5A) or AquaBlok Cap (5B) in Area III; Focused Removal, Off-Site Disposal (5A) or Activated Backfill (5B), and Monitored Natural Recovery in Area X; and Institutional Controls

Alternative 5A would combine focused removal, off-site disposal of nearshore contaminated sediments, and placement of an armored cap over deeper offshore contaminated sediments in Area III; focused removal, off-site disposal, and monitored natural recovery of sediments in Area X; and institutional controls.

Alternative 5B, which substitutes an AquaBlok clay cap for the armored cap in Area III and substitutes activated carbon backfill, was also evaluated. All other aspects of Alternative 5B are identical to Alternative 5A. Differences between the two are discussed below.

Focused Removal and Armored Cap in Area III. The focused removal of nearshore and shallow sediments in Area III and armored capping of contaminated offshore sediments in Area III are identical to Alternative 3A in Section 4.4.3. Dredge areas, depths, and volumes are described in Section 4.2 and are shown on Figure 4-8. Details on construction, dewatering, disposal, and monitoring for dredging, and construction, monitoring, and institutional controls for capping are identical to Alternative 3A.

Focused Removal and AquaBlok Cap in Area III. Alternative 5B is identical to Alternative 5A except that an AquaBlok cap rather than an armored cap would be used in Area III. The focused removal of nearshore sediments in Area III and AquaBlok capping over offshore contaminated sediments in Area III are identical to Alternative 3B, described in Section 4.4.3. Excavation areas, depths, and volumes are described in Section 4.2 and shown on Figure 4-15. Details on construction, dewatering, disposal, and monitoring for focused removal, and construction, monitoring, and institutional controls for AquaBlok capping are identical to Alternative 3B.

Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X. This alternative differs from Alternatives 4A and 4B in that focused removal would occur in all areas where the chemical concentrations in the top 1 foot of sediment exceeds the RAO. These excavated areas would be backfilled with clean backfill under Alternative 5A and backfilled with materials treated by activated carbon under Alternative 5B. Both alternatives would reduce future flux from any remaining deeper chemicals. The sediment would remain in place and be further addressed by MNR. . Focused removal and MNR would be the same as described in Alternatives 4A and 4B. Approximately 46,990 yd^3 of sediment would be removed in Area X under Alternatives 5A and 5B. The approximate areas for excavation in Area X are shown on Figure 4-15.

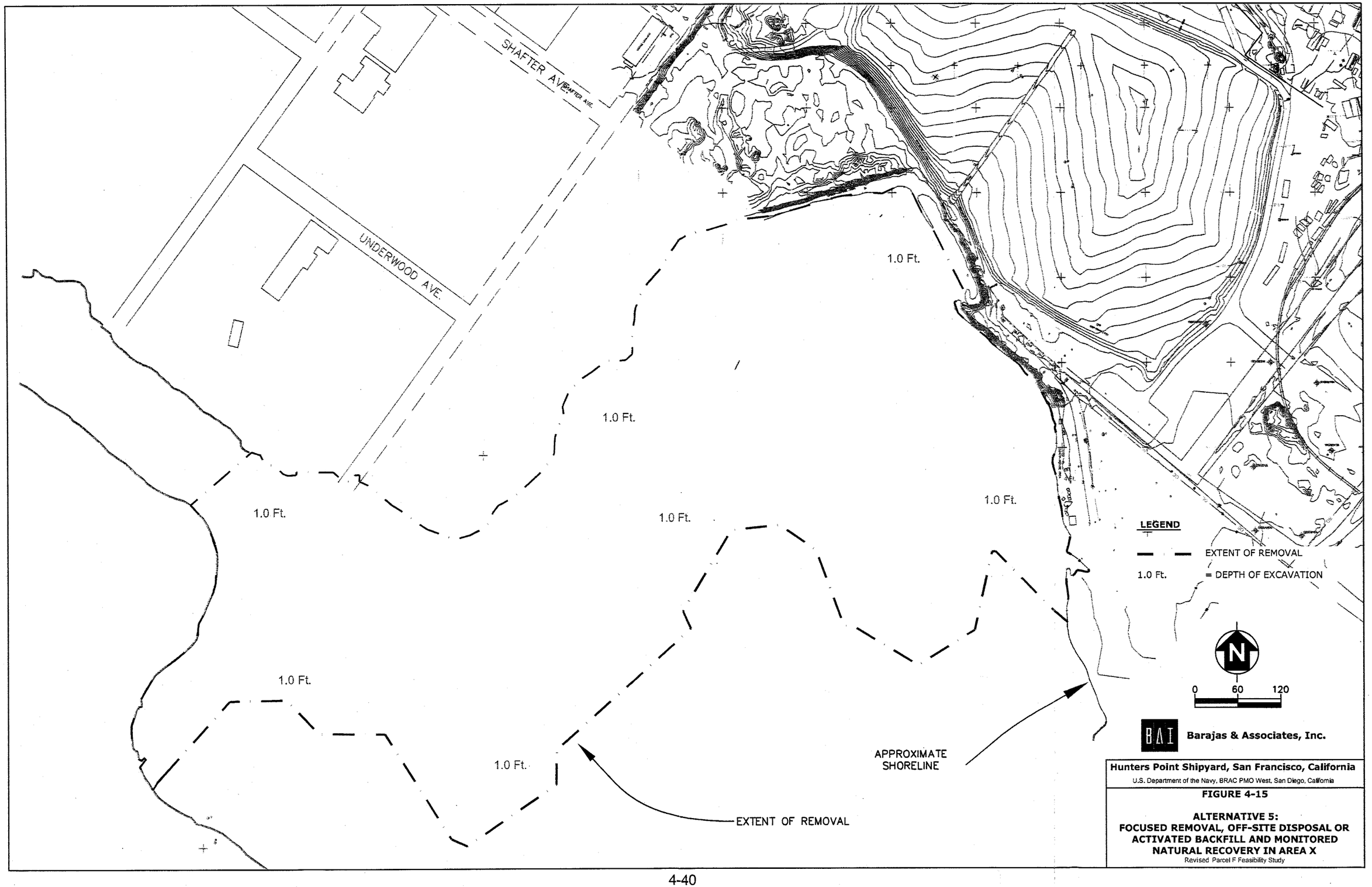
Sediments below 1 foot would be expected to remain stable in the environment and would not be affected by bioturbation, tides, or erosion from storm events. The well-defined, smooth vertical profiles of PCBs in sediment cores support the conclusion that the sediment in Area X is relatively stable. Little evidence exists of past erosion in the sediment cores, and sediment stability analysis predicts that scour depths of less than 10 centimeters would occur during storm events. In addition, a stiff layer of clay is present at 30 centimeters (1 foot) below the sediment surface in Area X that is expected to resist erosion even under high-shear stress conditions.

Details on construction, disposal, and monitoring for focused removal in Area X are identical to those described for complete removal in Area X under Alternative 2, except for the type of backfill used under Alternative 5B, as described above. The granulated activated carbon used under Alternative 5B would be mixed with backfill material with gradation similar to the native sediment to create a 3.4 percent activated carbon mixture. Implementation of MNR would be identical to Alternatives 4A and 4B, as described in Section 4.4.4.

As described in Section 3.2, institutional controls would be implemented for Area III and Area X.

4.4.5.1 Overall Protection of Human Health and the Environment – Alternatives 5A and 5B

Area III. Alternatives 5A and 5B are identical to Alternatives 3A and 4A for Area III and provide overall protection of human health and the environment. See Section 4.4.3 for discussion of protectiveness to human health and the environment.


SHAFTER AVE.
UNDERWOOD AVE.
1.0 Ft.
1.0 Ft.
1.0 Ft.
1.0 Ft.
1.0 Ft.
1.0 Ft.
1.0 Ft.
LEGEND
EXTENT OF REMOVAL
1.0 Ft. = DEPTH OF EXCAVATION
N
0 60 120
APPROXIMATE SHORELINE
EXTENT OF REMOVAL
BAI Barajas & Associates, Inc.
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California
FIGURE 4-15
ALTERNATIVE 5:
FOCUSED REMOVAL, OFF-SITE DISPOSAL OR ACTIVATED BACKFILL AND MONITORED NATURAL RECOVERY IN AREA X
Revised Parcel F Feasibility Study

Area X. Alternatives 5A and 5B would be protective of human health and the environment in nearshore areas, where the effectiveness of MNR is less certain, by removing all sediments with chemical concentrations that exceed the site-specific remediation goals in the top 1 foot of sediment. Placement of 1 foot of clean backfill enhanced with activated carbon would isolate residual contaminants left in place below the excavation depth. Chemicals removed would be disposed of at an off-site Class I or II landfill, as appropriate. Long-term human and ecological contact with chemicals in the top 0.5 foot of sediment, which is the most active for bioturbation, would be eliminated, also eliminating the direct contact and ingestion routes for humans and the most ecological receptors at the site. In addition, the clean backfill mixed with activated carbon would be placed over the excavated or dredged areas to serve as an additional barrier to any potential residual contamination. Flux through the clean cover is expected to be minimal, as described further in Section 4.1. Alternative 5A and 5B is identical to Alternative 4A and 4B in locations where the surface sediment elevation is below the MLLW elevation.

4.4.5.2 Compliance with ARARs – Alternatives 5A and 5B

Alternatives 5A and 5B comply with all chemical-, action-, and location-specific ARARs. Excavation would consider the substantive requirements of the Rivers and Harbors Act and the Coastal Zone Management Act. Results of sampling and analysis of excavated sediment would be used to evaluate whether contaminated sediment should be managed as a hazardous waste pursuant to the requirements of RCRA that have been identified as chemical-specific ARARs. Waste would also be characterized to determine if it is California non-RCRA waste pursuant to Cal Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C) or 66261.3(a)(2)(F), or a designated nonhazardous or inert waste as defined in Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20320. Sediment would be held in a laydown area that would comply with storage requirements for PCBs in 40 CFR § 761.65 and the additional requirements of Toxic Substances Control Act identified as ARARs. An off-site disposal facility would be selected based on the results of the analysis. The placement of the thin-layer cap would be designed to comply with the provisions of the Clean Water Act § 404, Executive Order 11990, and Rivers and Harbors Act § 10.

4.4.5.3 Long-Term Effectiveness – Alternatives 5A and 5B

Numerical modeling was used to evaluate the long-term effectiveness of Alternatives 5A and 5B. The modeling estimated both the residual PCB concentrations in the sediment bed, and the amount of PCBs released from the sediment bed into the water column due to bioturbation, diffusion, and porewater advection. Results of this modeling for Areas III and X are described below.

Area III. Alternatives 5A and 5B are identical to Alternatives 3 and 4 (A and B) for Area III and successfully provide long-term effectiveness, as described in Section 4.4.3.3.

Area X. Alternatives 5A and 5B combine excavation or dredging of contaminated sediment exceeding RAOs in sediment in the top 1 foot of sediment. The same six regions modeled in previous alternatives were used for this case.

Each of the cores used to represent the excavation or dredging areas was modified to reflect the removal. The sediment with PCB concentrations above 1,200 µg/kg were removed from the core profiles, and replaced with clean, PCB-free sediments with identical geotechnical properties. The sediment-water partition coefficients, rate and depth of bioturbation, and net sediment deposition rate of the fill sediment were assumed to be the same as the native Area X sediments.

The PCB fluxes in the six Area X (South Basin) regions were simulated for a 30-year period using these values. Figure 4-16 shows a summary of the average surface sediment PCB concentrations for all six regions. Surface sediment PCB concentrations slowly approach the background concentration, equal to the depositing sediments coming in from San Francisco Bay.

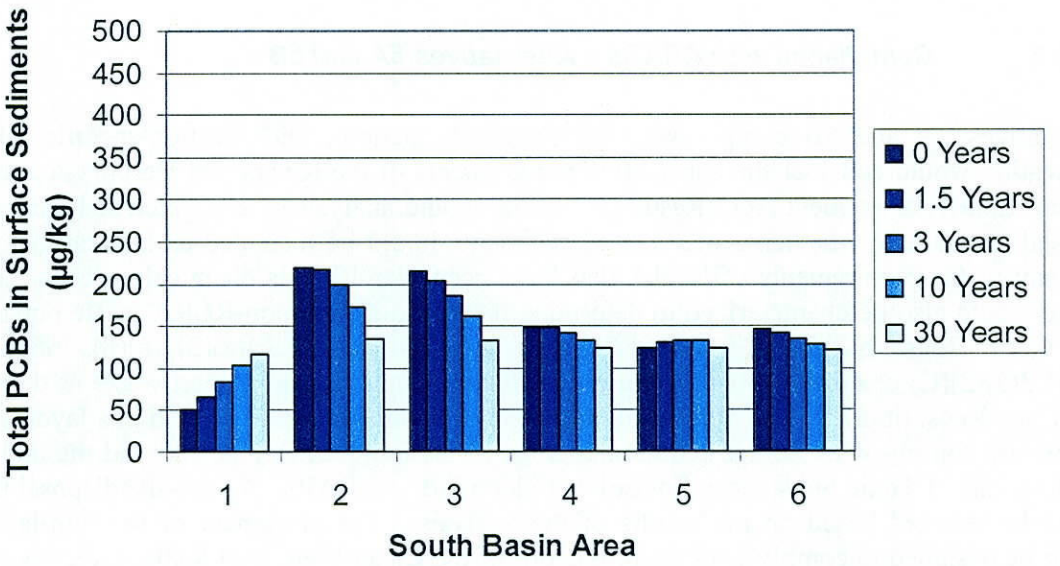


Figure 4-16. Predicted Surface Sediment PCB Concentrations Over Time in All Regions at Area X

Figure 4-17 shows the total mass of dissolved-phase PCBs released into the water column as a function of time for each area. The flux starts low from the clean fill material and slowly increases to a constant slope based on the assumption that the depositing sediments have a PCB concentration of approximately 121 µg/kg. If the San Francisco Bay-wide concentrations of PCBs are reduced such that concentrations in the depositing sediment decrease, this flux will decrease as well. These predictions indicate that approximately 6.0 grams of PCBs would be released to the bay from Area X (South Basin) over the next 30 years under Alternatives 5A and 5B.

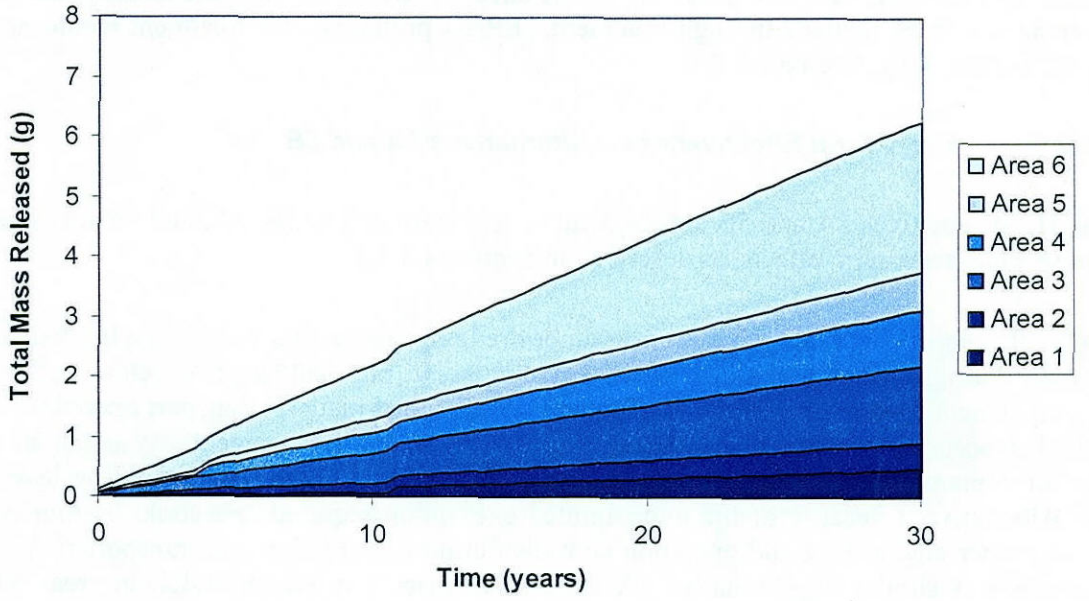


Figure 4-17. Mass of Dissolved-Phase PCBs Released into the Water Column Over Time at Area X

Conclusions for Long-Term Effectiveness

Nearshore sediment in Area X with chemical concentrations that exceed the remediation goals in the top 1.0 foot of sediment would be removed and disposed of off site, and clean sediment or clean sediment mixed with granulated activated carbon would be used as backfill over the removal area. This alternative differs from Alternative 2 in that only the top 1.0 feet of sediment is removed rather than all sediment (at any depth) with chemical concentrations exceeding the remediation goals. Backfilling to existing elevations eliminates reliance on natural sedimentation in suspect areas and thereby increases the potential for effectiveness in both the short term and long term.

Locations in Area X addressed by MNR will effectively protect human health and the environment in the long term and are similar to the long-term effectiveness of Alternatives 4A and 4B), as described in Section 4.4.4.

4.4.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment – Alternatives 5A and 5B

Area III. Alternatives 5A and 5B are identical to Alternatives 3A, 3B, 4A, and 4B for Area III and is not expected to generally address EPA's preference for treatment as a means to reduce toxicity, mobility, or volume.

Area X. Some treatment would occur in Area X under Alternative 5B, so the toxicity, mobility, or volume would be reduced through treatment. EPA's preference for treatment would not be satisfied in Area X by Alternative 5A.

4.4.5.5 Short-Term Effectiveness – Alternatives 5A and 5B

Area III. Alternatives 5A and 5B are identical to Alternatives 3A, 3B, 4A, and 4B for Area III and pose some short-term effects, as described in Section 4.4.4.5.

Area X. The local community and excavation or dredging contractors would face limited short-term risks during remediation, including construction noise, physical hazards such as traffic and heavy equipment associated with excavation and dredging and material transport operations, and potential exposures to dredged material during ex-situ solids management. A potential also exists for contamination of adjacent areas during excavation. These risks would be less than under Alternative 2 because of the more limited excavation required and could be minimized through proper engineering and operation controls during construction and transportation. The effectiveness is similar to Alternative 4A and 4B, described in Section 4.4.4, in areas where MNR would be implemented.

Workers engaged in implementing Alternatives 5A or 5B could be exposed to general hazards associated with heavy equipment such as noise; slip, trip, and fall incidents; utilities; and water-related accidents. Implementation of the remedy would be controlled by a project health and safety plan that would specify potential site hazards, as well as protective equipment and mitigation measures to minimize hazards and risks.

Alternatives 5A and 5B would have some limited short-term effect on the environment by altering the sediment surface and the native benthic community in the excavated areas. Excavation of the top 1.0 foot of sediment would remove benthic communities from the basin.

4.4.5.6 Implementability – Alternatives 5A and 5B

Area III. Alternatives 5A and 5B are identical to Alternatives 3A, 3B, 4A, and 4B for Area III. Alternatives 5A and 5B are considered implementable.

Area X. The MNR portion of this alternative is the same as was described for Alternative 4A and 4B in Section 4.4.4.6 and can be easily implemented. However, recreational and access restrictions required to protect human health and to ensure the area is not disturbed during the natural recovery process can be difficult to enforce in public access areas such as Area X (South Basin). However, appropriately placed health warning signage would reduce the incentive for gathering shellfish in the area.

Removal of the nearshore sediments can be implemented and involves the same difficulties as were described for Alternative 2 in Section 4.4.2. However, it will be more critical to excavate the sediments in dry conditions, so installation of a cofferdam is more important under this

alternative. Because only the top 1.0 foot of sediment would be removed, some areas of relatively high PCB contamination would be exposed during excavation. These areas would remain exposed until the clean backfill was in place. Excavating and backfilling in submerged conditions would increase the potential for contaminating the adjacent areas designated for MNR. The excavation areas cannot all be reached from shore but, fortunately, the areas appear to be limited enough and shallow enough that cofferdams can be installed and the areas can be dewatered. A detailed bathymetric survey should be performed before the remedial design to ensure the viability of installing cofferdams in this area.

4.4.5.7 Cost – Alternatives 5A and 5B

The detailed cost analysis for Alternatives 5A and 5B includes dredging or excavation, backfilling with and without activated carbon additive, dewatering Area X, dewatering the dredged material, disposing of dewatered material in an off-site landfill, capping, implementing institutional controls, implementing construction quality control and confirmation sampling, and long-term monitoring.

The estimated total present value is $26,880,000 for Alternative 5A and $28,970,000 for Alternative 5B. The cost estimate for these alternatives is presented in Appendix D (see Tables D7 and D8).

4.4.5.8 State Acceptance – Alternatives 5A and 5B

State acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

4.4.5.9 Community Acceptance – Alternatives 5A and 5B

Community acceptance would be evaluated during the review and comment period on the FS Report and during assembly of the Proposed Plan, and would be thoroughly addressed in the ROD.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares each of the eight remedial alternatives evaluated in Section 4.0. Remedial alternatives for each area (III and X) were compared against the nine National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria. The results for Areas III and X for each alternative were then combined to develop a relative ranking for comparison purposes. Figure 5-1 summarizes the combined comparison of remedial alternatives against the nine criteria. The U.S. Department of the Navy (Navy) will select their preferred remedial alternative after receipt and resolution of regulatory agency comments. The Navy will present their preferred alternative to the public in the Proposed Plan.

5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 (no action) would not provide additional protection of human health or the environment at Parcel F. All of the remaining alternatives meet the threshold criterion of overall protection of human health and the environment.

Alternatives 5A and 5B would provide the best overall protectiveness for Areas III and X because (1) contaminated sediments would be removed in the nearshore areas, (2) placement of a cap would provide a protective barrier between the sediment bed and ecological receptors in Area III, (3) activated carbon backfill in Area X would provide a barrier to residual contamination, and (4) monitored natural recovery (MNR) would be implemented in the deeper, less contaminated areas with removal.

Alternatives 2, 4A, and 4B are ranked slightly lower than Alternatives 5A and 5B. Under Alternative 2, this lower ranking is because in Area III the pattern of contamination is localized at varying depths, and it would be difficult to control releases of contamination to adjacent areas during dredging operations. Additionally, it is uncertain whether the dewatering operation could be effectively implemented and there is a greater potential for contamination to adjacent areas in Area X (South Basin) and greater short-term effects to the environment. Under Alternatives 4A and 4B, the effectiveness of Alternatives 4A and 4B (MNR) would be similar to Alternatives 5A and 5B in deeper areas. However, these alternatives would have lower short-term effectiveness in shallow areas, which are recovering less quickly than the deeper areas.

Alternatives 3A or 3B would provide moderate overall protectiveness by reducing the bioavailability of chemicals, thus reducing the overall risk to human and ecological receptors. However, the effectiveness of this technology when used alone remains under investigation, so it is ranked lower than the other alternatives.

Criteria	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 4A	Alternative 4B	Alternative 5A	Alternative 5B
	No Action	Removal and Off-Site Disposal	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls
Overall Protection of the Environment	○	◕	◑	◑	◕	◑	●	●
Compliance with Applicable or Relevant and Appropriate Requirements	○	●	●	●	●	●	●	●
Long-Term Effectiveness	○	◕	◑	◑	◑	◑	●	●
Reduction of Toxicity, Mobility, or Volume	○	○	◑	◑	○	○	○	◑
Short-Term Effectiveness	◑	◑	◑	◑	◑	◑	◕	◕
Implementability	●	◕	◑	◑	◕	◕	◕	◕
Cost	$0	$42.6M	$23.2M	$25.3M	$13.1M	$15.2M	$26.9M	$29M
Overall Rating	○	◑	◑	◑	◑	◑	●	●

Ranking Scale:

- ● Meets Criteria Best
- ◕ Meets Criteria Moderate to High
- ◑ Meets Criteria Low to Moderate
- ◑ Meets Criteria Least
- ○ Does Not Meet Criteria

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 5-1
QUALITATIVE COMPARISON OF FINAL REMEDIAL ALTERNATIVES

Revised Parcel F Feasibility Study

5.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

All alternatives would comply with the chemical-, action-, and location-specific applicable or relevant and appropriate requirements (ARAR), except for the no-action alternative. The requirement to meet ARARs is not triggered by the no-action alternative (U.S. Environmental Protection Agency 1991).

5.3 LONG-TERM EFFECTIVENESS

Alternative 1 (no action) would not meet the criterion for long-term effectiveness because the effectiveness of natural recovery processes would not be verified.

Alternatives 5A and 5B would best meet the criterion of long-term effectiveness for Areas III and X because they combine the removal of the most highly contaminated sediments with MNR processes, as well as placement of a cap in Area III. Use of MNR would provide long-term effectiveness in deeper areas because sedimentation studies and modeling results have shown that sedimentation will continue, effectively capping the sediment in place. Additionally, Alternative 5B would include the use of activated carbon as backfill, thus further reducing residual contamination left in place.

Alternative 2 ranked slightly lower than Alternatives 5A and 5B because in Area III the pattern of contamination is localized at varying depths, and it would be difficult to control releases of contamination to adjacent areas during dredging operations. Additionally, it is uncertain whether the dewatering operation could be effectively implemented and there is a greater potential for residual contamination to migrate to adjacent areas in Area X (South Basin).

Alternatives 3A, 3B, 4A, and 4B would provide moderate long-term effectiveness. Under Alternatives 3A and 3B, the remedial technology is relatively new. Although initial studies have proven promising, additional treatability studies would be required to evaluate the actual long-term effectiveness compared with the other alternatives. Under Alternatives 4A and 4B, the long-term effectiveness of MNR depends on the enforcement of institutional controls. In deeper areas, this alternative would be similar in long-term effectiveness to Alternatives 5A and 5B. However, sedimentation sufficient to cover the sediments in shallower areas is less certain, so this alternative is rated lower than Alternatives 5A and 5B.

5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Under Alternatives 1, 2, 4A, 4B, and 5A, there would be no reduction of the toxicity, mobility, or volume through treatment on site, thus none of these alternatives meet the criterion. Alternative 5B meets this criterion least because the placement of backfill mixed with activated carbon could reduce the bioavailability of residual polychlorinated biphenyls (PCB).

Alternatives 3A and 3B would moderately reduce the toxicity and mobility through treatment in Area X. Under these alternatives, PCBs would be reduced by mixing the sediment with activated carbon.

5.5 SHORT-TERM EFFECTIVENESS

Alternative 5B best meets the criterion for short-term effectiveness, with Alternative 5A ranked slightly lower. Under Alternative 5B, there would be less risk to workers and the community than the remaining alternatives because a much smaller volume of sediment would require handling and transportation. This alternative also would result in less impact to the aquatic environment than Alternative 2 because construction controls would be easier to implement under Alternative 5B. Finally, the addition of mixing clean backfill with activated carbon may further reduce the possibility for residual contamination. Alternative 5A was ranked slightly lower than Alternative 5B because only clean backfill would be used without the addition of activated carbon, thus the potential for residual contamination should be considered.

Alternatives 1, 2, 3A, and 3B would moderately meet the criterion for short-term effectiveness. Alternative 1 (no action) is rated moderate for short-term effectiveness because the environment and surrounding community would not be disturbed. Alternative 2 is ranked moderate because the volume of sediment would be larger than for Alternative 5B and construction controls would be more difficult to implement. Alternatives 3A and 3B are ranked moderate because the remedial technology recommended is relatively new. Although initial studies have proven promising, additional treatability studies would be required to evaluate the actual long-term effectiveness compared with the other alternatives.

Alternatives 4A and 4B least meet the criterion for short-term effectiveness. Although these alternatives have less of a short-term effect to the community since no active dredging would occur in Area X, the rate of recovery is slower. As a result, the short-effectiveness of this remedy is low.

5.6 IMPLEMENTABILITY

Alternative 1 would be the easiest to implement because no action would be involved.

Alternatives 2, 4A, 4B, 5A, and 5B are similarly ranked. Although implementation of these alternatives would pose unique challenges as described in Section 4.0, overall they are comparable in terms of implementability.

Alternatives 3A and 3B are ranked the lowest because the in-situ component of these alternatives is relatively new; although the results of the treatability study are promising.

5.7 COST

The detailed cost estimates for each alternative are located in Appendix D. Table 5-1 compares the costs for the alternatives. Alternative 1 is the lowest-cost option. The costs for Alternatives 4A and 4B are the next lowest due to inclusion of MNR. Alternatives 3A and 3B are the next most costly, followed by Alternatives 5A and 5B. Alternative 2 is the most expensive of the alternatives.

TABLE 5-1: REMEDIAL ALTERNATIVE COST SUMMARY
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

	Description	Base Cost[1]	30-Year O&M[2]	Total
Alternative 2	Removal and Off-Site Disposal	$42,630,000	$0	$42,630,000
Alternative 3A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	$20,310,000	$2,880,000	$23,190,000
Alternative 3B	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	$22,520,000	$2,760,000	$25,280,000
Alternative 4A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	$10,070,000	$2,990,000	$13,060,000
Alternative 4B	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	$12,270,000	$2,880,000	$15,150,000
Alternative 5A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls	$23,990,000	$2,890,000	$26,880,000
Alternative 5B	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls	$26,190,606	$2,779,394	$28,970,000

Note:

1. Base costs include future costs for remedial design and construction. See Table C-3 for present value costs.
2. Future costs for 30 year O&M.

O&M Operation and maintenance

5.8 STATE ACCEPTANCE

State acceptance will be addressed in the ROD.

5.9 COMMUNITY ACCEPTANCE

Community acceptance will be addressed in the ROD.

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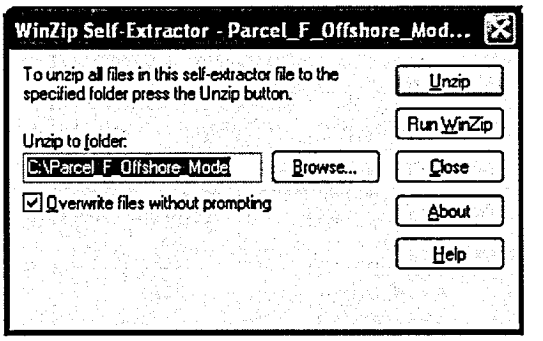
APPENDIX A
TETRA TECH OFFSHORE GIS MODEL

A1.0 OVERVIEW

The purpose of the Hunters Point Parcel F Offshore Model (the model) is to calculate the approximate remediation volume and area based on a set of user-supplied do-not-exceed criteria. The criteria are applied to a polygon data layer in a geographic information system (GIS), which contains relevant sample analytical data for five offshore subareas (Areas I, III, VIII, IX, and X) of Parcel F. The analytical data for each polygon is compared with the supplied criteria, and polygons that exceed one or more criterion are flagged for remediation.

A2.0 INSTALLATION

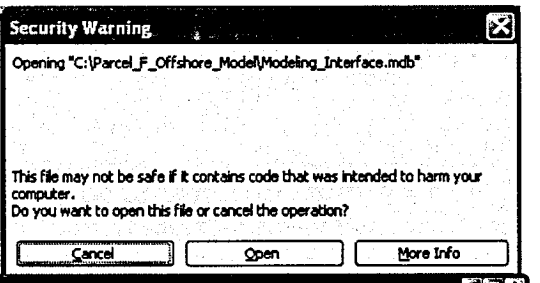
The program is approximately 4 megabytes in size, when installed, and requires that the user's computer have Microsoft Access™ 2000 or higher installed. If you do not have Access, consult with your system administrator.



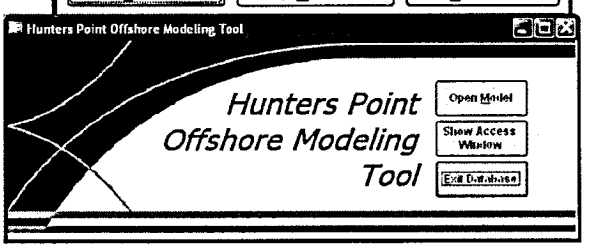
The setup program to install the model is called `Parcel_F_Offshore_Model.exe` and is located on the compact disc. It is a self-extracting compressed file. When run, the installation process will unzip three files (`Modeling_Interface.mdb`, `Parcel_F_Data.mdb`, and `HPS_Offshore_Modeling.mxd`) to a directory specified by the user (default is `C:\Parcel_F_Offshore_Model`).

Following installation, double-click `Modeling_Interface.mdb` to run the model. If you wish to use the optional mapping interface open `HPS_Offshore_Modeling.mxd` in ArcGIS version 9.1 or later.

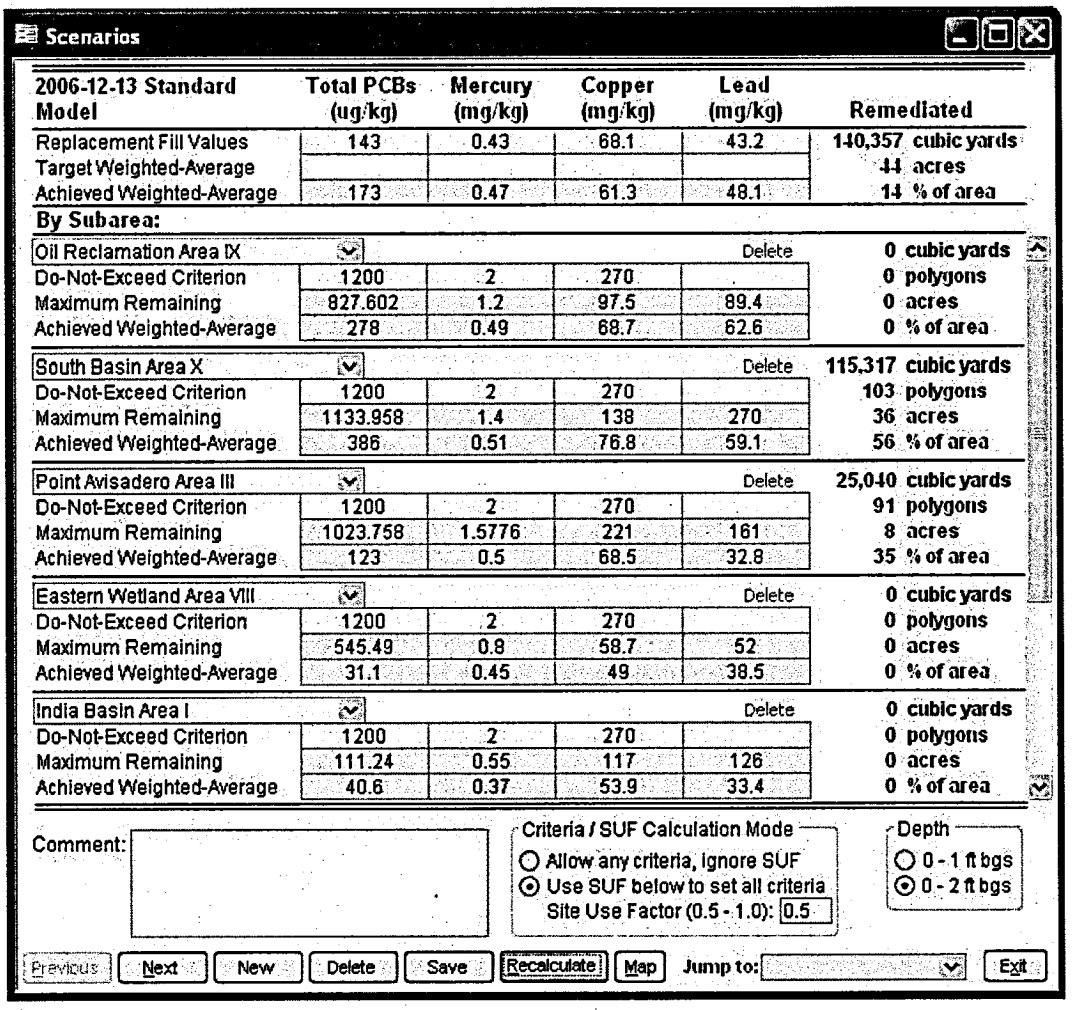
A3.0 SYSTEM USE



When `Modeling_Interface.mdb` is run, the user may be prompted with a security warning, as shown to the right. This security warning will display, depending on security settings within Access, whenever the user opens an .mdb file with executable code, and is not specific to the contents of the database. Click "OK" to proceed.



Following the security warning, the user will be presented with the database startup form, from which the user can open the model interface, show the standard access window (useful for viewing source code or the underlying data) or exit the database. Click Open Model to view the model interface.



Scenarios

2006-12-13 Standard Model	Total PCBs (ug/kg)	Mercury (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Remediated
Replacement Fill Values	143	0.43	68.1	43.2	140,357 cubic yards
Target Weighted-Average					44 acres
Achieved Weighted-Average	173	0.47	61.3	48.1	14 % of area
By Subarea:					
Oil Reclamation Area IX				Delete	0 cubic yards
Do-Not-Exceed Criterion	1200	2	270		0 polygons
Maximum Remaining	827.602	1.2	97.5	89.4	0 acres
Achieved Weighted-Average	278	0.49	68.7	62.6	0 % of area
South Basin Area X				Delete	115,317 cubic yards
Do-Not-Exceed Criterion	1200	2	270		103 polygons
Maximum Remaining	1133.958	1.4	138	270	36 acres
Achieved Weighted-Average	386	0.51	76.8	59.1	56 % of area
Point Avisadero Area III				Delete	25,040 cubic yards
Do-Not-Exceed Criterion	1200	2	270		91 polygons
Maximum Remaining	1023.758	1.5776	221	161	8 acres
Achieved Weighted-Average	123	0.5	68.5	32.8	35 % of area
Eastern Wetland Area VIII				Delete	0 cubic yards
Do-Not-Exceed Criterion	1200	2	270		0 polygons
Maximum Remaining	545.49	0.8	58.7	52	0 acres
Achieved Weighted-Average	31.1	0.45	49	38.5	0 % of area
India Basin Area I				Delete	0 cubic yards
Do-Not-Exceed Criterion	1200	2	270		0 polygons
Maximum Remaining	111.24	0.55	117	126	0 acres
Achieved Weighted-Average	40.6	0.37	53.9	33.4	0 % of area

Comment:

Criteria / SUF Calculation Mode
- Allow any criteria, ignore SUF
- Use SUF below to set all criteria

Site Use Factor (0.5 - 1.0): 0.5

Depth
- 0 - 1 ft bgs
- 0 - 2 ft bgs

Previous | Next | New | Delete | Save | Recalculate | Map | Jump to: | Exit

As distributed, the model includes two scenarios: one showing a cleanup scenario using cleanup criteria derived from a site-use factor (SUF) of 0.5 applied to sample data from the top 2 feet of sampling locations; and the second showing a preremediation scenario (that is, starting conditions.) Click the Next and Previous buttons to toggle between these existing scenarios. You may also click a button to create a New to or Delete an existing scenario.

An existing scenario may be modified in a number of ways. Do-not-exceed criteria may be changed in one of two modes set by the tool in the lower part of the interface labeled "Criteria/SUF Calculation Mode." When set to use the SUF, a user enters a number between 0.5 and 1.0 into the SUF box and clicks "Recalculate." Do-not-exceed criteria are derived from the SUF and applied to each subarea, and the remediated volume and area calculated. Alternatively, the mode may be switched to allow any criteria, and custom do-not-exceed criteria may be entered into each box, for each subarea. Different criteria may be applied to each subarea. Leaving a criterion blank instructs the program to not apply any do-not-exceed criterion for that chemical and subarea.

The user may choose to change the depth the model should consider by toggling between 0 to 1 feet below ground surface (bgs) and 0 to 2 feet bgs. Changing from 0 to 1 to 0 to 2 feet bgs has two effects: (1) it doubles the factor by which the area is multiplied to derive the remediation volume; and (2) it includes samples collected from 0 to 2 feet bgs in determining the maximum concentration of each chemical for each polygon, rather than 0 to 1 feet bgs. This last effect can result in additional polygons being flagged for remediation, in cases where samples from 1 to 2 feet bgs are of higher concentration than those from 0 to 1 feet bgs.

Subareas can be removed from a scenario by clicking the blue Delete link in the subarea's section of the form. Additional subareas can be added by scrolling the list of subareas down to a blank entry and using the subarea dropdown to select the desired subarea. When a new scenario is created, it starts with no subareas.

Following any change to the input parameters, the user must click the Recalculate button or alternatively (if the GIS mapping interface is being used) the Map button.

The model returns the maximum remaining and achieved weighted average concentrations for each subarea, and, at the top, the achieved weighted average concentrations for all subareas included in the scenario. The model also returns the estimated remediation area and volume for each subarea, and, at the top, the summed remediation area and volume of all subareas.

To use the GIS mapping interface, open `HPS_Offshore_Modeling.mxd` in ArcGIS. After clicking the "Map" button in the database interface, return to ArcGIS and click the refresh (⟲) button once or twice, until the map displays the latest scenario results. The map will always display the last scenario for which the Map button was clicked. Remediated polygon areas are highlighted yellow, while unremediated polygons are shown as a grey outline only. If a subarea is not included in a scenario, it will not be shown in the map.

To exit the application, the user clicks the "Exit" button on the interface and Exit Database on the startup form.

If there are any questions regarding the application, or to report any bugs encountered, please contact Simon Cardinale at 505-881-3188 x107 or simon.cardinale@ttemi.com.

APPENDIX B
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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ACRONYMS AND ABBREVIATIONS

§	Section
ARAR	Applicable or relevant and appropriate requirement
BCDC	San Francisco Bay Conservation and Development Commission
Cal. Code Reg.	California Code of Regulations
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
ch.	Chapter
CTR	California Toxics Rule
div.	Division
DTSC	Department of Toxic Substances Control
EP	Extraction procedure
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
mg/kg	Milligram per kilogram
MOU	Memorandum of Understanding
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PCB	Polychlorinated biphenyl
ppm	Part per million
RCRA	Resource Conservation and Recovery Act
Res.	Resolution
SWRCB	State Water Resources Control Board
tit.	Title
USC	*United States Code*
Water Board	San Francisco Bay Regional Water Quality Control Board

B1.0 INTRODUCTION

This appendix identifies and evaluates potential federal and state of California applicable or relevant and appropriate requirements (ARAR) and sets forth the Navy's determinations of potential ARARs proposed for each remedial alternative discussed in this Feasibility Study (FS) for Parcel F at Hunters Point Shipyard in San Francisco, California. This evaluation includes (1) an initial determination of whether potential ARARs actually qualify as ARARs and (2) a comparison for stringency between the federal and state regulations to identify the controlling ARARs. The identification of ARARs is an iterative process. The final determination will be made by the Navy in the Record of Decision after public review of the Proposed Plan, as part of the response action selection process.

B1.1 SUMMARY OF COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT AND NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN REQUIREMENTS

Section (§) 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (Title 42 *United States Code* [USC] § 9621[d]), as amended, states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. The requirement is applicable if the jurisdictional prerequisites of the standard show a direct correspondence when objectively compared to the conditions at the site. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, then the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations similar to the circumstances of the proposed response action and are well suited to the conditions of the site (U.S. Environmental Protection Agency [EPA] 1988a). A requirement must be determined to be both relevant <u>and</u> appropriate to be considered an ARAR.

The following criteria for determining relevance and appropriateness are listed in Title 40 *Code of Federal Regulations* (CFR) § 300.400(g)(2).

- The purpose of the requirement and the purpose of the CERCLA action
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site
- The substances regulated by the requirement and the substances found at the CERCLA site
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site
- The type of place regulated and the type of place affected by the release or CERCLA action
- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site

According to CERCLA ARARs guidance, a requirement may be "applicable" or "relevant and appropriate," but not both (EPA 1988a). Identification of ARARs must be conducted on a site-specific basis and involves a two-part analysis. First, determine if a given requirement is applicable. Second, if the requirement is not applicable, determine if it is nevertheless both relevant and appropriate. It is important to explain that some regulations may be applicable or, if not applicable, may still be relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA 1988a).

Tables included in this appendix present each potential ARAR with a determination of status (that is, applicable or relevant and appropriate). For the determination of relevance and appropriateness, the pertinent criteria were examined to determine whether the requirements addressed problems or situations sufficiently similar to the circumstances of the release or response action contemplated, and whether the requirement was well suited to the site.

To qualify as a state ARAR under CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a state requirement must be:

- A state law;
- An environmental or facility siting law;
- Promulgated (of general applicability and legally enforceable);
- Substantive (not procedural or administrative);

- More stringent than the federal requirement;
- Identified in a timely manner; and
- Consistently applied.

To constitute an ARAR, a requirement must be substantive. Therefore, only the substantive provisions of requirements identified as ARARs in this analysis are considered to be ARARs. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and state statutes and regulations that were determined to be procedural or not environmental, including permit requirements, are not considered to be ARARs. CERCLA § 121(e)(1) (42 USC § 9621[e][1]), states that, "No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with this section." The term "on site" is defined for purposes of this ARARs discussion as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (40 CFR § 300.5).

Nonpromulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. However, such requirements may be useful, and are "to-be-considered" criteria (40 CFR § 300.400[g][3]). To-be-considered criteria complement ARARs but do not override them. They are useful for guiding decisions on cleanup levels or methodologies when regulatory standards are not available.

Pursuant to EPA guidance, ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific (EPA 1988a). These categories were developed to aid identification of ARARs; some ARARs do not fall precisely into one group or another. ARARs are identified on a site basis for remedial actions where CERCLA authority is the basis for cleanup.

As the lead federal agency, the Navy has primary responsibility for identifying federal ARARs at Hunters Point Shipyard. Federal ARARs have been identified for Parcel F in the FS Report and are discussed in this appendix. Pursuant to the definition of the term "on site" in 40 CFR § 300.5, the on-station areas that are part of this action include Parcel F.

Identification of potential state ARARs was initiated through a Navy request to the San Francisco Bay Regional Water Quality Control Board (Water Board) dated November 15, 2005 (see Attachment B1). The state identification process is described in more detail in Section B1.2.3. State ARARs identified for Parcel F are discussed in this appendix.

B1.2 METHODOLOGY DESCRIPTION

This section describes the methods used to identify and evaluate federal and state ARARs.

B1.2.1 General

As the lead federal agency, the Navy has primary responsibility for identifying ARARs for Parcel F. In preparing this ARARs analysis, the Navy performed the following measures, consistent with CERCLA and the NCP.

- Identified federal ARARs for each remedial alternative
- Reviewed potential state ARARs identified by the state to determine whether they satisfy CERCLA and NCP criteria that must be met in order to constitute state ARARs
- Evaluated and compared federal ARARs and their state counterparts to determine whether state ARARs are more stringent than the federal ARARs or are in addition to the federally required actions
- Reached a conclusion as to which federal and state ARARs are the most stringent and "controlling" ARARs for each alternative

As outlined in Section 2.0 of the FS Report for Parcel F, the remedial action objectives are:

1. Reduce the risk of benthic feeding and piscivorous birds, including surf scoters, to acceptable levels from exposure to copper, mercury, and polychlorinated biphenyls (PCB) through consumption of contaminated prey and incidental ingestion of sediment.
2. Limit or reduce the potential risk to human health from consumption of shellfish from Parcel F.
3. Limit or reduce the potential biomagnifications of total PCBs at higher trophic levels in the food chain to reduce the potential risk to human health from consumption of sport fish.

For Parcel F, sediment was identified as the media of interest based on potential risks to ecological and human receptors. The following remedial alternatives are evaluated in the FS Report.

- Alternative 1: No Action
- Alternative 2: Removal and Off-Site Disposal
- Alternative 3A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls

- Alternative 3B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls

- Alternative 4A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 4B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 5A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls

- Alternative 5B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls

B1.2.2 Identifying and Evaluating Federal Applicable or Relevant and Appropriate Requirements

The Navy is responsible for identifying federal ARARs as the lead federal agency under CERCLA and the NCP. The final determination of federal ARARs will be made when the Navy issues the Record of Decision. The federal government implements a number of environmental statutes that are the source of potential federal ARARs, either in the form of the statutes themselves or as regulations promulgated thereunder. Examples include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and their implementing regulations, to name a few. See NCP preamble at Title 55 *Federal Register* (FR) §§ 8764 through 8765 for a more complete listing (EPA 1990).

The proposed remedial alternatives were reviewed against all potential ARARs, including but not limited to those set forth at 55 FR §§ 8764 through 8765 (EPA 1990), to determine if they were applicable or relevant and appropriate, using CERCLA and NCP criteria and procedures for ARARs identification by lead federal agencies.

B1.2.3 Identifying and Evaluating State Applicable or Relevant and Appropriate Requirements

This section describes the process of identifying and evaluating potential state ARARs by the state of California and the Navy.

B1.2.3.1 Solicitation of State ARARs under NCP

EPA guidance recommends that the lead federal agency consult with the state when identifying state ARARs for remedial actions (EPA 1988b). In essence, CERCLA and NCP requirements in

40 CFR § 300.515 for remedial actions provide that the lead federal agency request that the state identify chemical- and location-specific state ARARs when site characterization is complete. The requirements also provide that the lead federal agency request identification of all categories of state ARARs (chemical-, location-, and action-specific) upon completion of identification of remedial alternatives that have been retained for detailed analysis. The state must respond within 30 days of receipt of the lead federal agency requests.

The Navy followed the procedures of the process set forth in 40 CFR § 300.515 and § 7.6 of the Federal Facility Agreement for remedial actions in seeking state of California assistance in identifying state ARARs. The following subsections document the Navy's efforts to date to identify and evaluate state ARARs for Parcel F at Hunters Point Shipyard.

B1.2.3.2 Chronology of Efforts to Identify State ARARs

The Navy formally requested state chemical-, location-, and action-specific ARARs for Parcel F in a letter dated November 15, 2005 (see Attachment B1). The letter was sent to the Water Board. The Department of Toxic Substances Control (DTSC) then requested state ARARs from the California Department of Fish and Game (CDFG) and the San Francisco Bay Conservation and Development Commission (BCDC) based on preliminary remedial technologies and process options considered by the Navy.

The Water Board responded to the Navy's request in a letter dated January 9, 2006 (see Attachment B1). DTSC responded to the Navy's request on February 2, 2006, which consisted of ARARs from the CDFG and BCDC. The Navy evaluated the Water Board, CDFG, and BCDC's ARARs and assessed whether any of the laws and regulations cited satisfied the CERCLA and NCP criteria required to be considered state ARARs. Based on the assessment, the Navy updated the list of state ARARs in this appendix. For this FS Report, the Navy selected ARARs, including state of California ARARs, that are appropriate for its remedial action decision. Key correspondence between the Navy and the state agencies relating to this effort is and will be included in the Administrative Record for Parcel F.

B1.3 OTHER GENERAL ISSUES

This section discusses general issues identified during the evaluation of ARARs for Parcel F.

B1.3.1 General Approach to Requirements of the Federal Resource Conservation and Recovery Act

RCRA is a federal statute passed in 1976 to meet four goals: (1) the protection of human health and the environment, (2) the reduction of waste, (3) the conservation of energy and natural resources, and (4) the elimination of the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments of 1984 significantly expanded the scope of RCRA by adding new corrective action requirements, land disposal restrictions, and technical requirements. RCRA, as amended, contains several provisions that are potential ARARs for CERCLA sites.

Substantive RCRA requirements are applicable to response actions on CERCLA sites if the waste is an RCRA hazardous waste, and either:

- The waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; or
- The activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA (EPA 1988a).

The preamble to the NCP indicates that state regulations that are components of a federally authorized or delegated state program are generally considered federal requirements and potential federal ARARs for the purposes of the ARARs analysis (55 FR §§ 8666, 8742 [1990]). The state of California received approval for its military base RCRA hazardous waste management program on July 23, 1992 (57 FR § 32726 [1992]). The state of California "Environmental Health Standards for the Management of Hazardous Waste," set forth in *California Code of Regulations* (Cal. Code Regs.) Title (tit.) 22, Division (div.) 4.5, were approved by EPA as a component of the federally authorized state of California RCRA program. On September 26, 2001, California received final authorization of its revised State Hazardous Waste Management Program by the EPA (66 FR § 49118 [2001]).

As a result, the regulations of Cal. Code Regs. tit. 22, div. 4.5 are a source of potential federal ARARs for CERCLA response actions. The exception is when a state regulation is "broader in scope" than the corresponding federal RCRA regulations. In that case, such regulations are not considered part of the federally authorized program or potential federal ARARs. Instead, these regulations are purely requirements of state law and therefore are potential state ARARs.

The EPA July 23, 1992, notice approving the state of California RCRA program (57 FR § 32726 [1992]) specifically indicated that the state regulations addressed certain non-RCRA, state-regulated hazardous wastes that fell outside the scope of federal RCRA requirements. Cal. Code Regs. tit. 22, div. 4.5 requirements would be potential state ARARs for such non-RCRA, state-regulated wastes.

A key threshold question for the ARARs analysis is whether chemicals at Parcel F constitute federal hazardous waste as defined under RCRA and the state's authorized program or qualify as non-RCRA, state-regulated hazardous waste.

B1.4 WASTE CHARACTERIZATION

This section describes the selection of ARARs involving characterization of wastes.

B1.4.1 Resource Conservation and Recovery Act Hazardous Waste Determination

Federal RCRA hazardous waste determination is necessary to determine whether RCRA requirements at Cal. Code Regs. tit. 22, div. 4.5 and other state requirements at Cal. Code Regs. tit. 23, div. 3, Chapter (ch.) 15 are applicable. The first step in the RCRA hazardous waste characterization process is to evaluate contaminated media at the site and determine whether it constitutes a "listed" RCRA waste. The preamble to the NCP states that "...it is often necessary to know the origin of the waste to determine whether it is a listed waste and that, if such documentation is lacking, the lead agency may assume it is not a listed waste" (55 FR §§ 8666 and 8758 [1990]).

This approach is confirmed in EPA guidance for CERCLA Compliance with Other Laws (EPA 1989), as follows:

> "To determine whether a waste is a listed waste under RCRA, it is often necessary to know the source. However, at many Superfund sites, no information exists on the source of wastes. The lead agency should use available site information, manifests, storage records, and vouchers in an effort to ascertain the nature of these contaminants. When this documentation is not available, the lead agency may assume that the wastes are not listed RCRA hazardous wastes, unless further analysis or information becomes available that allows the lead agency to determine that the wastes are listed RCRA hazardous wastes."

Based on the available information, it is not possible to determine the source of chemicals in sediment for RCRA-listed waste purposes. Therefore, the Navy determined that the presence of metals, pesticides, and PCBs should not necessarily cause contaminated sediment from Parcel F at Hunters Point Shipyard to be classified as RCRA-listed hazardous wastes. Consequently, residuals generated during treatment of contaminated sediment at Parcel F would not be classified as RCRA-listed hazardous wastes.

The second step in the RCRA hazardous waste characterization process is to evaluate potential hazardous characteristics of the waste. The evaluation of characteristic waste is described in EPA guidance, as follows (EPA 1988a).

> "Under certain circumstances, although no historical information exists about the waste, it may be possible to identify the waste as RCRA characteristic waste. This is important in the event that (1) remedial alternatives under consideration at the site involve on-site treatment, storage, or disposal, in which case RCRA may be triggered as discussed in this section; or (2) a remedial alternative involves off-site shipment. Since the generator (in this case, the agency or responsible party conducting the Superfund action) is responsible for determining whether the wastes exhibit any of these characteristics (defined in 22 Cal. Code Regs. Sections 66261.21–66261.24), testing may be required. The lead agency must use best

professional judgment to determine, on a site-specific basis, if testing for hazardous characteristics is necessary.

In determining whether to test for the toxicity characteristic using the extraction procedures (EP) toxicity test, it may be possible to assume that certain low concentrations of waste are not toxic. For example, if the total waste concentration in soil is 20 times or less the EP toxicity concentration, the waste cannot be characteristic hazardous waste. In such a case, RCRA requirements would not be applicable. In other instances, where it appears that the substances may be characteristic hazardous waste (ignitable, corrosive, reactive, or EP toxic), testing should be performed."

Hazardous waste characteristics, as defined in 40 CFR §§ 261.21 through 261.24, are commonly referred to as ignitability, corrosivity, reactivity, and toxicity. California environmental health standards for the management of hazardous waste set forth in Cal. Code Regs. tit. 22, div. 4.5 were approved by EPA as a component of the federally authorized California RCRA program. Therefore, the characterization of RCRA waste is based on the state of California requirements.

The characteristics of ignitability, corrosivity, reactivity, and toxicity are defined in Cal. Code Regs. tit. 22, §§ 66261.21 through 66261.24. According to Cal. Code Regs. tit. 22, § 66261.24(a)(1)(A), "A waste that exhibits the characteristic of toxicity pursuant to subsection (a)(1) of this section has the EPA Hazardous Waste Number specified in Table I of this section which corresponds to the toxic contaminant causing it to be hazardous." Table I assigns hazardous waste codes beginning with the letter "D" to wastes that exhibit the characteristic of toxicity; D waste codes are limited to "characteristic" hazardous wastes.

According to Cal. Code Regs. tit. 22, § 66261.10, waste characteristics can be measured by an available standardized test method or be reasonably detected by generators of waste based on their knowledge of the waste. Sediment contamination at Parcel F at Hunters Point Shipyard is not ignitable, corrosive, or reactive, as defined in Cal. Code Regs. tit. 22, §§ 66261.21 through 66261.23. This determination was based on knowledge of the nature and concentrations of chemicals and on professional judgment.

The requirements at Cal. Code Regs. tit. 22, § 66261.24(a)(1) list the chemical concentrations that determine the characteristic of toxicity. Sediment excavated from Parcel F will be sampled and analyzed to determine if it is toxic under this regulation. Therefore, the Navy has selected Cal. Code Regs. tit. 22, § 66261.24(a)(1) as a potential ARAR.

B1.4.2 Toxic Substances Control Act Requirements for Waste Characterization

Sampling and analysis is necessary to determine whether soil and sediment containing PCBs is subject to the federal Toxic Substances Control Act requirements at 40 CFR § 761.61. In the definitions under 40 CFR § 761.3, "PCB remediation waste" is defined as waste that contains PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations:

- Material disposed of before April 18, 1978, that currently contains a PCB concentration of 50 parts per million (ppm) (or 50 milligrams per kilogram [mg/kg]), regardless of the concentration of the original spill.

- Materials currently at any volume or concentration where the original source was 500 ppm (or 500 mg/kg) of PCBs, beginning on April 18, 1978, or 50 ppm (or 50 mg/kg), beginning on July 2, 1979.

- Materials currently at any concentration if the PCBs are spilled or released from a source that is not authorized for use under this part.

PCB remediation waste means soil, rags, and other debris generated as a result of PCB spill cleanup.

The Navy determined that 40 CFR § 761.61(a)(4)(i) is an ARAR. However, the Navy has agreed to more stringent remediation goals for PCBs in sediment at Parcel F because of the parcel's proximity to endangered species habitats, estuaries, and wetlands as provided under 40 CFR § 761.61(a)(4)(vi). The lower remediation goal was based on the results of the ecological risk assessment conducted for this site. Concentrations of PCBs in excavated sediment will be measured to comply with the substantive requirements of 40 CFR § 761.61(a)(4)(i).

B1.4.3 California-Regulated, Non-Resource Conservation and Recovery Act Hazardous Waste

A waste determined not to be a RCRA hazardous waste may still be considered a state-regulated, non-RCRA hazardous waste. The state of California's RCRA program is broader in scope for determining hazardous waste than the federal program. Cal. Code Regs. tit. 22, § 66261.24(a)(2) lists the total threshold limit concentrations and the soluble threshold limit concentrations for non-RCRA hazardous waste. A waste is considered hazardous if its total concentrations exceed the total threshold limit concentrations or if the extract from the waste extraction test is equal to or greater than the soluble threshold limit concentration. A waste extraction test is required only when the total concentrations exceed the soluble threshold limit concentration but are less than the total threshold limit concentrations (Cal. Code Regs. tit. 22, §, div. 4.5, ch. 11, Appendix II [b]). The Navy determined that Cal. Code Regs. tit. 22, § 66261.24(a)(2) is an ARAR. Excavated and dredged sediment from Parcel F will be characterized to determine if it is state regulated, non-RCRA hazardous waste.

B1.4.4 Other California Waste Classifications

For waste discharged after July 18, 1997, solid waste classifications from the state of California in Cal. Code Regs. tit. 22, §§ 20210, 20220, and 20230 are used to determine the applicability of waste management requirements. These classifications are summarized below.

A "designated waste" under Cal. Code Regs. tit. 27, § 20210 is defined at *California Water Code* (Cal. Water Code) § 13173. Under Cal. Water Code § 13173, designated waste is hazardous waste that has been granted a variance from hazardous waste management requirements. Designated waste also may be nonhazardous waste that consists of or contains pollutants that, under ambient environmental conditions at a waste management unit, could be released in concentrations that would exceed applicable water quality objectives or that could reasonably be expected to affect beneficial uses of the waters of the state. The Navy determined that Cal. Code Regs. tit. 27, § 20210 is a potential ARAR.

A nonhazardous solid waste under Cal. Code Regs. tit. 27, § 20220 is defined as all putrescible and nonputrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, manure, vegetable or animal solid and semisolid wastes, and other discarded waste (whether of solid or semisolid consistency) provided that such wastes do not contain wastes that must be managed as hazardous wastes or wastes that contain soluble pollutants in concentrations that exceed applicable water quality objectives or could cause degradation of waters of the state. The Navy determined that Cal. Code Regs. tit. 27, § 20220 is a potential ARAR.

Under Cal. Code Regs. tit. 27, § 20230, inert waste is a subset of solid waste that (1) does not contain hazardous waste or soluble pollutants at concentrations exceeding applicable water quality objectives and (2) does not contain significant quantities of decomposable waste. Sediments from Parcel F that are not identified as hazardous will be characterized using these criteria to identify the appropriate disposal requirements. The Navy determined that Cal. Code Regs. tit. 27, § 20230 is a potential ARAR.

B2.0 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. Many potential ARARs associated with particular remedial alternatives (such as closure or discharge) can be characterized as action-specific but include numerical values or methodologies to establish them so they fit in both categories (chemical- and action-specific).

The sections below present the potential federal and state chemical-specific ARARs for sediment at Parcel F at Hunters Point Shipyard (see Table B-1).

B2.1 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SEDIMENTS

Both federal and state laws and regulations were reviewed to identify potential chemical-specific ARARs for sediment at Parcel F.

TABLE B-1: POTENTIAL FEDERAL AND STATE CHEMICAL-SPECIFIC[a] APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Requirement	Prerequisite	Citation[b]	Preliminary ARAR Determination	Comments
		SEDIMENT		
Federal Requirements				
Resource Conservation and Recovery Act (42 USC, ch. 82, §§ 6901 through 6991[i])[c]				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the toxicity characteristic leaching procedure, if the waste exceeds the toxicity characteristic leaching procedure maximum concentrations.	Waste	Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	Applicable for determining whether waste is hazardous.
Toxic Substances Control Act (15 USC, ch. 53, §§ 2601 through 2692)[c]				
Regulates storage and disposal of PCBs.	Soil, debris, sludge or dredged materials contaminated with PCBs	PCB remediation waste cleanup standards, 40 CFR § 761.61 (a)(4)(i)	Relevant and appropriate	The cleanup goal for bulk remediation waste in high-occupancy areas is less than or equal to 1 ppm (or 1 mg/kg) without further conditions; in low-occupancy areas the cleanup level is less than or equal to 25 mg/kg. Under Toxic Substances Control Act, 40 CFR § 761.61(a)(4)(vi), more stringent cleanup levels may be required based on the proximity to areas such as endangered species habitats, estuaries, and wetlands. Based on the results of the ecological risk assessment conducted for this site, a lower remediation goal was selected.

TABLE B-1: POTENTIAL FEDERAL AND STATE CHEMICAL-SPECIFIC[a] APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Requirement	Prerequisite	Citation[b]	Preliminary ARAR Determination	Comments
		SEDIMENT (Continued)		
State Requirements				
State and Regional Water Quality Control Boards[c]				
Definition of "non-RCRA hazardous waste"	Waste	Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)–(a)(8), 66261.101, 66261.3(a)(2)(C), or 66261.3(a)(2)(F)	Applicable	Applicable for determining whether a waste is a non-RCRA hazardous waste.
Definitions of designated waste, nonhazardous waste, and inert waste	Waste	Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20230	Applicable	Potential ARAR for classifying waste. These soil classifications determine state classification and siting requirements for discharging waste to land.
		SURFACE WATER		
Federal Requirements				
Discharges to waters of the United States	Impact to surface water	Water Quality Standards, National Toxics Rule and California Toxics Rule 40 CFR § 131.36(b) and 131.38	Applicable	Potentially applicable to the discharge of PCBs to surface water expected during dredging. Not an ARAR for cleanup of the sediment at Parcel F because surface water is not the medium of concern.
State and Regional Water Quality Control Boards[c]				
Beneficial use of surface water in San Francisco Bay. Establishes water quality objectives including narrative and numerical standards.	Impact to surface water	Comprehensive Water Quality Control Plan for the San Francisco Bay (Cal. Water Code § 13240) Chapter 2 Beneficial Uses Chapter 3 Water Quality Objectives for turbidity and dissolved oxygen, and Basin Plan Table 3-3	Applicable	Substantive requirements pertaining to beneficial uses and water quality objectives for turbidity and dissolved oxygen are potentially applicable during dredging activities. Not an ARAR for sediment cleanup because surface water is not the medium of concern.

TABLE B-1: POTENTIAL FEDERAL AND STATE CHEMICAL-SPECIFIC[a] APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Notes:

a	Many potential action-specific ARARs contain chemical-specific limitations and are addressed in the Table B-2, Potential Action-Specific ARARs.
b	Only the substantive provisions of the requirements cited in this table are potential ARARs.
c	Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of specific citations are considered potential ARARs.
§	Section
ARAR	Applicable or relevant and appropriate requirement
Cal. Code Regs.	*California Code of Regulations*
CFR	*Code of Federal Regulations*
ch.	Chapter
mg/kg	Milligram per kilogram
PCB	Polychlorinated biphenyl
ppm	Part per million
RCRA	Resource Conservation and Recovery Act
USC	*United States Code*

B2.1.1 Federal Chemical-Specific Applicable or Relevant and Appropriate Requirements

Sediment is the medium of concern at Parcel F. Other than RCRA hazardous waste classification requirements, there are no chemical-specific ARARs establishing cleanup levels for sediments. The Navy will use the site-specific remediation goals developed for concentrations of copper, mercury, and total PCBs in sediment at Parcel F at Hunters Point Shipyard. The federal chemical-specific ARARs identified for sediment at Parcel F are summarized in the following text.

Resource Conservation and Recovery Act

The key threshold question for potential sediment ARARs is whether the wastes located at Parcel F would be classified as hazardous waste. Sediment may be classified as a federal hazardous waste as defined by RCRA and the state-authorized program, or as non-RCRA, state regulated hazardous waste. If sediments are determined to be hazardous waste, the appropriate requirements will apply.

EPA and the states have not developed criteria for the protection of human or ecological receptors in sediments. While EPA proposed national sediment criteria in 1998 to set pollution thresholds that chemical concentrations in sediments could not exceed, those criteria were withdrawn after consultation with the U.S. Army Corps of Engineers. Accordingly, the only potential federal ARARs for sediments are RCRA hazardous waste and land disposal restrictions. The applicability of RCRA requirements depends on whether (1) the sediments contain listed or characteristic RCRA hazardous waste; (2) the waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; and (3) the activity at the site constitutes generation, treatment, storage, or disposal as defined by RCRA.

Excavation of sediments containing RCRA hazardous waste constitutes generation of waste, to which RCRA requirements may apply. RCRA requirements may also be relevant and appropriate even if they are not applicable. Examples include activities that are similar to the definition of RCRA treatment, storage, and disposal for waste that is similar to RCRA hazardous waste.

The determination of whether a waste is a RCRA hazardous waste can be made by comparing the site waste to the definition of RCRA hazardous waste. The RCRA requirements Cal. Code Regs. tit. 22, §§ 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are potential chemical-specific ARARs because they define RCRA hazardous waste. A waste can meet the definition of hazardous waste if it has the toxicity characteristic of hazardous waste. This determination is made by using the toxicity characteristic leaching procedure. The maximum concentrations allowable for the toxicity characteristic leaching procedure listed in Cal. Code Regs. tit. 22, § 66261.24(a)(1)(B) are potential federal ARARs for determining whether the site has hazardous waste. If the site waste has concentrations exceeding the maximum concentrations, it is determined to be a characteristic RCRA hazardous waste.

Toxic Substances Control Act

The federal chemical-specific ARARs for PCBs are in regulations adopted pursuant to the Toxic Substances Control Act. The Toxic Substances Control Act regulates storage and disposal of PCBs. EPA designed self-implementing procedures for a general, moderate-size site where residual environmental impact from remedial actions should be low. The requirements at 40 CFR § 761.61(a) are not binding for response actions under CERCLA (40 CFR § 761.61[a][1][ii]) and are therefore not applicable requirements. However, the substantive cleanup goals at 40 CFR § 761.61(a)(4) may be relevant and appropriate for soil and sediment response actions. Under 40 CFR § 761.61(a)(4)(i)(A), the cleanup goal for bulk PCB remediation waste in high-occupancy areas is less than or equal to 1 ppm (or 1 mg/kg) without further conditions. The cleanup goal for bulk PCB remediation waste in low-occupancy areas is less than or equal to 25 ppm (or 25 mg/kg) under 40 CFR § 761.61(a)(4)(i)(B)(1).

Under 40 CFR § 761.3, "PCB remediation waste" is defined as waste that contains PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations:

- Materials disposed of before April 18, 1978, that are currently at concentrations of 50 ppm (or 50 mg/kg) of PCBs, regardless of the concentration of the original spill.
- Materials that are currently at any volume or concentration where the original source was 500 ppm (or 500 mg/kg) of PCBs beginning on April 18, 1978, or 50 ppm (or 50 mg/kg) of PCBs beginning on July 2, 1979.
- Materials that are currently at any concentration if PCBs are spilled or released from a source not authorized for use under this part.

PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup. "High-occupancy" areas are areas such as residences, schools, and day-care centers where people spend at least 16.8 hours a week. "Low-occupancy" areas are areas such as electrical substations or locations in an industrial facility where a worker spends small amounts of time, which is less than 7 hours per week. Although these regulations may not be applicable because current concentrations are less than 50 ppm (or 50 mg/kg) and the concentrations of the original spill are unknown, the Navy has nevertheless concluded that these regulations are relevant and appropriate because similar substances are found at the site.

Based on the Toxic Substances Control Act, the cleanup goal for sediment would be 25 mg/kg because Parcel F is a low-occupancy area. However, according to the Toxic Substances Control Act [40 CFR § 761.61(a)(4)(vi)], more stringent cleanup goals may be required based on the proximity to areas such as endangered species habitats, estuaries, and wetlands. The level of 25 ppm (or 25 mg/kg) is not sufficiently protective of ecological receptors at Parcel F; therefore, site-specific remediation goals protective of ecological receptors were developed.

B2.1.2 State Applicable or Relevant and Appropriate Requirements

State RCRA requirements included within the EPA-authorized RCRA program for California are considered to be potential federal ARARs and are discussed above in Section B2.1.1. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. State requirements such as the non-RCRA, state-regulated hazardous waste requirements may be potential state ARARs because they are not within the scope of the federal ARARs (57 FR § 60848). Cal. Code Regs. tit. 22, div. 4.5 requirements that are part of the state-approved RCRA program would be potential state ARARs for non-RCRA, state-regulated hazardous wastes.

The site waste characteristics need to be compared to the definition of non-RCRA, state-regulated hazardous waste. The non-RCRA, state-regulated waste definition requirements at Cal. Code Regs. tit. 22, §§ 66261.22(a)(3) and (4), 66261.24(a)(2)-(a)(8), 66261.101, 66261.3(a)(2)(C), or 66261.3(a)(2)(F) are potential state ARARs for determining whether other RCRA requirements are potential state ARARs. Cal. Code Regs. tit. 22, § 66261.24(a)(2) lists the total threshold limit concentrations and soluble threshold limit concentrations. The site waste may be compared to these thresholds to determine if it meets the characteristics for a non-RCRA, state-regulated hazardous waste.

Cal. Code Regs. tit. 27, §§ 20210, 20220 and 20230 are state definitions for designated waste and nonhazardous waste. These may be potential ARARs for sediment that meets the definitions. These classifications determine state classification and siting requirements for discharging waste to land.

The Water Board identified State Water Resources Control Board (SWRCB) Resolutions (Res.) 88-63, 92-49 and 68-16 as ARARs for this FS Report. Groundwater is not a medium of concern at Parcel F; therefore, no groundwater requirements are ARARs for this FS Report. Furthermore, as discussed below, it is the Navy's position that Res. 92-49 and 68-16 are not ARARs.

SWRCB Resolutions 92-49 and 68-16

SWRCB Res. 92-49 (as amended on April 21, 1994, and October 2, 1996) is titled "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under California Water Code § 13304." This resolution contains policies and procedures for the regional boards that apply to all investigations and cleanup and abatement activities for all types of discharges subject to Cal. Water Code § 13304.

SWRCB Res. 68-16, "Statement of Policy With Respect to Maintaining High Quality of Waters in California," establishes the policy that high-quality waters of the state "shall be maintained to the maximum extent possible" consistent with the "maximum benefit to the people of the state." It provides that whenever the existing quality of water is better than the required applicable water quality policies, such existing high-quality water will be maintained until it has been

demonstrated to the state that any change will be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies. It also states that any activity that produces or may produce a waste or increased volume or concentration of waste and that discharges or proposes to discharge to existing high-quality waters will be required to meet waste-discharge requirements that will result in the best practicable treatment or control of the discharge necessary to assure that (1) pollution or a nuisance will not occur and (2) the highest water quality consistent with maximum benefit to the people of the state will be maintained.

Cleanup to below background water quality conditions is not required by SWRCB under the Porter-Cologne Water Quality Control Act. SWRCB Res. 92-49 II.F.1 provides that the regional boards may require cleanup and abatement to "conform to the provisions of the Resolution No. 68-16 of the State Water Board, and the Water Quality Control Plans of the State and Regional Water Quality Control Boards, provided that under no circumstances shall these provisions be interpreted to require cleanup and abatement, which achieves water quality conditions that are better than background conditions."

Navy's Position Regarding SWRCB Resolutions 92-49 and 68-16

The Navy and the State of California have not agreed whether the SWRCB Res. 92-49 and Res. 68-16 are ARARs for the remedial action at Parcel F. Therefore this FS Appendix documents each party's position but does not attempt to resolve the issue.

The Navy has also determined that SWRCB Res. 68-16 is not a chemical-specific ARAR for determining remedial action goals. However SWRCB Res. 68-16 is a potential action-specific ARAR for regulating new discharges such as discharges to surface water during dredging and dewatering activities. The Navy has determined that potential migration of sediment is not a discharge governed by the language of 68-16. More specifically, the language of SWRCB Res. 68-16 indicates that it is prospective in intent, applying to new discharges in order to maintain existing high-quality waters. It is not intended to apply to restoration of waters that are already degraded.

The substantive provisions of SWRCB Res. 92-49 at Section III.G. state that the Water Board shall "ensure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water cannot be restored." Surface water is not a medium of concern addressed by this remedial action for the sediments at Parcel F. Therefore, Res. 92-49 is not a potential ARAR; however, the cleanup levels agreed to by the Navy and oversight Agencies, including the Water Board, are consistent with the requirements of SWRCB Res 92-49.

State of California's Position Regarding SWRCB Resolutions 92-49 and 68-16

The state does not agree with the Navy's determination that SWRCB Res. 92-49 and 68-16 and certain provisions of Cal. Code Regs. tit. 23, div. 3, ch. 15 are not ARARs for this response action. SWRCB has interpreted the term "discharges" in the Cal. Water Code to include the movement of waste from soils to groundwater and from contaminated to uncontaminated water (SWRCB 1994). The Water Board asserts that SWRCB Res. 68-16 and 92-49 are ARARs for determining sediment cleanup levels. However, the State agrees that the remedial alternatives will comply with SWRCB Res. 92-49 and Res. 68-16.

Whereas the Navy and the State of California have not agreed on whether SWRCB Res. 92-49 and 68-16 and Cal. Code Regs. tit. 23, § 2550.4 are ARARs for this response action, this FS Report documents each of the parties' positions on the resolutions but does not attempt to resolve the issue.

B2.2 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SURFACE WATER

Both federal and state laws and regulations were reviewed to identify potential chemical-specific ARARs for surface water at Parcel F.

B2.2.1 Federal Chemical-Specific Applicable or Relevant and Appropriate Requirements

Surface water is not a medium of concern in this FS Report. However, the California Toxics Rule (CTR) is a potential ARAR in the event any remedial action results in a release of chemicals into the surface water.

EPA promulgated a rule on May 18, 2000, to fill a gap in California water quality standards that was created in 1994 when a state court overturned the state's water quality control plans that contained water quality criteria for priority toxic pollutants. The rule is commonly called the CTR. The rule is codified at 40 CFR § 131.38. These federal criteria are legally applicable in the state of California for inland surface waters and enclosed bays and estuaries for all purposes and programs under the Clean Water Act. The water quality standards at 40 CFR § 131.38 are potential applicable federal ARARs for discharges to surface water. The Navy has identified the CTR as potential ARAR for any discharge to the Bay which may occur as part of any remedial action.

B2.2.2 State Chemical-Specific Applicable or Relevant and Appropriate Requirements

Comprehensive Water Quality Control Plan for the San Francisco Bay Region

The Navy has determined that substantive provisions of the following sections of the Comprehensive Water Quality Control Plan for the San Francisco Bay Region (Basin Plan) are potential ARARs for surface water at Parcel F at Hunters Point Shipyard (Water Board 1995).

- Definitions of beneficial uses
- Present and potential beneficial uses of surface waters

In Chapter 3, Table 3-3, of the Basin Plan, the Water Board established water quality objectives for 12 chemicals in surface water with salinities greater than 5 parts per thousand (or micrograms per kilogram) (Water Board 1995). These standards apply to all estuarine waters within the region, except for the South Bay below Dumbarton Bridge. These standards apply to the Bay, which meets the salinity threshold. These standards were identified by the Water Board as potential state ARARs. The Navy has identified Table 3-3 of the Basin Plan as a potential ARAR for any discharge to surface water. The Navy will ensure that any water discharged to the Bay meets the standards promulgated in Table 3-3 of the Basin Plan.

The medium of concern in this FS Report is sediment, and no remedial action is proposed for surface water. The sediment remedial action is likely to result in discharges to surface water; therefore, potential federal and state ARARs were identified for surface water. Chemicals of concern at Parcel F include copper, mercury, and total PCBs. Therefore, surface water ARARs were identified for these chemicals of concern that may be associated with sediment actions that could result in discharges to surface water (see Table B-1)

B3.0 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section identifies and discusses the location-specific ARARs. The discussions are presented based on various attributes of Parcel F.

Biological resources and coastal resources are the resource categories relating to location-specific requirements potentially affected by the remedial alternatives at Parcel F. The conclusions for ARARs pertaining to these resources are presented in the following sections. Table B-2 summarizes the evaluation of federal and state location-specific ARARs for excavation of contaminated sediments.

TABLE B-2: POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination[a]	Comments
Biological Resources – Federal Requirements					
Migratory Bird Treaty Act of 1972 (16 USC § 703 through 712)[b]					
Migratory bird area	Protects almost all species of native migratory birds in the United States from unregulated "take," which can include poisoning at hazardous waste sites.	Presence of migratory birds.	16 USC §703	Relevant and appropriate	The substantive portions are relevant and appropriate as migratory birds have been observed at the site.
Marine Mammal Protection Action (16 USC §§ 1361 through 1421h)					
Marine mammal area	Protects any marine mammal in the United States except as provided by international treaties from unregulated "take."	Presence of marine mammals	16 USC § 1362(a)(2)	Applicable	Marine mammals are known to be present near Parcel F, thus substantive provisions are potentially applicable if the selected response action constitutes a take.
Coastal Resources – Federal Requirements					
Coastal Zone Management Act (Title 16 USC §§ 1451 through 1464)[b]					
Within coastal zone	Conduct activities in a manner consistent with approved state management programs.	Activities affecting the coastal zone, including lands there under and adjacent shore land.	16 USC § 1456(c) 15 CFR Part 930	Relevant and appropriate	Potentially relevant because Parcel F is located on the coast
Hydrologic Resources – Federal Requirements					
Rivers and Harbors Act of 1899 (Title 33 USC §§ 401 through 413)[b]					
Navigable waters	Permits required for structures or work in or affecting navigable waters.	Activities affecting navigable waters.	33 USC § 403 33 CFR Part 322	Relevant and appropriate	The substantive provisions of this requirement are relevant and appropriate requirements for dredging and capping that may affect navigable waters.

TABLE B-2: POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination[a]	Comments
		Wetlands Protection – Federal Requirements			
Executive Order No. 11990, Protection of Wetlands [b]					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland meeting definition of Section 7.	40 CFR § 6.302(a)	Applicable	The substantive provisions of 40 CFR § 602(a) are applicable requirements for the response action. The Navy will minimize the effects to wetlands when implementing the response action.
Clean Water Act of 1988, as Amended, Section 404 (33 USC § 1344) [b]					
Wetland	Action to prohibit discharge of dredged of fill material into wetland without permit	Wetland as defined by Executive Order No. 11990 Section 7.	33 USC § 1344 33 CFR §§ 320.4 and 323 40 CFR § 230.10; 230.11; 230.20 through 230.25; 230.31; 230.32; 230.41; 230.42; 230.530	Applicable	The substantive provisions are applicable for the discharge of dredged or fill material to a wetland.
		Biological Resources – State Requirements			
Habitat for bird nests and eggs	Prohibits the take, possession or needless destruction of the nest or eggs of any bird,	Nests and eggs	Cal. Fish and Game Code § 3503	Applicable	The substantive provisions of this requirement are potential ARARs.
Habitat for Nongame birds	Prohibits the take of nongame birds.	Nongame birds.	Cal. Fish and Game Code § 3800	Applicable	The substantive provisions of this requirement are potential ARARs.
Nongame mammals	Prohibits the take or possession of nongame mammals.	Nongame mammals	Cal. Fish and Game Code § 4150	Applicable	The substantive provisions of this requirement are potential ARARs.

TABLE B-2: POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination[a]	Comments
Biological Resources – State Requirements (Continued)					
Habitat for mollusks, crustaceans, and invertebrates	Prohibits the take or possession unless expressly permitted, of mollusks, crustaceans, and invertebrates.	Mollusks, crustaceans, and invertebrates	Cal. Fish and Game Code § 8500	Applicable	The substantive provisions of this requirement are potential ARARs.
Coastal Resources – State Requirements					
Within the San Francisco Bay coastal zone	Reduce fill and disposal of dredged material in San Francisco Bay, maintain marshes and mudflats to the fullest extent possible to conserve wildlife, abate pollution, and protect the beneficial uses of the bay.	Activities affecting San Francisco Bay and 100 feet of the shoreline.	San Francisco Bay Plan at Cal. Code Regs. tit. 14, §§ 10110 through 11990	Relevant and appropriate	The remedial alternatives will comply to the extent possible with the substantive purposes of the San Francisco Bay Plan.
Wetlands Protection – State Requirements					
Waters of the State	Prohibits depositing in, permitting to pass into, placing where it can pass into waters of the state petroleum acid, coal, or any substance or material harmful to fish, plant life, or bird life.	Deposit of material harmful to fish, plant, or bird life.	Cal. Fish and Game Code § 5650(a)	Relevant and appropriate	The substantive provisions of § 5650(a) are relevant and appropriate.

Notes:

a Only the substantive provisions of the requirements cited in this table are potential ARARs.

b Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs.

§ Section
ARAR Applicable or relevant and appropriate requirement
Cal. California
CFR *Code of Federal Regulations*
Regs. Regulations
TBC To-be-considered
USC United States Code

B3.1 POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR BIOLOGICAL RESOURCES

Both federal and state laws and regulations were reviewed to identify potential location-specific ARARs for biological resources at Parcel F.

B3.1.1 Federal Location-Specific Applicable or Relevant and Appropriate Requirements

The substantive provisions of the following federal biological resources are potential ARARs identified by the Navy for sediment at Parcel F at Hunters Point Shipyard.

Migratory Bird Treaty Act of 1972

The Migratory Bird Treaty Act (16 USC §§ 703 through 712) prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird. This act also prohibits the possession, sale, export, and import of any migratory bird or any part of a migratory bird, as well as nests and eggs. A list of migratory birds for which this requirement applies is found at 50 CFR § 10.13. It is the Navy's position that this act is not legally applicable to Navy actions; however, Executive Order No. 13186 (dated January 10, 2001) requires each federal agency taking actions that have or are likely to have a measurable effect on migratory bird populations to develop and implement, within 2 years, a memorandum of understanding (MOU) with the United States Fish and Wildlife Service to promote the conservation of such populations. A MOU was signed in July 2006.

The response action by the Navy for Parcel F at the former Hunters Point Shipyard will comply with the substantive provisions of §§ 703 through 712 of the Migratory Bird Treaty Act.

Marine Mammal Protection Act (16 USC §§ 1361 through 1421h)

The Marine Mammal Protection Act (16 USC §§ 1361 through 1421h) prohibits the taking of a marine mammal on the high seas or in a harbor or other place under the jurisdiction of the United States. It prohibits the possession, transport, and sale of a mammal or marine mammal product, unless authorized under law. The prohibitions that are potentially pertinent to CERCLA actions are at 16 USC § 1372(a)(2).

The substantive provisions of the Marine Mammal Protection Act are potential ARARs, and any remedial action at Parcel F will comply with the act.

B3.1.2 State Location-Specific Applicable or Relevant and Appropriate Requirements

The substantive provisions of the following additional requirements are also potential state ARARs, which were identified by the CDFG.

- **Cal. Fish and Game Code § 3503:** Prohibits the take, possession, or needless destruction of the nest or eggs of any bird,
- **Cal. Fish and Game Code § 3800:** Prohibits the take of nongame birds.
- **Cal. Fish and Game Code § 4150:** Prohibits the take or possession of nongame mammals.
- **Cal. Fish and Game Code § 8500:** Prohibits the possessing or taking of mollusks, crustaceans, or other invertebrates.

B3.2 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR COASTAL RESOURCES

Federal laws and regulations limit activities within coastal areas or that may affect coastal resources.

B3.2.1 Federal Location-Specific Applicable or Relevant and Appropriate Requirements

The paragraphs below summarize the federal coastal resources ARARs identified for sediment at Parcel F.

Coastal Zone Management Act

Only the Coastal Zone Management Act was identified as a federal ARAR for coastal resources. The Coastal Zone Management Act (16 USC § 1451-1464) specifically excludes federal lands from the coastal zone (16 USC § 1453[1]). Therefore, the Coastal Zone Management Act is not potentially applicable, but it may be relevant and appropriate. However, § 1456(a)(1)(A) requires each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource to conduct its activities in a manner that is consistent to the maximum extent practicable with enforceable policies of approved state management policies. A state coastal zone management program is developed under state law guided by the Coastal Zone Management Act and its accompanying implementing regulations in 15 CFR Part 930. A state program sets forth objectives, policies and standards to guide public and private uses of lands and water in the coastal zone.

B3.2.2 State Location-Specific Applicable or Relevant and Appropriate Requirements

California's approved coastal management program includes the San Francisco Bay Plan (hereafter referred to as the "Bay Plan") developed by the San Francisco BCDC (2006). The BCDC was formed under the authority of the McAteer-Petris Act, *California Government Code* § 66600 et seq. and subsequent sections, which authorizes the Bay Conservation and Development Commission to regulate activities within San Francisco Bay and the shoreline (100 feet landward from the shoreline) in conformity with the policies of the Bay Plan. The McAteer-Petris Act and the Bay Plan were developed primarily to halt uncontrolled development and filling of the bay. Their broad goals include (1) reducing fill and disposal of dredged material in the bay, (2) maintaining marshes and mudflats to the fullest extent possible to conserve wildlife and abate pollution, and (3) protecting the beneficial uses of the bay. Any remedial action will comply with the substantive provisions of the San Francisco Bay Plan to the extent possible.

B3.3 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR HYDROLOGIC RESOURCES

The paragraphs below summarize the federal hydrologic resources ARARs identified for Parcel F.

B3.3.1 Federal Location-Specific Applicable or Relevant and Appropriate Requirements

Section 10 of the Rivers and Harbors Act of 1899 prohibits the creation of any obstruction not authorized by Congress to the navigable capacity of any of the waters of the United States (33 USC §§ 401 through 413). The Act prohibits construction of wharves, piers, booms, weirs, breakwaters, bulkheads, jetties, or other structures in a port unless the construction is approved by the U.S. Army Corps of Engineers. In addition, excavation or filling of any port, harbor, channel, lake or any navigable water is prohibited without authorization. Section 10 permits from the U.S. Army Corps of Engineers are required for these activities. Section 10 permits cover construction, excavation, or deposition of materials in, over, or under navigable waters; or any work that would affect the course, location, condition, or capacity of those waters. Implementing regulations for Section 10 permits are codified at 33 CFR Part 322. The Navy has selected the substantive provisions of 33 USC § 403 and 33 CFR Part 322 as ARARs for excavation of sediment to the extent excavation affects navigable waters.

B3.3.2 State Location-Specific Applicable or Relevant and Appropriate Requirements

No state ARARs were identified for hydrologic resources.

B.3.4 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR WETLANDS PROTECTION

Parcel F includes three marine habitats that blend with one another in transition zones: open water aquatic, intertidal wetland, and bay mudflats. The following requirements are potential location-specific ARARs for wetlands protection.

B3.4.1 Federal Location-Specific Applicable or Relevant and Appropriate Requirements

Protection of Wetlands, Executive Order No. 11990

Executive Order No. 11990 requires that federal agencies minimize the destruction, loss, or degradation of wetlands; preserve and enhance the natural and beneficial value of wetlands; and avoid support of new construction in wetlands if a practicable alternative exists.

While Executive Orders themselves are not ARARs, they constitute to-be-considered criteria guidance that should be followed in any response action. Executive Order 11990 is codified at 40 CFR § 6.302(a). The substantive portions of 40 CFR § 6.302(a) are potential ARARs for general response actions within a wetland. Adverse effects to wetlands will be minimized during the general response action to be conducted by the Navy at Parcel F.

Clean Water Act (33 USC § 1344)

Section 404 of the Clean Water Act of 1977 governs the discharge of dredged and fill material into the waters of the United States, including adjacent wetlands. Wetlands are areas that are inundated by water frequently enough to support vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, mudflats, natural ponds, and similar areas. Both EPA and the U.S. Army Corps of Engineers have jurisdiction over wetlands. EPA's Section 404 guidelines are promulgated in 40 CFR Part 230, and the U.S. Army Corps of Engineer's guidelines are promulgated in 33 CFR Part 320.

The Navy has selected the substantive requirements of 33 USC § 1344, and the substantive provisions of the following implementing regulations as potential ARARs for any dredging or filling of wetlands or waters by the Navy at Parcel F. :

- 33 CFR §§ 320.4 and 323
- 40 CFR § 230.10; 230.11; 230.20 through 230.25; 230.31; 230.32; 230.41; 230.42; 230.53

B3.4.2 State Location-Specific Applicable or Relevant and Appropriate Requirements

Cal. Fish and Game Code § 5650(a) states that it is unlawful to deposit in, permit to pass into, or place into the waters of the state any of the following, including but not limited to: petroleum, acid, coal or oil tar, lampblack, aniline, asphalt, bitumen, or residuary product of petroleum, or carbonaceous material or substance; or any substance or material harmful to fish, plant life, or bird life. The Navy has selected the substantive provisions of this section as potential location-specific ARARs for Parcel F.

B4.0 ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The Navy is evaluating the following remedial alternatives for sediment at Parcel F Hunters Point Shipyard.

- Alternative 1: No Action
- Alternative 2: Removal and Off-Site Disposal
- Alternative 3A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls
- Alternative 3B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls
- Alternative 4A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 4B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 5A: Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls
- Alternative 5B: Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Focused Removal, Activated Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls

B4.1 NO ACTION

There is no need to identify action-specific ARARs for the no-action alternative because ARARs apply only to "any removal or remedial action conducted entirely on-site," and "no action" is not a removal or remedial action (CERCLA § 121(e), 42 USC § 9621[e]). Cleanup goals for selection of a CERCLA remedy, including the requirement to meet ARARs, are not triggered by

the no-action alternative (EPA 1991). Therefore, a discussion of compliance with ARARs is not appropriate for this alternative.

B4.2 ALTERNATIVE 2: REMOVAL AND OFF-SITE DISPOSAL

The following action-specific ARARs were identified for Alternative 2. Table B-3 summarizes the potential federal and state action-specific ARARs for each component of Alternative 2.

B4.2.1 Dredging and Excavation

This section summarizes the potential federal and state action-specific ARARs identified for dredging and excavation of sediment at Parcel F.

B4.2.1.1 Federal Action-Specific ARARs

The potential federal action-specific ARARs identified for dredging and excavation of sediment from Parcel F are discussed below.

Resource Conservation and Recovery Act

- The requirement to determine if generated waste is hazardous waste at Cal. Code Regs. tit. 22, §§ 66262.10(a) and 66262.11
- The requirement to analyze generated waste to determine if it is hazardous at Cal. Code Regs. tit. 22, §§ 66264.13(a) and (b)
- Temporary staging pile requirements at 40 CFR §§ 264.554(a), (d), (g), (h), (i), (j), and (k)

Clean Water Act

In addition, the Navy has identified the following potential federal action-specific ARARs under the Clean Water Act for the excavation associated with this activity at Parcel F.

- Stormwater discharge requirements for construction that will disturb 1 or more acres at 40 CFR §§ 122.44(k)(2) and (4).

This regulation requires the use of best management practices to control or abate the discharge of pollutants when authorized under Clean Water Act § 402(p) to control stormwater discharges. Under the Clean Water Act and its implementing regulations, individual National Pollutant Discharge Elimination System permits or coverage under promulgated stormwater general permits is required for construction that disturbs at least 1 acre. The state of California has issued a stormwater general permit at Order Number 99-08-DWQ.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Dredging and Excavation					
Federal Requirements					
Resource Conservation and Recovery Act (42 USC, ch. 82, §§ 6901 through 6991[i])*					
On-site generation of waste	Person who generates waste shall determine if the waste is a RCRA hazardous waste.	Generator of waste	Cal. Code Regs. tit. 22, §§ 66262.10(a) and 66262.11	Applicable	These regulations are applicable to any operation that generates waste. The Navy will make the determination of whether the waste in RCRA hazardous waste at the time it is generated.
On-site generation of waste	Requirements for analyzing waste for determining whether waste is hazardous.	Generator of waste	Cal. Code Regs. tit. 22, §§ 66264.13(a) and (b)	Applicable	These regulations are applicable to any operation that generates waste. The Navy will make the determination of whether the waste in RCRA hazardous waste at the time it is generated.
Stockpiling sediment for off-site disposal	Allows generators to accumulate solid remediation waste in an EPA-designated pile for storage only up to 2 years during remedial actions without triggering land disposal restrictions.	RCRA hazardous waste temporarily stored in piles	40 CFR §§ 264.554(a), (d), (g), (h), (i), (j), and (k)	Relevant and appropriate	The Navy will temporarily stockpile soil in staging piles prior to off-site disposal. The Navy does not anticipate that all soil will be RCRA hazardous waste; however, the Navy has determined that these requirements are relevant and appropriate for all stockpiled soil.
Clean Water Act of 1988, as Amended, Section 404 (33 USC § 1344)*					
Discharge of water	Owners and operators of construction activities must be in compliance with discharge standards.	Discharge of waster	40 CFR §§ 122.44(k) (2) and (4)	Relevant and appropriate	The substantive requirement of 40 CFR Part 122 Subpart C will be followed in addressing discharges.
Discharge to surface water	Monitor the mass for each pollutant limited in the permit; the volume of effluent discharged from each outfall. Monitor according to test procedures approved under 40 CFR Part 136 for the analyses of pollutants having approved methods	Permit requirements under CWA 301(b)	40 CFR §122.44(i)(1)(iiv)	Relevant and appropriate	Substantive provisions are relevant and appropriate for the discharge of dewatering effluent. Specific discharge requirements will be provided in the remedial design.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Dredging and Excavation (Continued)					
Federal Requirements (Continued)					
Clean Water Act of 1988, as Amended, Section 404 (33 USC § 1344)*					
Discharge to surface water	Technology-based treatment requirements for permits.	Permit requirements under CWA 301(b)	40 CFR §125.3	Relevant and appropriate	Substantive provisions are relevant and appropriate for the discharge of dewatering effluent. Specific discharge requirements will be provided in the remedial design.
Toxic Substances Control Act (15 USC ch. 53, §§ 2601-2692)*					
Disposal of PCBs	Provides options for disposing of PCB remediation waste and requirements to implement each option.	Remedial actions involving PCBs	40 CFR § 761.61(a)(5)(i)(B)(2)(ii) and (iii)	Relevant and appropriate	Excavated sediment containing PCBs may be disposed of in accordance with the requirements of this regulation. The cleanup goal for bulk remediation waste in high occupancy areas is less than or equal to 1 ppm (or 1 mg/kg) without further conditions; in low-occupancy areas the cleanup goal is less than or equal to 25 mg/kg. Under the Toxic Substances Control Act, 40 CFR § 761.61(a)(4)(vi), more stringent cleanup goals may be required based on the proximity to areas such as endangered species habitats, estuaries, and wetlands. Based on the results of the ecological risk assessment conducted for this site, a lower remediation goal was selected.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Dredging and Excavation (Continued)					
Federal Requirements (Continued)					
Toxic Substances Control Act (15 USC ch. 53, §§ 2601 through 2692)*					
Storage of PCB remediation waste	Establishes requirements for storage of PCB remediation wastes released into the environment.	Storage of PCBs	40 CFR §§ 761.65(c)(4) and (c)(9)	Relevant and appropriate	Excavated sediment that contains PCBs may be stored on site up to 180 days. The storage area must have a liner, cover, and runon control system.
Decontamination standards for water containing PCBs	Establishes standards for the disposal of water used for decontamination of equipment used in excavation, storage, and treatment of PCB remediation waste.	Decontamination of water	40 CFR § 761.79(b)(1)	Relevant and appropriate	The decontamination standard for PCBs is less than 3 µg/L for water discharges to a publicly owned treatment works or to navigable waters or less than or equal to 0.5 µg/L PCBs for unrestricted use.
State Requirements					
State Water Resources Control Board					
Stormwater discharge	Establishes the state stormwater permit program and sets forth substantive conditions for construction sites larger than 1 acre.	Stormwater discharge	State Water Resources Control Board Order 99-08 adopted pursuant to 40 CFR Part 122, Subpart C	To be considered	Order 99-08-DQW applies to excavation activities that affect at least 1 acre. Pursuant to the substantive permit requirements, best management practices will be taken to prevent construction pollutants from contacting stormwater and keep erosions products from moving off site.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Dredging and Excavation (Continued)					
State Requirements (Continued)					
State Water Resources Control Board					
Dredging and Excavation	Actions taken by or at the direction of public agencies to clean up or abate conditions of pollution or nuisance resulting from unintentional or unauthorized releases of waste or pollutants to the environment; provided that wastes, pollutants, or contaminated materials removed from the immediate place of release shall be discharged according to the SWRCB-promulgated sections of Article 2, Subchapter 2, Chapter 3, Subdivision 1 of this division (§ 20200 et seq.); and further provided that remedial actions intended to contain the wastes at the place of release shall implement applicable SWRCB-promulgated provisions of this division to the extent feasible.	Action taken by or at the direction of a public agency to cleanup release of pollutant.	Cal. Code Regs. tit. 27, § 20090(d)	Relevant and appropriate.	This is a potential ARAR for the Navy's response actions.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Institutional Controls					
State Requirements					
California Civil Code[a]					
Institutional controls	Provides conditions under which land use restrictions will apply to successive owners of land.	Transfer property from the Navy to a nonfederal agency.	Cal. Civil Code §1471	Relevant and Appropriate	Substantive provisions are the following general narrative standard: "to do or refrain from doing some act on his or her own land...where (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety of the environment as a result of the presence of hazardous materials, as defined in § 25260 of the Cal. Health & Safety Code." This narrative standard would be implemented through incorporation of restrictive covenants in the deed at the time of transfer.
California Health and Safety Code[a]					
Institutional controls	Allows DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.	Transfer property from the Navy to a nonfederal agency.	Cal. Health and Safety Code § 25202.5	Relevant and Appropriate	The substantive provisions of this section are the general narrative standards to restrict "present and future uses of all or part of the land on which the facility ...is located."

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
		Institutional Controls			
State Requirements					
California Health and Safety Code[a]					
Institutional controls	Provides a streamlined process to be used to enter into an agreement to restrict specific use of property in order to implement the substantive use restrictions of Cal. Health and Safety Code § 25232(b)(1)(A)–(E).	Transfer property from the Navy to a nonfederal agency.	Cal. Health and Safety Code § 25222.1 and 25355.5(a)(1)(C)	Relevant and Appropriate	This section is a potential ARAR when the Navy is transferring property to a nonfederal entity. Cal. Health & Safety Code § 25222.1 provides the authority for the state to enter into voluntary agreements to establish land-use covenants with the owner of the property. The substantive provision of Cal. Health and Safety Code § 25222.1 is the general narrative standard: "restricting specified uses of the property."
Institutional Controls	Provides a process for obtaining a written variance from a land use restriction.	Transfer property from the Navy to a nonfederal entity.	Cal. Health and Safety Code §§ 25233(c) and 25234	Relevant and Appropriate	This section is a potential ARAR for institutional controls where the Navy is transferring property to a nonfederal entity. Cal. Health and Safety Code § 25233(c) sets forth substantive criteria for granting variances from the uses prohibited in § 25232(b)(1)(A)-(E) based on specific environmental and health criteria.

TABLE B-3: POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Action	Requirement	Prerequisite	Citation	Preliminary ARAR Determination[a]	Comments
Institutional Controls (Continued)					
State Requirements (Continued)					
California Code Regulations Title 22					
Institutional controls	A land use covenant imposing appropriate limitations on land use shall be executed and recorded when facility closure, corrective action, remedial or removal action, or other response actions are undertaken and hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land.	Property transfer by federal government to non-federal entity.	Cal. Code Regs. tit. 22, § 67391.1	Relevant and Appropriate	Relevant and appropriate when the Navy is transferring property to a nonfederal agency. EPA specifically considers substantive portions of §§ (a), (b), (d), and (e) to be ARARs for this FS.

Notes:

* Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of specific citations are considered potential ARARs.

BAAQMD Bay Area Air Quality Management District
Cal. Code Regs. *California Code of Regulations*
CFR *Code of Federal Regulations*
DTSC Department of Toxic Substances Control
mg/kg Milligram per kilogram
PCB Polychlorinated biphenyl
ppm Part per million
RCRA Resource Conservation and Recovery Act
USC *United States Code*

Under CERCLA § 121(e)(1), no federal, state, or local permit is required for any remedial action conducted entirely on site, where it is selected and carried out in compliance with CERCLA § 121. Therefore, the Navy is not required to obtain an individual stormwater permit or submit a notice of intent to discharge under the state's general permit. However, for Parcel F the Navy will use the substantive requirements of the state's general permit for stormwater discharges as to-be-considered criteria for complying with the requirement to apply best management practices for stormwater discharges promulgated at 40 CFR §§ 122.44(k)(2) and (4).

In addition, the following Clean Water Act requirements are potential ARARs:

- Monitoring requirements for the discharge of dewatering effluent back to the Bay. These requirements require monitoring the mass of each pollutant and volume of the discharge and require the use of 40 CFR Part 136 methods for pollutants with approved methods [40 CFR 122.44(i)(1)(i-iv)].
- Technology-based treatment requirements for the dewatering effluent at 40 CFR 125.3.

Toxic Substances Control Act

Section 761.61(a)(5)(i)(B)(iii) requires that PCB-remediated waste that contains more than 50 ppm (or 50 mg/kg) taken off site must be disposed of in a landfill permitted under § 3004 of RCRA (referred to as a Title C landfill) or a permitted PCB disposal facility such as an incinerator. Under 40 CFR § 761.61(a)(5)(i)(B)(2)(ii), soil contaminated with PCBs at a concentration less than 50 ppm (or 50 mg/kg) may be disposed of in a permitted state municipal landfill or a nonhazardous nonmunicipal landfill (Class III). If the concentrations of PCBs do not meet any of the criteria for PCB remediation waste, and if no chemical analyzed meets the criteria for hazardous waste or as a state-designated waste, none of the Toxic Substances Control Act regulations in 40 CFR Part 761 or the requirements at Cal. Code Regs. tit. 22, tit. 23, and tit. 27 for storage, treatment, and disposal will be applicable.

Excavated sediments that are PCB remediation waste will be managed in accordance with PCB remediation waste storage and disposal requirements and decontamination procedures specified in federal PCB regulations, at 40 CFR §§ 761.65(c)(9), 761.61, and 761.79(b)(1), which the Navy determined to be potential action-specific ARARs. The Navy has determined that 40 CFR § 761.65(c)(4), which establishes the requirements for storage of PCB remediation waste, is a potential action-specific ARAR for Parcel F at Hunters Point Shipyard. Excavated sediment from Parcel F that contains PCBs may be stored on site up to 180 days in a lined storage area. The Navy has selected the decontamination standard of less than 3 micrograms per liter in 40 CFR § 761.79(b)(1) for waste discharged to a publicly owned treatment work or to navigable waters. The decontamination water either will meet the standard or will be disposed off site.

B4.2.1.2 State Action-Specific Applicable or Relevant and Appropriate Requirements

State RCRA requirements included within the EPA-authorized RCRA program for California are considered federal action-specific ARARs and are discussed above. When state regulations are either broader in scope or are more stringent than their federal counterparts, they are considered state action-specific ARARs. State requirements such as the non-RCRA, state-regulated hazardous waste requirements may be potential state action-specific ARARs because they are not within the scope of the federal ARARs (57 FR 60848). Cal. Code Regs. tit. 22, div. 4.5 requirements that are part of the state-approved RCRA program would be potential state action-specific ARARs for non-RCRA, state-regulated hazardous wastes.

The site waste characteristics must be compared with the definition of non-RCRA, state-regulated hazardous waste discussed in Section B1.4.3.

The Navy determined that the substantive provisions of California stormwater requirements of SWRCB Order No. 99-08-DWQ are potential state action-specific ARARs for Parcel F at Hunters Point Shipyard.

Cal. Code Regs. tit. 27, § 20090(d) is a potential ARAR. This section states that actions taken by public agencies to clean up unauthorized releases are exempt from tit. 27 and tit. 23, except that wastes removed from the immediate place of release and discharged to land must be managed in accordance with classification (Cal. Code Regs. tit. 27, §20200 and Cal. Code Regs. tit. 23, § 2520) and siting requirements of tit. 27 or tit. 23 and wastes contained or lift in place must comply with tit. 27 or tit. 23 to the extent feasible.

B4.2.2 Off-Site Disposal

The only potential federal and state action-specific ARARs associated with off-site disposal are the RCRA requirements discussed under Section B4.2.1.

B4.3 ALTERNATIVES 3A AND 3B: FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (3A) OR AQUABLOK CAP (3B) IN AREA III; IN SITU STABILIZATION IN AREA X; AND INSTITUTIONAL CONTROLS

This remedial alternative for Parcel F at the former Hunters Point Shipyard involves (1) removal of contaminated sediment and off-site disposal, (2) an armored cap (Alternative 3A) or AquaBlok cap (Alternative 3B) in Area III, (3) in-situ stabilization in Area X, and (4) institutional controls.

B4.3.1 Dredging and Excavation

The ARARs identified in Section B4.2.1.1 are ARARs for dredging for this component of Alternatives 3A and 3B.

B4.3.2 Off-Site Disposal

The only potential ARARs associated with this action are the requirements discussed under Section B4.2.1. There are no additional ARARs for off-site disposal.

B4.3.3 Capping

Under Alternatives 3A and 3B, respectively, either an armored cap of an AquaBlok cap would be placed in Area III of Parcel F.

The ARARs associated with the caps include the location-specific ARARs identified in Section B3.0. There are no additional ARARs.

B4.3.4 In-Situ Treatment

Contaminated sediments would be treated through a stabilization process using activated carbon. The in-situ treatment would adsorb the PCBs and render them not bioavailable to ecological receptors. The only ARARs associated with the in-situ treatment are the RCRA ARARs identified in Section B4.2.1.1.

B4.3.5 Institutional Controls

B4.3.5.1 Federal Action-Specific ARARs

There are no potential federal action-specific ARARs for institutional controls.

B4.3.5.2 State Action-Specific ARARs

State statutes that have been accepted by the Navy as potential ARARs for implementing institutional controls and entering into an environmental restrictive covenant and agreement with DTSC include substantive provisions of Cal. Civil Code § 1471, Cal. Health and Safety Code §§ 25202.5, 25222.1,, 25233(c), 25234 and 25355.5(a)(1)(C). DTSC promulgated a regulation on April 19, 2003 regarding "Requirements for Land Use Covenants" at Cal. Code Regs. tit. 22, § 67391.1. The substantive provisions of this regulation have been determined to be "relevant and appropriate" state ARARs by the Navy.

The substantive provisions of Cal. Civil Code § 1471 are the following general narrative standard: "to do or refrain from doing some act on his or her own land ... where...(c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in Section 25260 of the Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive environmental covenants in the deed

when the property is transferred. These covenants would be recorded with the environmental restriction covenant and agreement and would run with the land.

The substantive provisions of Cal. Health and Safety Code § 25202.5 are the general narrative standard to restrict "present and future uses of all or part of the land on which the facility is located." These substantive provisions will be implemented by incorporation of restrictive environmental covenants in the Environmental Restriction Covenant and Agreement when the property is transferred for purposes of protecting present and future public health and safety.

Cal. Health and Safety Code §§ 25222.1 and 25355.5(a)(1)(C) provide the authority for the state to enter into voluntary agreements to establish land use covenants with the owner of property. The substantive requirements of the following Cal. Health and Safety Code § 25222.1 provisions are relevant and appropriate: (1) the general narrative standard "...restricting specified uses of the property,..." and (2) "...the agreement is irrevocable, and shall be recorded by the owner, ...as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following Cal. Health and Safety Code § 25355.5(a)(1)(C) provisions are relevant and appropriate: "...execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof, as appropriate, upon the present and future uses of the land." The Navy will comply with the substantive requirements of Cal. Health and Safety Code §§ 25222.1 and 25355.5(a)(1)(C) by incorporating the CERCLA use restrictions into the Navy's deed of conveyance in the form of restrictive covenants under the authority of Cal. Civil Code § 1471 and into the environmental restriction covenant and agreement. The substantive provisions of Cal. Health and Safety Code §§ 25222.1 and 25355.5(a)(1)(C) may be interpreted in a manner that is consistent with the substantive provisions of Cal. Civil Code § 1471. The covenants will be recorded with any deed and will run with the land.

Cal. Health and Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances from prohibited uses based on specified environmental and health criteria. Cal. Health and Safety Code § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land use restriction on the grounds that "...the waste no longer creates a significant existing or potential hazard to present or future public health or safety."

In addition to being implemented through the Environmental Restriction Covenant and Agreement between the Navy and DTSC, the appropriate and relevant portions of Cal. Health and Safety Code §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5(a)(1)(C) and Cal. Civil Code § 1471 will also be implemented through the any deed between the Navy and any future transferee.

EPA aggress that the substantive provisions of the state statutes and regulations referenced in this section are ARARs. EPA specifically considers sections (a), (b), (d) and (e) or Cal. Code Regs., tit. 22, §67391.1 to be ARARs for this FS. DTSC's position is that all of the state statutes and regulations referenced in this section are ARARs.

B4.4 ALTERNATIVES 4A AND 4B – FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (4A) OR AQUABLOK CAP (4B) IN AREA III; MONITORED NATURAL RECOVERY IN AREA X; AND INSTITUTIONAL CONTROLS

This remedial alternative for Parcel F at the former Hunters Point Shipyard involves (1) focused removal of contaminated sediment, (2) an armored cap (Alternative 4A) or AquaBlok cap (Alternative 4B) in Area III, (3) monitored natural recovery (MNR) in Area X, and (4) institutional controls.

B4.4.1 Dredging and Excavation

The ARARs identified in Section B4.2.1.1 are ARARs for dredging and excavation for this component of Alternatives 4A and 4B.

B4.4.2 Off-Site Disposal

The only potential ARARs associated with this action are the RCRA requirements discussed under Section B4.2.1. There are no additional ARARs for off-site disposal.

B4.4.3 Capping

Under Alternatives 4A and 4B, respectively, either an armored cap of an AquaBlok cap would be placed in Area III of Parcel F. The ARARs associated with the cap include the location-specific ARARs identified in Section B3.0. There are no additional ARARs.

B4.4.4 Institutional Controls

The same ARARs associated with the institutional controls identified in Section B4.3.5 are potential action-specific ARARs for this alternative.

B4.5 ALTERNATIVES 5A AND 5B – FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (5A) OR AQUABLOK CAP (5B) IN AREA III; FOCUSED REMOVAL, OFF-SITE DISPOSAL (5A) OR ACTIVATED BACKFILL (5B), AND MONITORED NATURAL RECOVERY IN AREA X; AND INSTITUTIONAL CONTROLS

This remedial alternative for Parcel F at the former Hunters Point Shipyard involves (1) focused removal of contaminated sediment, (2) an armored cap (Alternative 5A) or AquaBlok cap (Alternative 5B) in Area III, (3) monitored natural recovery (MNR) in Area X, and (4) institutional controls. Additionally, the excavations in Area X would be backfilled with activated carbon mixed with clean sediment.

B4.5.1 Dredging and Excavation

The ARARs identified in Section B4.2.1.1 are ARARs for dredging for this component of Alternatives 5A and 5B.

B4.5.2 Off-Site Disposal

The only potential ARARs associated with this action are the requirements discussed under Section B4.2.1. There are no additional ARARs for off-site disposal.

B4.5.3 In-Situ Treatment

Contaminated sediments will be treated through a stabilization process using activated carbon. The in-situ treatment will adsorb the PCBs and render them not bioavailable to ecological receptors. The only ARARs associated with the in-situ treatment are the RCRA ARARs identified in Section B4.2.1.1.

B4.5.4 Capping

Under Alternatives 5A and 5B, respectively, either an armored cap of an AquaBlok cap would be placed in Area III of Parcel F. The ARARs associated with the cap include the location-specific ARARs identified in Section B3.0. There are no additional ARARs.

B4.5.5 Institutional Controls

The same ARARs associated with the institutional controls identified in Section B4.3.5 are potential ARARs for this alternative.

B5.0 REFERENCES

Bay Conservation and Development Commission. 2006. "San Francisco Bay Plan." January. Available Online at: http://www.bcdc.ca.gov/pdf/planning/plans/bayplan/bayplan.pdf

San Francisco Bay Regional Water Quality Control Board. 1995. "Water Quality Control Plan, San Francisco Bay Basin, Region 2." December.

U.S. Environmental Protection Agency (EPA). 1988a. "CERCLA Compliance with Other Laws Manual, Draft Guidance." EPA/540/G-89/006. Office of Emergency and Remedial Response. Washington, DC. August.

EPA. 1988b. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." EPA/540/G-89/004. Office of Solid Waste and Emergency Response. Directive 9355.3-01-02. October.

EPA. 1989. "CERCLA Compliance with Other Laws Manual: Part II – Clean Air Act and Other Environmental Statutes and State Requirements." EPA/540/G-89/009. Office of Solid Waste and Emergency Response. Directive 9234.1-02. Washington, D.C. August.

EPA. 1991. "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions." Office of Solid Waste and Emergency Response Directive 9355.0-30. April.

ATTACHMENT B1
CORRESPONDENCE BETWEEN NAVY AND REGULATORY AGENCIES

DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
1455 FRAZEE ROAD, SUITE 900
SAN DIEGO, CA 92108-4310

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Ser BPMOW.dg/1387
November 15, 2005

VIA CERTIFIED MAIL

Mr. Jim Ponton
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Dear Mr. Ponton:

Pursuant to meeting the Federal Facilities Agreement (FFA) schedule for the Feasibility Study for Parcel F, at Hunters Point Shipyard, we are hereby requesting that the Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, as the lead agency for the State of California, identify potential State chemical-specific and location-specific "Applicable" or "Relevant and Appropriate" Requirements (ARARs) for the Feasibility Study for Parcel F.

In addition, the Navy is requesting that the State of California identify any other criteria, advisories, guidance, and proposed standards that the State requests be considered for the above site. Please coordinate responses from all California state agencies.

The Navy is requesting timely identification of potential State ARARs consistent with §121(d)(2)(A) of CERCLA and the National Contingency Plan 40 CFR §§300.400(g) and 300.515(d) & (h). Experience to date around the country has shown that a failure to identify ARARs with sufficient precision, early in the process, can cause severe disruptions in timely implementation of remedial actions. To ensure timely and complete ARARs identification for the FS identified above, please include the following information:

1 A specific citation to the statutory or regulatory provision(s) for the potential State ARAR and the date of enactment or promulgation.

2. A brief description of why the potential State ARAR is applicable or relevant and appropriate to the particular IR Site.

3 If the State believes its proposed ARAR is more stringent than the corresponding Federal ARAR, please provide the rationale and technical justification for this position.

4. Any advisories, criteria, or guidance that your agency thinks should be considered and a brief description and justification as to why it should be considered.

5. If the State determines that there is not enough information to fully respond to our request, please identify any additional information that would be required to support identification of State ARARs and their application.

Chemicals of potential concern (COPC) include mercury, copper and PCBs. A list and description of remedial technologies and process options that are currently being evaluated for remedial alternatives at Parcel F is provided as enclosure (1).

Consistent with 40 CFR §300.515 (h)(2), we are requesting that you send a response via first class mail addressed to Mr. Ryan Ahlersmeyer and postmarked within thirty (30) calendar days of receipt of this request. Please direct any technical questions that you may have concerning this request to Mr. Ryan Ahlersmeyer at (619) 532-0960 and legal questions to Mr. Rex Callaway, Associate Counsel (Environmental), at (619) 532-0988

Sincerely,

Doug Gilkey
Base Closure Manager

Enclosure:
(1) Table 1, Potential Remedial Technologies and Process Options

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Ser BPMOW.dg/1387
November 15, 2005

Copy to: (Hard Copy)

Mr. Michael Work (SFD 8-3)
U.S. EPA, Region IX
75 Hawthorne Street
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San Francisco, CA 94102

Mr. Gregg Olson
City of San Francisco
Public Utilities Commission
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Mr. Tom Lanphar
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November 15, 2005

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Ms. Julia Vetromile (w/o Encl)
Tetra Tech EMI
135 Main Street, Suite 1800
San Francisco, CA 94105

Writer: R. Ahlersmeyer
Typist: Tetra Tech EMI

E-mail/FS for Parcel F.doc

TABLE 1: POTENTIAL REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Parcel F, Hunters Point Shipyard, San Francisco

Remedial Technology Alternative	Description
SEDIMENT OPTIONS	
Institutional Controls	Applying deed restrictions on future excavation. Deed restrictions would inform future property owners of the presence of contaminated sediment and fish advisories.
Containment via capping	Capping is the placement of clean material over contaminated sediment. The cap material being evaluated for Parcel F includes AquaBlock (clay), sand, carbon and armored caps.
Excavation/Dredging and Off-site disposal	Excavation/Dredging – Removal of sediment with mechanical or hydraulic dredge equipment and backfilling with clean fill. The dredged sediment will be transported to a Class I, II, or III landfill facility off-site. Sediment transported to a Class I facility may require additional treatment, such as stabilization.
In-Situ Treatment	Treatment of contaminated sediments in place. PCBs in the sediment tend to preferentially accumulate in coal-derived particles and therefore reduces contaminant mobility and bioavailability. The in-situ technology under consideration is carbon.
Monitored Natural Recovery	Monitored natural recovery is the process of addressing contaminated sediments in place using ongoing aquatic processes to contain, destroy or reduce bioavailability of contaminants. The process involves natural sedimentation creating a clean surface sediment layer, thereby burying contaminated sediment over time.

California Regional Water Quality Control Board
San Francisco Bay Region

Alan C. Lloyd, Ph.D.
Agency Secretary

1515 Clay Street, Suite 1400, Oakland, California 94612
Phone (510) 622-2300 • FAX (510) 622-2460
http://www.waterboards.ca.gov/sanfranciscobay

Arnold Schwarzenegger
Governor

Date:
File No. 2169.6032 (JDP)
PCA No.: 16525

Department of the Navy
Base Realignment and Closure
Program Management Office West
ATTN: Mr. Ryan Ahlersmeyer
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

SUBJECT: Response to the November 15, 2005 Department of Navy Request for Identification of State Applicable or Relevant and Appropriate Requirements (ARARs) for Parcel F, Hunters Point Shipyard, San Francisco, California.

Dear Mr. Ahlersmeyer:

This letter responds to a November 15, 2005 Department of Navy letter that requested that:

(a) The Water Board act as the State lead agency for the State of California for Parcel F; and,

(b) As the State lead, that the Water Board identify potential State chemical-specific and location-specific "Applicable" or "Relevant and Appropriate" Requirements (ARARs) for the Parcel F Feasibility Study

With respect to Point (a), our interpretation of the Federal Facility Agreement for Naval Station Treasure Island – Hunters Point Annex (the FFA) may not allow the Water Board to act as State lead agency for the State of California. Our interpretation is based on the following FFA language that states:

- The Department of Toxic Substances Control (DTSC) is the designated State agency, in accordance with the California Health and Safety Code section 25159.7, responsible for coordinating the federal programs to be carried out under the FFA; and,
- The DTSC, as the State coordinating agency, will contact those State and local governmental agencies, which are a potential source of ARARs.

With respect to Point (b), attached please find a tabulation of Regional Water Quality Control Board ARARs for Parcel F.

If you have questions, please contact me by telephone at (510) 622-2492 or by electronic mail at jponton@waterboards.ca.gov.

Sincerely,

James D. Ponton, P.G. 6106
Project Manager

Attachment:
ARARs for the Feasibility Study for Parcel F, Hunters Point Shipyard, San Francisco, CA

cc:

Department of the Navy
Base Realignment and Closure
Program Management Office West
ATTN: G. Patrick Brooks
1455 Frazee Road, Suite 900
San Diego, CA 92108-4310

U.S. Environmental Protection Agency, Region IX
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California Department of Toxic Substances Control
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Department of Public Health
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San Francisco, CA 94102

Tech Law
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San Francisco, CA 94105

Barbara Bushnell
HPS RAB Co-Chair

Applicable or Relevant and Appropriate Requirements (ARARs) for the Feasibility Study for Parcel F Hunters Point Shipyard, San Francisco

No.	Source	Standard, Requirement, Criterion, or Limitation	Description	ARARs Status
1	Porter-Cologne Water Quality Control Act (California Water Code Sections 13240)	Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan), January 21, 2004	Establishes water quality objectives, including narrative and numerical standards that protect beneficial uses of surface waters and groundwaters in the region.	Applicable
2	Porter-Cologne Water Quality Control Act (California Water Code Section 13000, 133304, 13240, 13241, 13242, 13243)	Basin Plan Chapter 2 – Beneficial Uses	Chapter 2 describes beneficial uses of surface and ground waters.	Applicable
		Basin Plan Chapter 3 – Water Quality Objectives	Chapter 3 establishes water quality objectives, including narrative and numerical standards that protect the beneficial uses and water quality objectives of surface and groundwaters in the region. Narrative objectives describe the water quality to attain via pollution control and form the basis for the numerical values. Numerical objectives are designed to limit the adverse effects of pollutants.	Applicable
		Basin Plan Chapter 4 – Implementation Plan	Chapter 4 describes implementation plans and other control measures designed to ensure compliance with statewide plans and policies. Includes groundwater and surface water protection and management. Describes program goals, how water quality objectives are applied, and strategies for managing polluted sites.	Applicable

Applicable or Relevant and Appropriate Requirements (ARARs) for the Feasibility Study for Parcel F Hunters Point Shipyard, San Francisco

No.	Source	Standard, Requirement, Criterion, or Limitation	Description	ARARs Status
3	Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13263, 13304)	State Water Resources Control Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality Waters in California ("Anti-degradation Policy").	Requires that high quality surface and groundwater be maintained to the maximum extent possible. Establishes policy that whenever the existing water quality is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated that any change will be consistent with the maximum benefit to the people of the State, won't unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than prescribed in the policies. Discharge or proposed discharges to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that a pollution or nuisance will not occur and the highest water quality consistent with the maximum benefit to the people of the State will be maintained.	Applicable
4	Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240)	State Water Resources Control Board Resolution No. 88-63 ("Sources of Drinking Water Policy"), as contained in the RWQCB's Water Quality Control Plan	Specifies that, with certain exceptions, all ground and surface waters must have the beneficial use of municipal or domestic water supply. SWRCB Resolution 88-63 applies to all sites that may be affected by discharges of waste to groundwater or surface water. The resolution specifies that, with certain exceptions, all groundwater and surface waters have beneficial uses of municipal or domestic water supply. These exceptions include, among others, if: 1) the TDS exceed a 3,000 mg/L or 2) the water source does not provide sufficient water to supply as single well capable of producing and average sustained yield of 200 gallons per day.	Applicable

Applicable or Relevant and Appropriate Requirements (ARARs) for the Feasibility Study for Parcel F Hunters Point Shipyard, San Francisco

No.	Source	Standard, Requirement, Criterion, or Limitation	Description	ARARs Status
5	California Water Code Section 13160 and Clean Water Act Sections 402(p) and 301	SWRCB Order 99-08-DWQ (General order for storm water management at construction sites).	Must identify the sources of sediment and other pollutants that affect the quality of stormwater discharges and implement practices to reduce these discharges. Stormwater discharges from construction sites must meet pollutant limits and standards. The narrative effluent standard included the requirement to implement BMPs can/or appropriate pollution –prevention control practices. Section 13160 designates the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act and any other federal act, and is (a) authorized to give any certificate or statement required by any federal agency that an activity of any person subject to the jurisdiction of the state board will not reduce water quality below applicable standards, and (b) authorized to exercise any powers delegated to the state by the Federal Water Pollution Control Act.	Applicable
6	Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240, 13260, 13263, 13267, 13300, 13304, 13307)	State Water Resources Control Board Resolution No. 92-49, (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304"), as amended April 21, 1994, and October 2, 1996.	Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of Title 23, CCR, Section 2550.4, to cleanups.	Applicable
7	Porter-Cologne Water Quality Control Act (California Water Code Section 13240 –13147, 13172, 13260, 13263, 13267, 13304)	Title 27 (Environmental Protection), Division 2 (Solid Waste), Chapter 1, 27 CCR 20090(d)	Actions taken by or at the direction of public agencies to cleanup up from unauthorized releases are exempt from Title 27, except that wastes removed from the immediate place of release and discharged to land must be managed in accordance with classification (Title 27 CCR Section 20200) and siting requirements of Title 27. Waste contained or left in place must comply with Title 27 to the extent feasible.	Applicable

Applicable or Relevant and Appropriate Requirements (ARARs) for the Feasibility Study for Parcel F Hunters Point Shipyard, San Francisco

No.	Source	Standard, Requirement, Criterion, or Limitation	Description	ARARs Status
8	Staff Report of the RWQCB, Central Valley Region	"A Compilation of Water Quality Goals"	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.	Relevant and Appropriate
9	27 CCR Sections 20210, 20220(a), and 20230(a)	Title 27 (Environmental Protection), Division 2 (Solid Waste), Chapter 3	Applicable for characterizing dredged sediment.	Applicable
10	Staff Report of the RWQCB, Central Valley Region	"A Compilation of Water Quality Goals"	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.	Relevant and Appropriate
11	Technical Document prepared by San Francisco Bay Regional Board Staff	"Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater" (Interim Final - July 2003) (Updated 9/4/03)	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.	Relevant and Appropriate
12	California Toxics Rule	40 CFR 131.38	Contains criteria for priority toxic pollutants in the State of California for inland surface waters and enclosed bays and estuaries, except in those waters subject to objectives in the Regional Board's 1995 Basin Plan.	Applicable
13	Porter-Cologne Water Quality Control Act (California Water Code Section 13160)	Federal Clean Water Act 40 CFR 122 – EPA Administered Permit Programs: The National Pollution Discharge Elimination System; 40 CFR 122.26; 40 CFR 122.41(d); 40 CFR 122.41(e); 40 CFR 122.44(d).	The state board is designated as the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act and any other federal act, heretofore or hereafter enacted, as is (a0 authorized to give certificate or statement required by any federal agency pursuant to any such federal act that there is reasonable assurance that any activity of any person subject to the jurisdiction of the state board will not reduce water quality below applicable standards, and (b) authorized to exercise any powers delegated to the stat by the Federal Water Pollution Control Act.	Applicable

Applicable or Relevant and Appropriate Requirements (ARARs) for the Feasibility Study for Parcel F Hunters Point Shipyard, San Francisco

No.	Source	Standard, Requirement, Criterion, or Limitation	Description	ARARs Status
14	Porter-Cologne Water Quality Control Act (California Water Code Section 13160)	Federal Clean Water Act 40 CFR 230.3, Section 404 – Definition of Wetlands USACE, Public Notice 92-7: Interim Testing Procedures for Evaluating Dredged Material Disposed of in San Francisco Bay Section 401, 33 U.S.C. 1341	Authorizes the USACE to delineate wetlands. Reassures that all wetland creation, uplands disposal, or dredging projects complete certain notifications and listings. State Water Quality Certification – wetlands destruction/alteration would require a 404 permit and this certification assures that the proposed activity will comply with state water quality standards.	Applicable Relevant and Appropriate Applicable

State of California

Memorandum

To: Mr. Thomas Lanphar
Department of Toxic Substances Control
700 Heinz Avenue, Suite 200
Berkeley, CA 94710

Date: February 2, 2006

From: Charlie Huang, Ph.D.
Staff Toxicologist
Scientific Division
Office of Spill Prevention and Response
Department of Fish and Game

Subject: **Applicable or Relevant and Appropriate Requirements (ARARs) for Parcel F, Hunters Point Shipyard, San Francisco, California**

This memo is in response to your December 30, 2005 letter requesting potential State ARARs for the draft feasibility study for Parcel F at Hunters Point Shipyard (HPS). The Department of Fish and Game, Office of Spill Prevention and Response (DFG-OSPR) appreciates this opportunity to provide State laws and regulations to guide the planned cleanup of HPS.

It is our understanding that the Navy is making the request for ARARs for the purpose of ensuring a coordinated cleanup effort. The request for DFG-OSPR to define appropriate State cleanup requirements is made pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as a portion of the removal action process. This memo will serve to advise you of the DFG's continuing interest in coordinating any natural resource issues, as the designated natural resource trustee for the State of California. This may be necessary should release(s) of any hazardous materials at the subject site affect State natural resources.

HPS, located in southeast San Francisco on a peninsula that extends east into San Francisco Bay, was identified for closure during the Base Closure and Realignment (BRAC) process of 1991. The shipyard is approximately 936 acres in size, 443 acres of which are on land with the remaining acreage under water.

Hunters Point was operated as a commercial dry dock facility from 1869 until 1939. In 1940, the Navy obtained ownership of the shipyard for ship building, repair, and maintenance activities. After World War II, activities shifted from ship repair to submarine servicing and testing. HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of the property to a privately-owned ship repair firm. In 1986, the Navy again occupied the shipyard and began a program to investigate and clean up contamination resulting from past activities.

HPS is divided into six parcels (A through F). Parcel F includes all of the off-shore property at HPS and is approximately 432 acres. Chemicals of potential concern in Parcel F include mercury, copper, polychlorinated biphenyls (PCBs), and radionuclides.

Listed on the enclosed table is a site-specific list of Fish and Game Code Sections which may apply as State ARARs or TBCs (to be considered) with the date of enactment or promulgation. The specific citation and explanation for each listed ARAR and TBC are also enclosed, in addition to applicable statutes and regulations.

The DFG-OSPR appreciates the opportunity to provide our ARARs. If you have any questions or need further information, please contact me at (916) 324-9805 or by e-mail at chuang@ospr.dfg.ca.gov.

Reviewer: Julie Yamamoto, Ph.D., Senior Toxicologist
Wendy Johnson, Staff Counsel

Enclosure

cc: Department of Fish and Game
Office of Spill Prevention and Response
Julie Yamamoto, CDFG/OSPR-Scientific
Wendy Johnson, CDFG/OSPR-Legal

File: OSPR-RF, Huang, Chron
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CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
Aquatic habitat/species	Action must be taken if toxic materials are placed where they can enter waters of the State. There can be no release that would have a deleterious effect on species or habitat.	Fish and Game Code section 5650 (a), (b) & (f)	This code section prohibits depositing or placing where it can pass into waters of the state any petroleum products (Section 5650(a)(1)), factory refuse (section 5650(a)(4)), sawdust, shavings, slabs or edgings (section 5650(a)(3)), and any substance deleterious to fish, plant life or bird life (section 5650(a)(6)). These are substantive, promulgated environmental protection requirements. These requirements impose strict criminal liability on violators. (*People v. Chevron Chemical Company (1983) 143 Cal. App. 3d 50).* This imposition of strict criminal liability imposes a standard that is more stringent than federal law. The extent to which each subdivision of section 5650 is relevant and appropriate depends on the site characterization and the potential for contaminants to be deposited near or within waters of the state.
Wildlife Species	Action must be taken to prohibit the taking of birds and mammals, including the taking by poison	Fish and Game Code section 3005 (Stats. 1957, c. 456, p. 1353 section 3005)	This code section prohibits the taking of birds and mammals, including taking by poison. ATake@ is defined by Fish and Game Code section 86 to include killing. APoison@ is not defined in the code. Although there is no state authority on this point, federal law recognizes that poison, such as Strychnine, may affect incidental taking. (*Defenders of Wildlife v. Administrator, Environmental Protection Agency (1989) 882. F. 2d. 1295).* This code section imposes a substantive, promulgated environmental protection requirement.
Endangered Species	Action must be taken to conserve endangered species, there can be no releases and/or actions that would have a	Fish and Game Code section 2080 (Added by Stats. 1984, c.	This section prohibits the take, possession, purchase or sell within the state, any species (including rare native plant species), or any product thereof, that the commission determines to be an endangered or threatened species, or the attempt of any of these acts. This section is applicable and relevant to the extent that there are endangered or threatened species in the area which have the

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
	deleterious effect on species or habitat.	1240, section 2).	potential of being affected if actions are not taken to conserve the species. This section prohibits releases and/or actions that would have a deleterious effect on species or their habitat. This section and applicable Title 14 regulations should be considered as ARARs. *California Code of Regulations Title 14 sections 670.2* provides a listing the plants of California declared to be Endangered, Threatened or Rare. *California Code of Regulations Title 14 section 670.5* provides a listing of Animals of California declared to be endangered or threatened. *California Code of Regulations Title 14 section 783 et. seq.,* provides the implementation regulations for the California Endangered Species Act.
Fully protected bird species/habitat	Action must be taken to prevent the taking of fully protected birds	Fish and Game Code section 3511 (Added by Stats.1970, c. 1036, p. 1848 section 4)	This section provides that it is unlawful to take or possess any of the following fully protected birds: (a). American peregrine falcon (b). Brown Pelican (c). California black rail (d). California clapper rail (e). California condor (f). California least tern (g). Golden eagle (h). Greater sandhill crane (i). Light-footed clapper rail (j). Southern bald eagle

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
			(k). Trumpeter swan (l). White-tailed kite (m). Yuma clapper rail This should be considered Applicable and Relevant to the extent that such fully protected birds or their habitat are detected on or near the site. The Brown Pelican and California least tern are known to occur on or near this site.
Wetlands	Actions must be taken to assure that there is Ano net loss@ of wetlands acreage or habitat value. Action must be taken to preserve, protect, restore and enhance California=s wetland acreage and habitat values.	Fish and Game Commission Wetlands Policy (adopted 1987) included in Fish and Game Code Addenda	This policy seeks to provide for the protection, preservation, restoration, enhancement and expansion of wetland habitat in California. Further, it opposes any development or conversion of wetland that would result in a reduction of wetland acreage or habitat value. It adopts the USFWS definition of a wetland which utilizes hydric soils, saturation or inundation, and vegetable criteria, and requires the presence of at least one of these criteria (rather than all three) in order to classify an area as a wetland. This policy is not a regulatory program and should be included as a TBC.
Fully Protected Mammals	Actions must be taken to assure that no fully protected mammals are taken or possessed at any time.	Fish and Game Code section 4700 (Added by Stats. 1970, c.	This section prohibits the take or possession of any of the fully protected mammals or their parts. The following are fully protected mammals: (a) Morro Bay kangaroo rat (b) Bighorn sheep except Nelson bighorn sheep (c) Northern elephant seal

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
		1036, p. 1848 section 6)	(d) Guadalupe fur seal (e) Ring-tailed cat (f) Pacific right whale (g) Salt-marsh harvest mouse (h) Southern sea otter (i) Wolverine This section is applicable, relevant, and appropriate to the extent that such mammals and/or their habitat are located on or near the site.
Fully Protected Reptiles and Amphibians	Actions must be taken to prevent the take or possession of any fully protected reptile or amphibian.	Fish and Game Code section 5050 (Added by Stats. 1970, c. 1036, p. 1849, section 7)	This section prohibits the take or possession of fully protected reptiles and amphibians or parts thereof. The following are fully protected reptiles and amphibians: (1) Blunt-nosed leopard lizard (2) San Francisco garter snake (3) Santa Cruz long-toed salamander (4) Limestone salamander (5) Black toad This section is applicable, relevant and appropriate to the extent that these amphibians or reptiles and/or their habitat are located on or near the site.
Birds	Action must be taken to avoid the take or destruction of the nest	Fish and Game Code section 3503	This section prohibits the take, possession, or needless destruction of the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto.

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
	or eggs of any bird		
Birds of Prey	Action must be taken to prevent the take, possession, or destruction of any birds-of prey or their eggs	Fish and Game Code section 3503.5 (Added by Stats. 1985, c. 1334, section 6)	This section prohibits the take, possession, or destruction of any birds in the orders of Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto. This section will be applicable and relevant to the extent that such species or their eggs are located on or near the site.
Nongame birds	Actions must be taken to prevent the take of nongame birds.	Fish and Game Code section 3800 (Added by Stats. 1971, c. 1470, p. 2906, section 13)	This section prohibits the take of nongame birds, except in accordance with regulations of the commission, or when related to mining operations with a mitigation plan approved by the department. This section further provides requirements concerning mitigation plans related to mining. This section is applicable and relevant to the extent that nongame birds or their eggs are located on or near the site and such species have not been included in the fish and wildlife conservation plan filed pursuant to the Federal Fish and Wildlife Conservation Act. Species included in the plan will be protected at the federal standard making this section an ARAR to the extent that it is more stringent than the federal standard of protection.
Fur-bearing mammals	Provides manners under which fur-bearing mammals may be taken	Fish and Game Code section 4000, et. Seq. (Stats.	This section provides that a fur-bearing mammal may be taken only with a trap, a firearm, bow and arrow, poison under a proper permit, or with the use of dogs.

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
		1957, c. 456, p. 1380, section 4000)	
Nongame mammals	Action must be taken to avoid the take or possession of nongame mammals	Fish and Game Code section 4150 (Added by Stats. 1971, c. 1470, p. 2907, section 21)	Nongame mammals are those occurring naturally in California which are not game mammals, fully protected mammals, or fur-bearing mammals. These mammals, or their parts, may not be taken or possessed except as provided in this code or in accordance with regulations adopted by the commission.
White Shark	Action must be taken to avoid the take of any white shark	Fish and Game Code section5517 (Added by Stats. 1993, c. 1174 (A.B. 522), section 2)	It is unlawful to take any white shark (Carcharodon carcharias), except under permit issued pursuant to section 1002 for scientific or educational purposes.
Tidal Invertebrates	Action must be taken to avoid the take or possession of mollusks, crustaceans, or other invertebrates	Fish and Game Code section 8500(Added by Stats.	It is unlawful to possess or take, unless otherwise expressly permitted in this chapter, mollusks, crustaceans, or other invertebrates, unless a valid tidal invertebrate permit has been issued. The taking, possessing, or landing of such invertebrates pursuant to this section shall be subject to regulations adopted by the commission.

CALIFORNIA DEPARTMENT OF FISH AND GAME
LOCATION AND ACTION SPECIFIC ARARs AND TBCs
For Parcel F, Hunters Point Shipyard

LOCATION	STANDARD	SPECIFIC CITATION	ARAR/TBC EXPLANATION
		1972, c. 1248, p. 2436. Section 2, eff. Dec. 13, 1972)	
White Shark	Action must be taken to prevent the take of any white shark.	Title 14 C.C.R. section 28.06 (effective 03/07/94)	Regulation provides that white shark may not be taken, except under permit issued by the Department pursuant to section 1002 of the Fish and Game Code for scientific or educational purposes.
Protected Amphibians	Action must be taken to avoid the take or possession of protected amphibians.	Title 14 C.C.R. sections 40 (Section 40 designated effective 03/01/74)	This regulation makes it unlawful to capture, collect, intentionally kill or injure, possess, purchase, propagate, sell, transport, import, or export any native reptile or amphibian, or parts thereof unless under special permit from the department issued pursuant to Title 14 C.C.R. sections 650, 670.7, or 783 of these regulations, or as otherwise provided in the Fish and Game Code or these regulations.

MCATEER-PETRIS ACT

CHAPTER 1. FINDINGS AND DECLARATIONS OF POLICY

66605. Findings and Declarations as to Benefits, Purposes and Manner of Filling.
The Legislature further finds and declares:
(a) That further filling of San Francisco Bay and certain waterways specified in subdivision (e) of Section 66610 should be authorized only when public benefits from fill clearly exceed public detriment from the loss of the water areas and should be limited to water-oriented uses (such as ports, water-related industry, airports, bridges, wildlife refuges, water-oriented recreation and public assembly, water intake and discharge lines for desalinization plants and power generating plants requiring large amounts of water for cooling purposes) or minor fill for improving shoreline appearance or public access to the Bay;
(b) That fill in the Bay and certain waterways specified in subdivision (e) of Section 66610 for any purpose should be authorized only when no alternative upland location is available for such purposes;
(c) That the water area authorized to be filled should be the minimum necessary to achieve the purpose of the fill;
(d) That the nature, location and extent of any fill should be such that it will minimize harmful effects to the Bay Area, such as, the reduction or impairment of the volume surface area or circulation of water, water quality, fertility of marshes or fish or wildlife resources, or other conditions impacting the environment, as defined in Section 21060.5 of the Public Resources Code;
(e) That public health, safety and welfare require that fill be constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters;
(f) That fill should be authorized when the filling would, to the maximum extent feasible, establish a permanent shoreline;
(g) That fill should be authorized when the applicant has such valid title to the properties in question that he may fill them in the manner and for the uses to be approved.

CHAPTER 2. DEFINITION OF SAN FRANCISCO BAY

66610. Specification of Areas of Jurisdiction of San Francisco Bay Conservation and Development Commission; Definition as prescribing Jurisdiction; Construction; Areas Excluded from Jurisdiction.
For the purposes of this title, the area of jurisdiction of the San Francisco Bay Conservation and Development Commission includes:
(a) San Francisco Bay, being all areas that are subject to tidal action from the south end of the bay to the Golden Gate (Point Bonita–Point Lobos) and to the Sacramento River line (a line between Stake Point and Simmons Point, extended northeasterly to the mouth of Marshall Cut), including all sloughs, and specifically, the marshlands lying between

mean high tide and five feet above mean sea level; tidelands (land lying between mean high tide and mean low tide); and submerged lands (land lying below mean low tide).
(b) A shoreline band consisting of all territory located between the shoreline of San Francisco Bay as defined in subdivision (a) of this section and a line 100 feet landward of and parallel with that line, but excluding any portions of such territory which are included in subdivisions (a), (c) and (d) of this section; provided that the commission may, by resolution, exclude from its area of jurisdiction any area within the shoreline band that it finds and declares is of no regional importance to the bay.
(c) Saltponds consisting of all areas which have been diked off from the bay and have been used during the three years immediately preceding the effective date of the amendment of this section during the 1969 Regular Session of the Legislature for the solar evaporation of bay water in the course of salt production.
(d) Managed wetlands consisting of all areas which have been diked off from the bay and have been maintained during the three years immediately preceding the effective date of the amendment of this section during the 1969 Regular Session of the Legislature as a duck hunting preserve, game refuge or for agriculture.
(e) Certain waterways (in addition to areas included within subdivision (a)), consisting of all areas that are subject to tidal action, including submerged lands, tidelands, and marshlands up to five feet above mean sea level, on, or tributary to, the listed portions of the following waterways:
(1) Plummer Creek in Alameda County, to the eastern limit of the saltponds.
(2) Coyote Creek (and branches) in Alameda and Santa Clara Counties, to the easternmost point of Newby Island.
(3) Redwood Creek in San Mateo County, to its confluence with Smith Slough.
(4) Tolay Creek in Sonoma County, to the northerly line of Sears Point Road (State Highway 37).
(5) Petaluma River in Marin and Sonoma Counties to its confluence with Adobe Creek, and San Antonio Creek to the easterly line of the Northwestern Pacific Railroad right–of–way.
(6) Napa River, to the northernmost point of Bull Island.
(7) Sonoma Creek, to its confluence with Second Napa Slough.
(8) Corte Madera Creek in Marin County to the downstream end of the concrete channel on Corte Madera Creek which is located at the United States Army Corps of Engineers Station No. 318+50 on the Corte Madera Creek Flood Control Project. The definition which is made by this section is merely for the purpose of prescribing the area of jurisdiction of the commission which is created by this title. This definition shall not be construed to affect title to any land or to prescribe the boundaries of the San Francisco Bay for any purpose except the authority of the commission created by this title. The jurisdiction of the commission under this section shall not extend to the areas commonly known as the Larkspur and Greenbrae Boardwalks in the County of Marin, such areas to be defined by commission regulation.

SAN FRANCISCO BAY PLAN

Bay Plan Policies on Water Surface Area and Volume

1. The surface area of the Bay and the total volume of water should be kept as large as possible in order to maximize active oxygen interchange, vigorous circulation, and effective tidal action. Filling and diking that reduce surface area and water volume should therefore be allowed only for purposes providing substantial public benefits and only if there is no reasonable alternative.

2. Water circulation in the Bay should be maintained, and improved as much as possible. Any proposed fills, dikes, or piers should be thoroughly evaluated to determine their effects upon water circulation and then modified as necessary to improve circulation or at least to minimize any harmful effects.

3. Because further study is needed before any barrier proposal to improve water circulation can be considered acceptable, the Bay Plan does not include any barriers. Before any proposal for a barrier is adopted in the future, the Commission will be required to replan all of the affected shoreline and water area.

Water Quality

1. To the greatest extent feasible, the Bay marshes, mudflats, and water surface area and volume should be maintained and, whenever possible, increased. Fresh water inflow into the Bay should be maintained at a level adequate to protect Bay resources and beneficial uses. Bay water pollution should be avoided.

2. Water quality in all parts of the Bay should be maintained at a level that will support and promote the beneficial uses of the Bay as identified in the Regional Water Quality Control Board's Basin Plan. The policies, recommendations, decisions, advice and authority of the State Water Resources Control Board and the Regional Water Quality Control Board, should be the basis for carrying out the Commission's water quality responsibilities.

3. Shoreline projects should be designed and constructed in a manner that reduces soil erosion and protects the Bay from increased sedimentation through the use of appropriate erosion control practices.

4. Polluted runoff from projects should be controlled by the use of best management practices in order to protect the water quality and beneficial uses of the Bay, especially where water dispersion is poor and near shellfish beds and other significant biotic resources. Whenever possible, runoff discharge points should be located where the discharge will have the least impact. Approval of projects involving shoreline areas polluted with hazardous substances should be conditioned so that they will not cause harm to the public or the beneficial uses of the Bay.

Bay Plan Policies on Fish and Wildlife

1. The benefits of fish and wildlife in the Bay should be insured for present and future generations of Californians. Therefore, to the greatest extent feasible, the remaining

marshes and mudflats around the Bay, the remaining water volume and surface area of the Bay, and adequate fresh water inflow into the Bay should be maintained.

2. Specific habitats that are needed to prevent the extinction of any species, or to maintain or increase any species that would provide substantial public benefits, should be protected, whether in the Bay or on the shoreline behind dikes. Such areas on the shoreline are designated as Wildlife Areas on the Plan maps.

Bay Policies on Marshes and Mudflats

1. Marshes and mudflats should be maintained to the fullest possible extent to conserve fish and wildlife and to abate air and water pollution. Filling and diking that eliminate marshes and mudflats should therefore be allowed only for purposes providing substantial public benefits and only if there is no reasonable alternative. Marshes and mudflats are an integral part to the Bay tidal system and therefore should be protected in the same manner as open water areas.

2. Any proposed fills, dikes, or piers should be thoroughly evaluated to determine their effects on marshes and mudflats, and then modified as necessary to minimize any harmful effects.

3. To offset possible additional losses of marshes due to necessary filling and to augment the present marshes, (a) former marshes should be restored when possible through removal of existing dikes, (b) in areas selected on the basis of competent ecological study, some new marshes should be created through carefully placed lifts of dredged spoils, and (c) the quality of existing marshes should be improved by appropriate measures whenever possible.

Bay Plan Policies on Navigational Safety and Oil Spill Prevention

1. Physical obstructions to safe navigation, as identified by the U.S. Coast Guard and the Harbor Safety Committee of the San Francisco Bay Region, should be removed to the maximum extent feasible when their removal would contribute to navigational safety and would not create significant adverse environmental impacts. Removal of obstructions should ensure that any detriments arising from a significant alteration of Bay habitats are clearly outweighed by the public and environmental benefits of reducing the risk to human safety or the risk of spills of hazardous materials, such as oil.

2. The Commission should ensure that marine facility projects are in compliance with oil spill contingency plan requirements of the Office of Spill Prevention and Response, the U.S. Coast Guard and other appropriate organizations.

3. To ensure navigational safety and help prevent accidents that could spill hazardous materials, such as oil, the Commission should encourage major marine facility owners and operators, the U. S. Army Corps of Engineers and the National Oceanic and Atmospheric Administration to conduct frequent, up-to-date surveys of major shipping channels, turning basins and berths used by deep draft vessels and oil barges. Additionally, the frequent, up-to-date surveys should be quickly provided to the U.S. Coast Guard Vessel Traffic Service-San Francisco, masters and pilots.

APPENDIX C
MEMORANDUM OF AGREEMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

June 30, 1998

Mr Henry Gee
BRAC Business Line Coordinator
Department of the Navy
Engineering Field Activity, West
900 Commodore Drive
San Bruno, California 94066-2402

Dear Mr. Gee:

The issue of groundwater classification has recently come up on many of our Bay Area bases, and I would like to take this opportunity to provide some clarification on the differences between the State of California's definition of a potential drinking water source and the federal EPA definition.

Under State Water Board resolution 88-63, all state waters are considered to be potential drinking water unless either the total dissolved solids (TDS) exceeds 3,000 mg/l and the Regional Water Board makes a determination that the water is not reasonably expected to supply a public water system, or the yield is less than 200 gal/day. However, EPA's Groundwater Classification Guidelines use a stricter standard of 10,000 mg/l TDS or less and a yield of 150 gal/day to define a potential drinking water source. The NCP Preamble directs EPA to use the Guidelines when determining the appropriate remediation for contaminated groundwater at CERCLA sites, and EPA's OSWER Direction # 9283.1-09 directs EPA to defer to the NCP Preamble and the Guidelines when a state does not have an EPA endorsed Comprehensive State Groundwater Protection Program (CSGWPP). EPA's definition is based on experiences around the country where the use of aquifers with a TDS up to 10,000 mg/l proved viable as a drinking water source. It also recognizes the importance of maintaining broad protections of potential drinking water sources in light of the growing demands on drinking water supplies. Please see the enclosures for related background information.

Since California does not have a CSGWPP, the federal definition of potential drinking water (10,000 ppm TDS or less and a yield of 150 gal/day) is used during the RI/FS. Many of the Navy's Bay sites overlie aquifers that meet the federal standard of a potential drinking water source and therefore the groundwater beneath these sites needs to be carried into the feasibility study for evaluation of remedial actions to meet potential source of drinking water cleanup goals. Likewise, drinking water Maximum Contaminant Levels (MCLs) are ARARs when an aquifer is a potential drinking water source. The feasibility study should look at a variety of remedial alternatives, which could also include natural attenuation, and, if necessary, the feasibility study

might also include the evaluation for a Technical Impracticability waiver of MCLs as ARARs.

I want to acknowledge that in a few past instances, EPA may have inappropriately concurred with determinations made by the State that an aquifer is not a potential source of drinking water, rather than applying the federal criteria. Unfortunately, in some cases, such as at Hunters Point, the application of federal criteria will require us to revisit some of the RI/FS work that has already been completed. I want to also apologize for the impacts that this may have on the process for making cleanup decisions, and let you know that we will work with you as much as possible and appropriate to minimize these impacts.

At each of the closing bases, EPA will work closely with the Navy to assist in the application of the federal criteria for determining potential drinking water sources. Thank you for your attention to this matter. We should discuss this further at our next monthly managers meeting, and please feel free to call me at (415) 744-2384 if you want to discuss this sooner.

Sincerely,

Tom Huetteman

Tom Huetteman
Chief, Navy Section
Federal Facilities Cleanup Branch

Enclosure 1: NCP preamble, pages 8732-8735
Enclosure 2: OSWER Directive #9283.1-09
Enclosure 3: Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy, December 1986, Executive Summary

cc: Dan Murphy, DTSC
Dennis Mishek, RWQCB
Richard McMurtry, RWQCB

Enclosure 5
Application of Federal Criteria
for Determining Beneficial Uses of Groundwater for CERCLA Cleanups

In a letter to EPA-West dated June 30, 1998, EPA provided the Navy information about the document *Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy* (December 1986) and its use in CERCLA cleanups. This is an expansion on that information. It is intended to provide the Navy specific recommendations on how to evaluate groundwater using these guidelines in order to determine whether a contaminated aquifer or portion of an aquifer should be considered a potential drinking water source for the purposes of making CERCLA cleanup decisions.

An evaluation to determine whether an aquifer is a potential drinking water source should include the following:

Determine whether the yield criterion is met. EPA's yield criterion is 150 gals/day, and the State of California's yield criterion is 200 gals/day. Generally, most sites meet both the state and federal yield criterion. The Navy needs to provide a conclusion about this criterion using both the state and federal yield criteria.

Determine whether and where the Total Dissolved Solids (TDS) criterion is met. Maps should be provided that show where the TDS in the aquifer meets both the state (3,000 mg/l in California) and federal (10,000 mg/l) criteria, where it meets the federal criterion but not the state criterion, and where it does not meet either the state or federal criterion. For maps of the federal TDS criterion, the Navy may use the highest recorded TDS values for each well from their data set (the Navy should consult with the Water Board on which data points they need to see mapped). In addition to map(s), a table should be provided showing all of the available TDS data. Note, indirect measurements of TDS, such as electric conductivity, should not be used in this analysis.

Provide a hydrogeological profile of the site. The documentation should include a description of the site hydrogeology, including identification of each distinct water bearing unit at the site.

Determine the groundwater classification. Using the yield and TDS data, document the portions of the aquifer(s) that meet the federal criteria for a class II aquifer, and document the portions that meet the state criteria. Where a contaminated aquifer is potentially interconnected with an uncontaminated aquifer, the classification of the uncontaminated aquifer also needs to be determined for setting cleanup levels in the contaminated aquifer.

Determine what portions of the contaminated aquifer should be considered a potential drinking water source for a CERCLA cleanup. All waters that the state has determined are potential drinking water sources must be considered potential drinking water sources

for CERCLA cleanups unless the state makes a determination that an aquifer or part of an aquifer is not a potential drinking water source. Although not specifically discussed in EPA's Groundwater Classification Guidelines, the NCP, or the related OSWER Directive #9283.1-09, Region 9 believes that, in applying the federal groundwater classification criteria, other site specific factors can be considered in order to make a final determination as to whether all or portions of the aquifer(s) should be considered a potential drinking water source for making a CERCLA cleanup decision. The following is a list of factors that might be considered: the thickness of the aquifer (i.e., the size of the groundwater resource impacted), the actual TDS levels (are they closer to 10,000 mg/l or closer to 3,000 mg/l), the actual groundwater yield, the proximity to salt water and the potential for salt water intrusion, the quality of underlying water bearing units and whether these units are or are not current or potential drinking water sources, the existence of institutional controls on well construction or aquifer use, information, if any, on current and historic use of the aquifer on the base or in the community surrounding the base, and the cost of cleanup to MCLs. None of these factors by itself is necessarily justification for not being a potential drinking water source.

Tables summarizing groundwater contamination. Develop a groundwater screening table to determine where groundwater contamination is at acceptable concentrations for human health, regardless of whether it is a potential drinking water source, and where it is at potentially unacceptable concentrations. Groundwater data should be screened against MCLs, the tap water PRGs, and, where applicable, background.

Finally, as part of a proposed plan, the public should be given the chance to comment on decisions made about beneficial use of groundwater during the public comment period for a groundwater cleanup decision, and these comments need to be considered in making a final cleanup decision.

When the contaminated portion of an aquifer is determined to be a potential drinking water source, MCLs are ARARs for any CERCLA remedy selected for the aquifer. Where the Navy has made a determination that a contaminated aquifer, or portion of a contaminated aquifer, is not a potential drinking water source for its CERCLA cleanup decision, the Navy still needs to evaluate and address potential health threats from all other pathways, such as vapor phase migration to above ground or migration to surface waters, and all other potential beneficial uses, such as commercial, industrial, and agricultural. Consideration should also be given to the potential health threats that may result from unanticipated or even prohibited uses. For example, if the failure of a groundwater remedy that relies on institutional controls could result in a significant or even acute health threat, a more active remedy may be appropriate.

In those instances where a decision is made not to treat a class II aquifer as a potential drinking water source, the Navy should consider source control and mass removal as part of a remedy where there is the potential for substantial long term further degradation of the groundwater resource through the continued spread of contamination or where there is the potential for

significant health threats from unanticipated use of the groundwater. Such an approach involves a balance between overall protection of the groundwater resource, the Superfund policy to generally treat all class II aquifers as potential drinking water sources, and the necessary site specific requirements for a protective and cost-effective remedy. Region 9 is unwilling to support greater flexibility in the application of Superfund policy on the use of EPA's groundwater classification if such a balance is not met in the final cleanup decision. Therefore, EPA concurrence with any Navy determination that a class II aquifer should not be considered a potential drinking water source for a CERCLA cleanup decision will be contingent on the selected remedy and ultimate cleanup number.

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

JAN 16 2004

MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY (ENVIRONMENT, SAFETY, AND OCCUPATIONAL HEALTH)
DEPUTY ASSISTANT SECRETARY OF THE NAVY (ENVIRONMENT)
DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE (ENVIRONMENT, SAFETY, AND OCCUPATIONAL HEALTH)
STAFF DIRECTOR, ENVIRONMENT AND SAFETY, DEFENSE LOGISTICS AGENCY SUPPORT SERVICES

SUBJECT: Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Record of Decision (ROD) and Post-ROD Policy

The Department of Defense (DoD) and the Environmental Protection Agency (EPA) have reached agreement on an interim two-prong approach for Records of Decision (RODs) and post-ROD implementation and documentation for National Priorities List (NPL) sites. My office fully supports both interim approaches. Components may choose either approach, or elements from each.

It is fully expected that regulators will not pressure any one Component to adopt a particular approach. If regulators seek to do so, or to diverge from either approach by adding requirements not encompassed within them, please report such deviations to my office.

My office, with input from Service representatives, has developed several metrics to evaluate the effectiveness of each approach. I realize that because each approach confers different requirements and agreements at different stages of the environmental restoration process, there is not a specific metric by which to fully evaluate each approach. As such, these metrics focus on multiple factors that will be viewed holistically. The two interim approaches are described at attachment 1 and the metrics are provided at attachment 2. Data should be accumulated beginning on October 1, 2003.

The Department recognizes that adopting these interim approaches requires revising some existing policies, especially those for Federal Facility Agreements (FFAs) and overall post-ROD policies for National Priorities List (NPL) sites. Interim guidance on these issues is provided at attachment 3.

The Department has also made a commitment to establish a priority post-ROD task force with the EPA to streamline and resolve issues regarding site and installation close-out requirements and to evaluate the best elements of both approaches. I encourage your support on this very important task. My point of contact is Ms. Patricia Ferrebee at (703) 695-6107.

Alex A. Beehler

Alex A. Beehler
Assistant Deputy Under Secretary of Defense
(Environment, Safety and Occupational Health)

Attachments:
As stated

Attachment 1

NAVY

PRINCIPLES AND PROCEDURES FOR SPECIFYING, MONITORING AND ENFORCEMENT OF LAND USE CONTROLS AND OTHER POST-ROD ACTIONS

PREAMBLE

Since the Department of Defense (DoD) /Environmental Protection Agency (EPA) Model Interagency Agreement (IAG)/Federal Facility Agreement (FFA) was developed in 1988, EPA and Navy have gained considerable knowledge and understanding about post-Records of Decisions (ROD) activities, especially Land Use Controls (LUCs). Thinking, policies, regulations and procedures concerning LUCs have evolved considerably since DoD and EPA developed the 1988 FFA model language. New statutes and regulations related to LUCs are being considered in many states. Accordingly, EPA and the Department of the Navy (DON) believe that a set of Principles will assist Navy field commands and EPA Regions to better implement our respective Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) responsibilities. The Principles described below do not replace or substitute for any existing CERCLA statutory or regulatory requirement. Rather they provide a mutually agreeable framework to provide a more efficient process to implement LUCs at National Priority List (NPL) installations.

These Principles will guide the EPA and DON personnel involved in these decisions. They are written in full knowledge that state regulatory and trustee organizations have independent responsibilities and authorities. EPA and the DON recognize the importance of the state role in helping to ensure a cleanup is protective of human health and the environment. Headquarters EPA and DoD will jointly develop a communications plan to ensure we include the states in this important issue.

These Principles support the President's Management Agenda by focusing on improving environmental results. The Principles encourage continued innovation and improvement in CERCLA implementation. EPA and the Components should continue to propose and pilot initiatives at Component installations or at other properties for which they are responsible. This includes

proposing variations in, or alternatives such as performance-based practices to, the approach described in this document.

PRINCIPLES

- At sites where remedial action is determined necessary to protect human health and the environment, the actions must be documented in accordance with CERCLA and its implementing regulation, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

- At sites where contaminants are left in place at levels that do not allow for unrestricted use, LUCs are used to ensure that the contaminants do not pose an unacceptable risk to human health or the environment. LUCs consist of engineering controls and/or institutional controls.

- The EPA and DON desire to ensure that LUCs are specified, implemented, monitored, reported on, and enforced in an efficient, cost-effective manner that ensures long-term protectiveness. In addition, in accordance with CERCLA and the NCP, if an equally protective but more cost-effective remedy is identified, DON may propose, and EPA will consider, using the more cost-effective remedy.

- The EPA acknowledges the DON's role and responsibilities as the Federal Lead Agent for response actions. This role includes selecting remedies with EPA at NPL sites and funding response actions.

- The DON acknowledges EPA's role and responsibilities for regulatory oversight and enforcement at NPL sites. This role includes ultimate ability to select the remedy at NPL sites if EPA disagrees with DON's proposed remedy and dispute resolution fails.

- Federal Facilities Agreements (FFAs) are CERCLA 120 agreements used by DON and EPA to describe in detail the roles and relationships among DON, EPA and often the state. They form the foundation for these relationships regarding DON's response actions at NPL sites. FFAs also contain installation specific details and procedures for planning, budgeting, and dispute resolution. DON and EPA desire FFAs to be as standardized as possible and relatively static (i.e., the FFA should not need to be changed for a given installation).

- Primary Documents developed under the FFA are relatively dynamic and document important plans and actions. In that sense, they are action-oriented. For example, a Site Management Plan is revised yearly via collaboration among DON

and EPA remedial project managers and is an important tool for planning response actions and demonstrating commitment to the public. Likewise, a LUC Remedial Design (RD) or Remedial Action Work Plan (RAWP) describes those actions that are needed to ensure viability of both long-term engineered and institutional control remedies.

- Records of Decision should document the remedy selection process and remedy decision in accordance with CERCLA and the NCP, as well as applicable and appropriate guidance, regulations, standards, criteria, and policy. With regard to LUCs, the ROD should describe the LUC objectives; explain why and for what purpose the LUCs are necessary, where they will be necessary, and the entities responsible for implementing, monitoring, reporting on and enforcing the LUCs. The ROD will refer to the RD or RAWP for implementation actions.

- Where situations arise (such as new cleanup standards; new or additional contamination is discovered on a site, etc.) that require additional response actions that go beyond the actions and objectives described in a ROD, and any related ROD Amendment or Explanation of Significant Difference (ESD), the additional actions required and their remedial objectives will be further documented in an ESD or ROD Amendment, as appropriate. There may also arise situations after a remedy has been completed that require removal actions to protect human health and the environment, such as the newly discovered contamination posing an imminent risk to human health. In such circumstances, documentation as required in the removal process should be created.

- Given the above, EPA and DON agree that the most efficient framework for specifying, implementing, monitoring, reporting on and enforcing LUCs is:
  - a standard FFA for NPL sites,
  - a clear, concise RoD with LUC objectives, and
  - a RD or RAWP with LUC implementation actions.

Note: These documents are described more fully below.

- EPA and DON will move expeditiously to finalize all outstanding FFAs using a standard FFA template as a guide to minimize the development/writing process.

Note: A "standard FFA" means the Agreement presently being used between EPA and DoD using the DoD-EPA model language, plus site-specific statements of fact, plus the additional primary document shown in Attachment (1).

- EPA and DoD will initiate a task force with appropriate headquarters and field representatives from EPA and the military services. The task force will make recommendations as to how to ensure that the same documentation can be used to memorialize both remedial action completion and deletion, as well as to determine the process whereby DoD and EPA will document the completion of the remedial actions required by the ROD in a single primary document. The task force will examine ways to reduce document size, review time, and revisions. The task force will recommend changes to guidance and policy that will help reduce document size or streamline the process in order to manage costs. The task force may also include other stakeholders.

  After reviewing the task force recommendations EPA and DoD will determine how to ensure that the same documentation can be used to memorialize both remedial action completion and deletion, as well as to determine the process whereby DoD and EPA will document the completion of the remedial actions required by the ROD in a single primary document. In addition, EPA and DoD will streamline the remedial process and better manage costs. While the efforts of the Task Force are meant to complement the Principles described above, its work is separate from the Principles and must not impede their implementation. The work of the Task Force also must not impede completion or closeout of individual sites or operable units.

GENERAL PROCEDURES

1. <u>Federal Facility Agreement</u>

   - The LUC implementation and operation/maintenance actions will be included in the RD or RAWP which are already primary documents deliverable under standard FFAs. In addition, the same documentation as determined by the task force and approved by the Parties to memorialize both the remedial action completion and deletion will be provided as a primary document for new FFAs. For existing FFAs without such a primary document, this document will be provided as an attachment to the RD or RAWP with the same enforceability as a primary document.

Note: Model FFA language will need to be supplemented to reflect these Principles and Procedures. Attachment (1) contains necessary modifications to FFA language.

2. Record of Decision

- It is EPA's and DON's intent that Records of Decision (RoDs) continue to be consistent with CERCLA and the National Contingency Plan. Relative to land use controls and institutional controls, the ROD shall:
  - Describe the risk(s) necessitating the remedy including LUCs;
  - Document risk exposure assumptions and reasonably anticipated land uses;
  - Generally describe the LUC, the logic for its selection and any related deed restrictions/notifications;
  - State the *LUC performance objectives*. (See attachment (2) for examples of LUC performance objectives);
  - List the parties responsible for implementing, monitoring, reporting on, and enforcement of the LUC;
  - Provide a description of the area/property covered by the LUC (should include a map);
  - Provide the expected duration of the LUCs; and
  - Refer to the RD or RAWP for LUC *implementation actions*, since these details may need to be adjusted periodically based on site conditions and other factors. (See attachment (2) for examples of LUC implementation actions).

- The ROD at transferring properties will need to be crafted based on the responsibilities of the new owner and state-specific laws and regulations regarding LUCs. At transferring properties, compliance with the LUC performance objectives may involve actions by the subsequent owners in accordance with deed restrictions, however, ultimate responsibility for assuring that the objectives are met remains with DON as the party responsible under CERCLA for the remedy. DON and regulators will consult to determine appropriate enforcement actions should there be a failure of a LUC objective at a transferred property.

3. LUC Remedial Design (RD) or Remedial Action Work Plan (RAWP)

- The RD or RAWP will be provided as a primary document in accordance with the FFA.
- The RD or RAWP will describe short and long-term implementation actions and responsibilities for the actions in order to ensure long-term viability of the remedy which may include both LUCs (e.g., institutional controls) and an engineered portion (e.g., landfill caps, treatment systems) of the remedy. The term "implementation actions" includes all actions to implement, operate, maintain, and enforce the remedy. Depending on the LUC and site conditions, these actions can include:

- Conducting CERCLA five-year remedy reviews for the engineered remedies and/or LUCs.
- Conducting periodic monitoring or visual inspections of LUCs; frequency to be determined by site-specific conditions.
- Reporting inspection results.
- Notifying regulators prior to any changes in the risk, remedy or land use including any LUC failures with proposed corrective action.
- Including a map of the site where LUCs are to be implemented.

For active bases,

- Developing internal-DON policies and procedures with respect to LUC monitoring, reporting, and enforcement in order to institutionalize LUC management and to ensure base personnel are aware of restrictions and precautions that should be taken; Consulting with EPA at least 14 days prior to making any changes to these policies and procedures to ensure that any substantive changes maintain a remedy that is protective of human health and the environment.
- Developing a comprehensive list of LUCs with associated boundaries and expected durations.
- Notifying regulators of planned property conveyance, including federal-to-federal transfers. "Property conveyance" includes conveying leaseholds, easements and other partial interests in real property.
- Obtaining regulator concurrence before modifying or terminating land use control objectives or implementation actions.

For closing bases/excess property:

- Notifying regulators of planned property conveyance, including federal-to-federal transfers.
- Consulting with EPA on the appropriate wording for land use restrictions and providing a copy of the wording from the executed deed.
- Defining responsibilities of the DON, the new property owner and state/local government agencies with respect to LUC implementation, monitoring, reporting, and enforcement.
- Providing a comprehensive list of LUCs with associated boundaries and expected durations.
- Obtaining regulator concurrence before modifying or terminating land use control objectives or implementation actions.

Note: The mix of responsibilities among DON, the new property owner, and other government agencies depends on state and federal laws and regulations

that are applied in the state. Implementation actions at closing bases may include elements characteristic of both active and closing bases, depending on the timing of transfer.

- Should there be a failure to complete LUC implementation actions at an active base, the EPA Region shall notify the installation and seek immediate action. Should there be a failure to complete LUC actions after such notification to the base, EPA may notify the Deputy Assistant Secretary of the Navy (Environment) who will ensure that LUC actions are taken.

- Should there be a failure to complete implementation actions that are the responsibility of a subsequent owner or third party at a transferred property, EPA and DON will consult on the appropriate enforcement action. Should there be a failure to complete implementation actions that are the remaining responsibility of DON at a transferred property, the EPA Region will notify the cognizant Navy Engineering Field Division. If necessary, EPA may notify the Deputy Assistant Secretary of the Navy (Environment) who will ensure that corrective action is taken.

  Note: The RD or RAWP should contain no more or no less implementation actions than needed to ensure the viability of the remedy. There is a delicate balance required. EPA and DON both desire to ensure protectiveness while minimizing process and documents. The parties agree to work diligently to define the appropriate implementation actions for each LUC. EPA and DON believe the key elements can be easily developed between RPMs in a matter of a few hours. Based on detailed discussions and the examples shown in Attachment (2), EPA and DON expect that the LUC portion of the RDs or RAWPs to be in the range of 2-6 pages. If combined with a sampling plan, there may be additional pages needed to list the analyses, sampling locations and frequencies.

4. <u>LUC Data</u>

- The DON will ensure that all LUCs at its installations are included in the Service LUC database.

Attachments:

1. Incorporating Land Use Control (LUC) Objectives and Implementing Actions into Federal Facilities Agreements (FFAs)
2. Examples of LUC objectives and LUC Implementation Actions

Attachment 1 to Navy Principles

INCORPORATING LAND USE CONTROL (LUC) OBJECTIVES AND IMPLEMENTATION ACTIONS INTO FEDERAL FACILITIES AGREEMENTS (FFAs)

FFA Model Template Additions/Changes

1. Definitions Section:

Add: "Land use controls" shall mean any restriction or administrative action, including engineering and institutional controls, arising from the need to reduce risk to human health and the environment.

2. Primary Documents:

Add: A document memorializing remedial action completion.

Note: EPA and DoD believe it is important that a primary document: (1) document the completion of remedy-in-place and/or site close-out and (2) receive concurrence from EPA. The task force discussed above will make recommendations on the scope and content of the document, and DoD and EPA will determine this document after reviewing the task force recommendations. In the meantime, EPA and DON shall enter into FFAs which include a primary document memorializing remedy completion. The document shall not duplicate information in the Administrative Record or previously provided to EPA. Previously provided information shall be referenced and itemized. New information/data (e.g., sampling data) may be needed to demonstrate that the Remedial Action Objectives have been met. The report shall also include any as-built drawings for remedies if different from the remedial design. EPA and DoD do not envision this to be a lengthy document, but shall contain only the information needed to justify the remedy completion. EPA and DoD believe the document should discuss how the remedial objectives in the ROD have been met. It should not be used to expand the scope of requirements beyond the remedial actions required in the original ROD or any subsequent amendment or explanation of significant difference. Instead, if new requirements are needed for a protective remedy, these will be documented in an Explanation of Significant Difference or ROD Amendment, as appropriate, prior to

reaching the milestone. The EPA and DoD will determine the precise nature of this document after reviewing the task force's recommendations.

Change: Eliminate the sub-bullets (subsidiary documents) under remedial action work plan for document streamlining purposes.

Attachment 2 to Navy Principles

EXAMPLES OF LUC OBJECTIVES AND LUC IMPLEMENTATION ACTIONS

(Note: Actions are to be tailored to site-specific conditions.
This is neither a mandatory nor a complete list)

LUC OBJECTIVES (contained in ROD)

- Ensure no construction on, excavation of, or breaching of the landfill cap.
- Ensure no residential use or residential development of the property.
- Ensure no withdrawal and/or use of groundwater.
- Ensure no excavation of soils without a use permit and special handling procedures.

***LUC IMPLEMENTATION ACTIONS** (contained in the RD or RAWP)*

- Conduct a CERCLA five-year remedy review of the LUC and provide to EPA for review.
- Conduct annual inspections of the LUC and report results (active or BRAC – responsible party to be defined).
- Record the LUC in the base master plan. (active)
- Produce a survey plat of the LUC by a state registered land surveyor. (active or BRAC).
- File the survey plat with the local government/Circuit Court for purposes of public notification (active or BRAC)
- Place a survey plat in CERCLA administrative record, and send copies to EPA and state. (active or BRAC).
- Develop and implement a base procedure that requires excavation to be approved by the Public Works Officer or equivalent official. (active)
- Develop and implement a base procedure that requires changes in land use to be approved by the Public Works Officer or equivalent official. (active)
- Notify the regulatory agencies 45 days in advance of any Base proposals for a major land use change at a site inconsistent with the use restrictions and exposure assumptions described in the RoD, any anticipated action that may disrupt the effectiveness of the land use controls, any action that might alter or negate the need for the land use controls, or any anticipated transfer of the property subject to the land use controls.
- Obtain regulator concurrence before modifying or terminating land use control objectives or implementation actions.
- Maintain a comprehensive list of LUCs with associated boundaries and expected durations.

Note: These examples are consistent with draft EPA guidance: "Describing

Institutional Controls in Remedy Decision Documents at Active Federal Facilities".

AIR FORCE
PRINCIPLES OF AGREEMENT FOR
PERFORMANCE-BASED RECORDS OF DECISION
IN ENVIRONMENTAL RESTORATION

1. *The President's Management Agenda* clearly directs federal agencies to reform their activities to prioritize performance and results so that "emphasis on process will be replaced by a focus on results." Thus the focus of the Air Force's (AF) environmental restoration program is to select, implement, maintain, and where necessary review and monitor remedial action results that protect human health and the environment. EPA has joint responsibility with the AF to select the remedy at National Priority List (NPL) facilities, and an interest in confirming that such remedies remain in place and continue to be protective. The actions of both agencies should reflect the President's direction to restore freedom to manage to responsible agencies, eliminating excessive command and control, approval mechanisms and red tape that hinder efficiency.

2. Records of Decision (RODs) are public documents that should direct: (i) remedy implementation based on performance needed to achieve remedial objectives, (ii) notification and dialogue among parties, (iii) reasonable access to sites for performance verification, and (iv) accountability for performance on the part of the AF.

3. The AF has the responsibility and obligation to carry out the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and National Contingency Plan (NCP) requirements as it implements, maintains, and where necessary reviews and monitors protective remedies needed to achieve remedial objectives.

4. Restoration resources in the form of time, money and personnel should be focused on defining remedial objectives (i.e., results) and the essential actions required to achieve those objectives. Such objectives and essential actions are enforceable requirements of the ROD under CERCLA and the NCP.

a. The ROD should be streamlined to contain remedial objectives, essential implementation and maintenance actions to achieve the objectives, and other content elements required by CERCLA and the NCP. These performance objectives in the ROD, supported by the "essential actions" taken to meet them, are enforceable requirements of the remedy.

b. The Air Force must still determine the detailed steps to take to carry out actions that achieve remedial objectives. This can include, as appropriate, O&M plans or detailed implementation plans; the details of such documents will be shared with regulators for review and comment, but are not subject to additional EPA approval and enforcement beyond that applied to the ROD, subject to Section 8 below.

c. The ROD should not require new or further deliverables and documents, or contain repetitive information, and should use cross-references, existing data, templates, and remedy selection assumptions wherever it makes sense and is cost-effective to do so.

5. The Air Force will be held accountable to achieve the remedial objectives and essential actions identified in the ROD. This means being prepared for enforcement action should the Air Force fail to perform its essential responsibilities.

a. The Air Force remains subject to CERCLA enforcement mechanisms by EPA, states, and citizens if it fails to implement and maintain a protective remedy, such as, but not limited to, citizen suits, civil penalties, etc.

b. The Air Force remains subject to stipulated penalty provisions where existing Federal Facilities Agreements (FFAs) identify RODs as "primary documents."

6. The Air Force will agree to provide essential information to EPA, states and the public regarding the status of achieving performance objectives and essential actions identified in the ROD. EPA and states can independently verify such information through reasonable access to documents and facilities. Depending on site-specific risk factors that may warrant a change in reporting frequency, the expectation is that an annual summary report will be appropriate, supplemented by additional prompt reporting of any remedy deficiency or failure that presents or could imminently lead to an actual risk to human health and the environment, and the actions taken or planned to address and correct such deficiency or failure. Such limited monitoring and reporting, as described here, is an exception to the prohibition on post-ROD implementation measures reflected in the 23 Jan 2002 Air Force Policy and Guidance on Remedy Selection Documentation in Records of Decision (RODs).

7. Because "success" and "compliance" will be defined in terms of achieving performance objectives and essential actions, rather than meeting document exchange deadlines, Air Force personnel must foster and maintain dialogues with the regulators, particularly concerning technical implementation issues. Work plans or other technical documents that are not independently enforceable or subject to regulator approval should nonetheless undergo review by all parties to ensure compatibility with ultimate remedial objectives. The failure to do so will increase the likelihood of a legitimate challenge by the regulators and the public as to whether remedial action objectives in fact are being achieved (or have been achieved, if a closeout determination is at issue).

8. Integration of Performance-Based Response Actions with existing FFAs and RODs:

a. The process improvements developed as part of the Air Force performance-based principles do not change obligations under existing FFAs or RODs. However, parties to existing FFAs may amend them or interpret them to incorporate these performance-based actions and improvements.

b. If an existing FFA already addresses implementation, O&M plans, or completion and review provisions (e.g., identifies an O&M plan as a

"primary" document"), then such documents should conform to the enforceable objectives and actions contained in the ROD.

c. The Air Force should update the ROD as necessary to protect human health and the environment in conformance with Section 300.435 of the National Contingency Plan (i.e. perform a ROD amendment for fundamental changes, or an Explanation of Significant Difference (ESD) for significant changes, or record non-significant or minor changes in the post-ROD site file). If the Air Force finds that such an update is necessary, it should be done in accordance with the approach defined by these principles. In particular, if hazardous substances are left in place above unlimited use and unrestricted exposure levels, the 5-year review affords the Air Force an opportunity to confirm the conclusions in an existing ROD or to update the ROD if differences significantly or fundamentally alter the basic features of the selected remedy with respect to scope, performance or cost.

d. The Air Force shall incorporate these principles both in negotiating future Interagency Agreements and in modifying existing FFAs.

Attachment 2

Metrics

Objective: Measure the results of the two Post-ROD approaches being used in DoD.

Method: The best measure of any method is the end results achieved and at what cost. The following measures will allow DoD to determine the programmatic effects the Post-ROD approaches are having on key indicators of performance. In addition, a selected group of bases will be examined in detail to determine post-ROD procedures, practices and results. This information will also be useful for the DoD-EPA post-ROD task force.

Measures:

- Planned versus actual sites reaching RIP/RC in the current FY
- Reductions or increases in Cost-to-Complete for sites reaching RIP/RC in the current FY
    - Show reasons for any increases (e.g., new contamination; additional documents/approvals required by regulators)
- Report any violations of Land Use Controls (where DoD retains responsibility for the LUC) and reason for violation
- Examination of the following post-ROD elements at selected bases:
    - Procedures
    - Documents
    - Disputes
    - Results (site closures, de-listing)

Benefits:

- Uses two metrics already available
- Focuses on end results per the President's Management Agenda
- Adds an additional metric (LUC violations) but one that will show if LUC implementation actions are effective.
- Provides added qualitative assessment that can be used for benchmarking; avoids pitting services against one another; the best elements of each approach can be used by the services.

Attachment 3
DoD Policy for Federal Facility Agreements, Records of Decision, and Post-ROD Implementation and Documentation for National Priorities List (NPL) Sites

Federal Facility Agreement (FFA) Policy

The existing EPA-DoD model FFA language remains in effect, as amplified by the principles in Attachment 1, as described below. This includes the original 1988 model FFA, edits regarding state participation dated March 17, 1989, and DoD/EPA revisions dated February 10, 1999.

- *Direction on Signing Federal Facility Agreements* (April 23, 2001) and *Guidance on Land Use Control Agreements with Environmental Regulatory Agencies* (March 2, 2001) is amended to allow the addition of a document memorializing remedial action completion as a primary document as outlined in the Navy Principles.
- Other proposed FFA language that conflicts with the model FFA language must undergo a 72-hour review by DUSD(I&E) and the Components before being signed and are not binding precedent for other FFAs.

Record of Decision (ROD) Policy

- *Interim Guidance on Environmental Restoration Records of Decision* (June 4, 2002) is superseded to the extent it:
    - Prohibits the inclusion of periodic monitoring or visual inspection of use restrictions, and submission of associated reports (for information only) to regulators in RODs (such provisions may be included in RODs or an already defined primary document in accordance with the respective Navy or Air Force Principles); or
    - Requires inclusion of dispute resolution language in a ROD (as referenced in the final paragraph of the policy and attached thereto).

Post-ROD Implementation and Documentation Policy

- *Policy on Land Use Controls Associated with Environmental Restoration Activities* (January 17, 2001) remains in effect with the following changes:
    - Section 2, *Definition*: Components may use the following definition of land use controls in this section: "LUCs include any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property to prevent or reduce risks to human health and the environment" or if following the Navy Principles, Components may use the definition used in the Navy Principles.
- *Guidance on Land Use Control Agreements with Environmental Regulatory Agencies* (March 2, 2001) remains in effect for voluntary agreements for implementation of LUCs. Where the guidance limits outlined provisions to voluntary agreement only as compared to enforceable documents, it is amended to allow inclusion of Land Use Control provisions listed in either the Navy or Air Force Principles in the manner described in those Principles.

Memorandum of Agreement Between
The United States Department of the Navy and
The California Department of Toxic Substances Control

Use of Model "Covenant to Restrict Use of Property" at Installations Being Closed and Transferred by the United States Department of the Navy

1. Background

   a. The purpose of this Memorandum of Agreement (MOA) is to formalize the use of two model environmental restriction covenants (attached) that have been drafted during negotiations between representatives of the United States Department of the Navy (DON) and the California Department of Toxic Substances Control (DTSC).

   b. Under CERCLA Sec. 104, as delegated to DON by E.O. 12580, and implemented pursuant to the National Contingency Plan (NCP – 40 CFR Sec. 300 et seq.) and 10 USC Sec. 2701, et seq., the cleanup of hazardous substances, pollutants and contaminants is required to be at a level that protects human health and the environment. As a result, this protection can be achieved at certain sites by the imposition of "institutional controls" (i.e., ICs – legal mechanisms to protect human health and the environment by restricting access or exposure to the contaminants in question) with or without underlying "engineering controls" (i.e., ECs – engineered mechanisms such as a cap on a landfill, designed to physically insure access or exposure to the contaminants in question is prevented). Collectively these ICs and ECs are called "land use controls" (LUCs).

   c. In the case of property being closed and transferred by DON to a nonfederal entity, it is necessary to insure that these LUCs stay in place and are honored by all future owners and occupants of the property in question, for as long as contamination is present at levels that do not permit unrestricted use. One key way such LUCs can be maintained is by DON's retention of sufficient legal title and interest to insure continuing enforcement of the terms of the LUCs. This retention would entail burdening such conveyances of title with deed covenants insuring that the deed transferring such property contain a formal restriction – a restrictive covenant – on the use of the property that will "run with the land," and is enforceable against the "servient estate" (i.e., all future owners of the land) and is retained by the United States, as represented by DON, acting as holder of the "dominant estate." In addition, DON can convey a separate and similar restrictive covenant to DTSC as provided in

Section 2 below.

d. In the State of California, such a restriction on the use of land, to protect human health and the environment is recognized by Section 1471 of the California Civil Code. This statute characterizes such a restrictive covenant as an "environmental restriction" and requires such words to be placed in the title of the document creating such an interest. DON has agreed to include such restrictive language in the deeds it executes where it imposes LUCs as a remedy under applicable law.

e. Similar to CERCLA, State environmental protection laws recognize the availability of using LUCs as remedies to protect human health and the environment. Currently, DTSC's authority under Chapter 6.5 and 6.8 of Division 20 of the California Health and Safety Code, provides statutory avenues to impose LUCs at a cleanup site to insure that the LUCs are honored by future owners. Chapter 6.5 is generally used when the cleanup site in question is one subject to the State's authorities under the hazardous waste facilities law, and Chapter 6.8 is generally used when the cleanup site in question is one subject to the State's equivalent to the federal CERCLA program.

f. In the case of property being closed and transferred to a nonfederal entity by DON where a cleanup remedy has used LUCs as a remedy as described above, DON and DTSC have a mutual interest in insuring that the "environmental restriction" imposed on the land is enforced for however long the protection of public health and the environment requires such restrictions.

g. As a result, DON and DTSC agree that it is in both parties' and the public's interests, that DTSC be in a position to enforce the "environmental restrictions" that the DON will be imposing on these transferring parcels of property. To this end, in addition to retaining the power to enforce protective covenants, DON agrees to convey a separate power to enforce such restrictive covenants to DTSC equivalent to DON's power to enforce any "environmental restrictions" burdening the transferring property by entering into a "Covenant to Restrict Use of Property." Under both Chapter 6.5 and Chapter 6.8, DTSC has the authority to monitor and enforce such "environmental restrictions" conveyed to it by the owner of property on which such an "environmental restriction" has been found necessary. Therefore, in consideration of DON's conveying such an interest, DTSC may implement as appropriate the various statutory authorities it possesses under Chapter 6.5 and Chapter 6.8 (as applicable) to insure these "environmental restrictions" are honored by all future owners and occupants.

2. Terms of Understanding:

a. DON and DTSC agree that in all future property transfers to a nonfederal agency, where DON is acting on behalf of the United States as the transferring or disposing agent, the applicable model "Covenant to Restrict Use of Property" attached to this MOU will be used throughout California when the proposed remedy involves imposing an IC (except those "early transfers" where 1) the transferee will perform the cleanup, and 2) the cleanup includes an IC in the remedy, and 3) has executed an order or enforceable agreement with DTSC or has entered into a Sec. 25222.1 agreement with DTSC, that calls for the transferee entering into a "Covenant to Restrict Use of Property" directly with DTSC).

b. DON and DTSC have entered into a number of Federal Facility Agreements and Federal Site Remediation Agreements for DON property. These Agreements generally call for coordination of the DON's satisfaction of its corrective action obligations under the Resource Conservation and Recovery Act (RCRA) and Health and Safety Code section 25200.10 with its responsibilities under CERCLA section 120(l), EO 12580, the Defense Environmental Restoration Program and the NCP. The Agreements recognize that the DON may satisfy some or all of its corrective action obligations through CERCLA response actions. Where such corrective action at hazardous waste management units is being satisfied through CERCLA, Attachment A shall be used. Attachment B is the model which will be used for hazardous waste management facilities not addressed in Federal Site Remediation or Federal Facility Agreements.

c. When issuing Proposed Plans for public comment, DON will attach a copy of this MOU and the appropriate model "Covenant to Restrict Use of Property" so as to assure the public that the specific LUC being proposed will be enforced, in part, by DON's retained power to enforce the deed covenants and conveyance of the power to enforce protective deed covenants to DTSC contemporaneously with the execution of the deed transferring DON's interests to the new owner.

d. In using these models to draft the appropriate "Covenant to Restrict Use of Property," DON's and DTSC's personnel will work collaboratively to develop the specific information applicable to the given site called for by Articles I (Statement of Facts) and IV (Restrictions) of the attached models. A final "Covenant to Restrict Use of Property" that is ready for signature for a given site, will be prepared in time to allow it to be

executed contemporaneously with the execution of the deed transferring DON's non-retained interests in the property to the new owner. In the case of "early transfers" where DON is performing the cleanup after the transfer, and is imposing an LUC at the time of the "early transfer" in support of its ongoing cleanup activities, the Parties recognize that the contents of Articles I and IV of the model covenants for such sites will likely not be as detailed as that suggested in the attached models. The degree of detail contained within the model covenant will be the information available as to the cleanup site, although the covenants must be adequate to protect human health and the environment to allow an early transfer. The form of remedy and any additional associated IC will be more fully developed once the remedy is selected and implemented.

e. The Parties recognize that given the need to tailor the terms of the "environmental restriction" to the remedy that is finally selected after seeking public comment on the Proposed Plan, the terms of the final "Covenant to Restrict Use of Property" may vary greatly from the draft proposal. The Parties recognize that the public should be given specific notice of this fact in the Proposed Plan.

f. The Parties recognize that remedies proposed by the DON will be submitted to DTSC for concurrence. However, there may be unresolved disagreements at some cleanup sites concerning the remedy being proposed by DON including, in particular, the scope and nature of the LUCs, and the terms of any underlying, proposed "Covenant to Restrict Use of Property." In such situations the Parties will use their best efforts to resolve all disputes informally. If the Parties are ultimately unable to resolve the issue in dispute, DON and DTSC reserve any rights they might have to take any action available under applicable state or federal law.

g. Either Party may terminate its involvement in this Agreement by giving thirty (30) days written notice to the other Party. Upon receipt of notice and the expiration of thirty days termination shall occur by operation of law.

Signed: _____ 10 March 2000

F.R. Ruehe
Rear Admiral
United States Navy
Commander Navy Region Southwest

Date

Signed: Edwin F. Lowry 3/10/00

Edwin F. Lowry
Director
Department of Toxic Substances Control

Date

Attachment A: Model Site Mitigation Program "Environmental Restriction Covenant and Agreement"

Attachment B: Model Hazardous Waste Management Program/State Regulated Unit "Environmental Restriction Covenant and Agreement"

Approved as to form:

Date: 9 March 00 By: Mary Kay Faryan

Approved as to form:

Date: March 16, 2000 By: [illegible]

MODEL SITE MITIGATION PROGRAM

DEED RESTRICTION

RECORDING REQUESTED BY: **[Covenantor's Name]** **[Street Address]** **[City]**, California **[Zip Code]** WHEN RECORDED, MAIL TO: Department of Toxic Substances Control Region ___ **[Street Address]** **[City]**, California **[Zip Code]** Attention: **[Name of Branch Chief]**, Chief **[Branch Designation]**	

SPACE ABOVE THIS LINE RESERVED FOR RECORDER'S USE

COVENANT TO RESTRICT USE OF PROPERTY

ENVIRONMENTAL RESTRICTION

(Re: *[Insert parcel number(s) and name of site property to be restricted.]*)

This Covenant and Agreement ("Covenant") is made by and between the United States of America acting by and through the Department of the Navy ("DON") (the "Covenantor"), the current owner of property situated in *[city]*, County of [ ], State of California, described in Exhibit "A", attached hereto and incorporated herein by this reference (the "Property"), and the State of California acting by and through the Department of Toxic Substances Control (the "Department"). Pursuant to Civil Code section 1471(c), Health and Safety Code Sections 25222.1 and 25355.5 the

Department has determined that this Covenant is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials as defined in Health and Safety Code ("H&SC") section 25260. In addition, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104 (42 USC Section 9604), as delegated to the Covenantor by E.O. 12580, ratified by Congress in 10 USC Sec. 2701, et seq., and implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP – 40 CFR Part 300) and implementing guidances and policies, the Covenantor has also determined that this Covenant is reasonably necessary to protect present or future human health or safety or the environment as the result of the presence on the land of hazardous substances, pollutants and contaminants as defined in CERCLA Section 101 (42 USC Section 9601).

The Covenantor and the Department, collectively referred to as the "Parties", therefore intend that the use of the Property be restricted as set forth in this Covenant, in order to protect human health, safety and the environment.

The Covenantor retains sufficient legal title and interest in the subject property to insure continuing enforcement of the protective covenants and agreements contained within this Covenant to Restrict the Use of Property. Further in any subsequent transfers or conveyance of title to nonfederal entities the DON shall burden the property with additional deed covenants that insure that any subsequent deed or transfer contains the protective covenants and right of access and power to conduct monitoring of wastes retained on site. Those covenants and agreements shall be enforceable against the servient estate in that those protective covenants shall run with the land to

all successors and assigns.

ARTICLE I

STATEMENT OF FACTS

1.01 The Property, totaling approximately [acres] [square yards] is more particularly described and depicted in Exhibit "A", attached hereto and incorporated herein by this reference. ***[Exhibit "A" must include the legal description of the property used by the county recorder. This must include the particular description of the boundaries of the area to be subject to a particular use restriction. If the property does not already have a legal description (it generally will not if it is a portion of a larger piece of property) a survey will be required.]*** The Property is located in the area now generally bounded by ***[Include narrative description of the area; this will typically be street names: e.g., Main Street on the north, Maple Street on the east, etc.]*** County of [ ], State of California.

1.02 ***[Use this paragraph if imposing additional restrictions on a portion of the Property, for example on a capped portion, or if for any other reason it is necessary to precisely identify any portion of the property, such as an area with groundwater monitoring wells. The purpose of this paragraph is to give the precise location of such areas where use restrictions generally will apply. Renumber following paragraphs accordingly.]*** A limited portion of the Property is more particularly described in Exhibit "B" which is attached and incorporated by this reference ("Capped Property") as defined below ***[or "(other identified) Property"]***. ***[Exhibit B must include a legal description of the exact area(s) being restricted***

and any necessary diagram(s). This will generally require a legal survey and engineering drawing for the Cap or other area to be further restricted.] The [Capped *(or other description)*] Property is located in the area now generally bounded by [ ]. ***[Include language that generally describes the Capped or other identified Property.]*** The [Capped *(or other identified)* Property is also more specifically described as encompassing [ ] County Assessor's Parcel No.(s) [ ].

1.03 ***[Briefly describe the remedial measures implemented at the Property, including, if applicable, installation of a cap and construction and ongoing operation and maintenance of a groundwater treatment system, in order to identify the remaining contaminants and physical remedial measures on the Property that necessitate this deed restriction. This paragraph should also briefly discuss the regulatory context for the DON facility. Reference should be made to any applicable Federal Facility Agreement (FFA) or Federal Facility Site Remediation Agreement(FFSRA) and any corrective action obligations under RCRA or Chapter 6.5 of Division 20 of the Health and Safety Code covered by the FFA or FFSRA. This paragraph should refer to, and give the approval date for, the RAP, ROD, RAW or other decision document that selected the remedial measures at the Property and required this Covenant.]***

SAMPLE [For a facility which has an FFA or FFSRA and hazardous waste management units]: The DON and the Department entered into a Federal Facility Agreement (FFA) on [date]. Pursuant to that FFA, the DON may satisfy some or all of its corrective action obligations under the Resource Conservation and Recovery Act

(RCRA)(42 USC 6901 et seq)or California Health and Safety Code sectin 25200.10 through CERCLA response actions. ***{Proceed to additional SAMPLES as appropriate.]***

SAMPLE [For a property with remaining contamination, but no cap, O&M, or other ongoing response activities]: The Property is [a portion of a site] being remediated pursuant to a Record of Decision (ROD) pursuant to the Defense Environmental Restoration Program (DERP), 10 U.S.C. section 2701 et seq, and CERCLA; and a Remedial Action Plan (RAP) pursuant to Chapter 6.8 of Division 20 of the H&SC, under the oversight of the Department. The ROD/RAP provides that a deed restriction be required as part of the site remediation, because lead, which is a hazardous substance, as defined in H&SC section 25316, and a hazardous material as defined in H&SC section 25260 remains at depths of 10 feet or more below the surface of the Property. The DON circulated the ROD/RAP, for public review and comment. The ROD/RAP was approved by the DON and concurred in by the Department on [date], pursuant to which the Property was excavated to a depth of 10 feet, graded, then backfilled with clean soil.

SAMPLE [For a property with ongoing operation and maintenance of a monitoring or treatment system and/or cap. The exact provisions of this paragraph will vary depending upon the facts of the particular site or facility. The paragraph below is illustrative of the kind of information that should be included. Note specifically there is reference to a signed Operation and Maintenance Agreement.]: [Covenantor] ***[or party responsible for the activity, if different from***

Covenantor] is remediating the Property under the supervision and authority of the Department. The Property is [a portion of a site] being remediated pursuant to a Record of Decision (ROD) pursuant to the Defense Environmental Restoration Program (DERP), 10 U.S.C. section 2701 et seq; and a Remedial Action Plan (RAP) pursuant to Chapter 6.8 of Division 20 of the H&SC. Because hazardous substances, as defined in H&SC section 25316, which are also hazardous materials as defined in H&SC section 25260, including volatile organic compounds, total petroleum hydrocarbons, chlorinated benzenes and polychlorinated biphenyls, remain in the soil and groundwater in and under portions of the Property, the Remedial Action Plan provides that a deed restriction be required as part of the site remediation. The DON circulated the ROD/RAP for public review and comment. The ROD/RAP were approved by the DON and concurred in by Department on [*date*]. Remediation includes installing and maintaining a synthetic membrane cover ("Cap") over the Capped Property. The Cap consists of a low permeability synthetic membrane and other associated layers, as more particularly described in the engineering drawing attached as Exhibit "B" hereto. The response action also includes the installation and operation of: (1) a passive gas collection system on the Capped Property which removes volatile organic compounds migrating upward from under the Cap, (2) a vapor extraction system, which remediates certain volatile organic compound-impacted soils, and (3) groundwater monitoring wells ("Monitoring Wells"). The location of the gas collection system, vapor extraction system, and Monitoring Wells are shown on Exhibit "B". ***[This exhibit will have been identified in paragraph 1.02.]*** The operation and maintenance of the Cap, gas collection system, vapor extraction system, and Monitoring Wells is pursuant to an Operation and

Maintenance Manual incorporated into the Operation and Maintenance Agreement between [Covenantor] ***[or name of other entity]*** and the Department dated [ ]. ***[If an O&M Agreement has not been signed, the approval date for the O&M Manual or Plan should be referenced.]***

1.04 ***[This paragraph should set out specific information about the risk assessment findings relevant to the contaminants of concern remaining at the property, essentially the basis for the restrictions imposed by this covenant. The Restrictions in Paragraphs 4.01, and any requirement for Soil Management Activity and any Prohibited Activity must be linked to the contaminants and risk assessment as discussed in this paragraph. The following paragraph is given for purposes of illustration. Each site will have different facts; those should be developed in a manner similar to the sample paragraph given here. Land use must be consistent with the approved RAW, RAP or ROD and the health risk assessment.]***

SAMPLE: As detailed in the Final Health Risk Assessment ***[or other appropriate document]*** as proposed by the Covenantor and approved by the Department on ***[date]***, all or a portion of the surface and subsurface soils within 10 feet of the surface of the Property contain hazardous substances, as defined in H&SC section 25316, which include the following metal contaminants of concern in the ranges set forth below: arsenic (0.3 to 38.1 parts per million ("ppm"), beryllium (2.6 ppm), copper (4.6 to 756 ppm, and nickel (7.3-105 ppm). In addition, there are low pH soils. Based on the Final Risk Assessment the Department and the Covenantor have

concluded that use of the Property as a residence, hospital, school for persons under the age of 21 or day care center would entail an unacceptable cancer risk to the users or occupants of such property operated or occupied. The Department and the Covenantor have further concluded that the Property, as remediated, and operated or occupied subject to the restrictions of this Covenant, does not present an unacceptable threat to human safety or the environment, if limited to ***[as applicable:*** commercial and industrial, parks, open space,***[or other appropriate]]*** use.

SAMPLE: [Note: Groundwater restrictions in Paragraph 3.04 must be based on a discussion of what contaminants are found in groundwater at the site, and what the drinking water standards are.]

Groundwater at the Property is found 15 to 20 feet below ground surface. Contaminants in the groundwater include benzene (50- 123 ppm), chromium (75- 213 ppm) and TCE (350-780 ppm). California drinking water standards are benzene at 0.08 ppm, chromium at 30 ppm and TCE at 5 ppm. The Department and the Covenantor concludes that the groundwater presents an unacceptable threat to human health and safety absent an environmental restriction to eliminate exposure to such levels of groundwater.

ARTICLE II

DEFINITIONS

2.01 Department. "Department" means the State of California by and through the Department of Toxic Substances Control and includes its successor agencies, if

any.

2.02 Owner. "Owner" shall include the Covenantor's successors in interest, and their successors in interest, including heirs and assigns, during his or her ownership of all or any portion of the Property.

2.03 Occupant. "Occupant" means Owners and any person or entity entitled by ownership, leasehold, or other legal relationship to the right to occupy any portion of the Property.

2.04 Covenantor. "Covenantor" shall mean the United States acting through the Department of the Navy (DON).

ARTICLE III

GENERAL PROVISIONS

3.01 Restrictions to Run with the Land. This Covenant sets forth protective provisions, covenants, restrictions, and conditions (collectively referred to as "Restrictions"), subject to which the Property and every portion thereof shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, and/or conveyed. These Restrictions are consistent with the separate restrictions placed in the deed by and in favor of the Covenantor, conveying the Property from the Convenantor to its successor in interest described above. Each and every Restriction: (a) runs with the land in perpetuity pursuant to H&SC sections 25222.1 25355.5(a)(1)(C) and Civil Code section 1471; (b) inures to the benefit of and passes with each and every portion of the Property; (c) shall apply to and bind all subsequent Occupants of the Property; (d) is for the benefit of, and is enforceable by the Department; and (e) is imposed upon the entire Property unless expressly stated as applicable only to a specific portion thereof.

3.02 Binding upon Owners/Occupants. Pursuant to H&SC sections 25222.1, 25355.5(a)(1)(C), this Covenant binds all Owners of the Property, their heirs, successors, and assignees, and the agents, employees, and lessees of the owners,

heirs, successors, and assignees. Pursuant to Civil Code section 1471(b), all successive owners of the Property are expressly bound hereby for the benefit of the Department.

3.03 Written Notice of Hazardous Substance Release. The Owner shall, prior to the sale, lease, or rental of the Property, give written notice to the subsequent transferee that a release of hazardous substances has come to be located on or beneath the Property, pursuant to Health and Safety Code section 25359.7. Such written notice shall include a copy of this Covenant. *[This last sentence is optional, to be used at sites where it is important that buyers and tenants be specifically aware of the ongoing remediation and their obligations.]*

3.04 Incorporation into Deeds and Leases. The Restrictions set forth herein shall be incorporated by reference in each and all deeds and leases for any portion of the Property.

3.05 Conveyance of Property. The Owner shall provide notice to the Department not later than thirty (30) days after any conveyance of any ownership interest in the Property (excluding mortgages, liens, and other non-possessory encumbrances). The Department shall not, by reason of this Covenant alone, have authority to approve, disapprove, or otherwise affect a conveyance, except as otherwise provided by law, by administrative order, or by a specific provision of this Covenant.

ARTICLE IV

RESTRICTIONS

[The following examples are intended to be illustrative. Not all of them will be

applicable. The restrictions for a particular property should have a direct relationship to what the Health Risk Assessment said was appropriate for use at the site. The restrictions must also protect the integrity and physical accessibility of, and legal rights of access to, any ongoing remediation facilities at the site.]

4.01 Prohibited Uses. The Property shall not be used for any of the following purposes: ***[Note: These prohibitions must be based on the appropriate decision documents as set forth in Paragraphs 1.03 and 1.04]***

[Sample provisions:]

(a) A residence, including any mobile home or factory built housing, constructed or installed for use as residential human habitation.

(b) A hospital for humans.

(c) A public or private school for persons under 21 years of age.

(d) A day care center for children.

4.02. Soil Management ***[Note: The basis for the soil restrictions must be in Paragraphs 1.03 and 1.04]***

[Sample provisions]

(a) No activities that will disturb the soil [at or below [ ] feet below grade] (e.g., excavation, grading, removal, trenching, filling, earth movement or mining) shall be allowed on the Property without a Soil Management Plan and a Health and Safety Plan approved by the Department.

(b) Any contaminated soils brought to the surface by grading, excavation, trenching or backfilling shall be managed in accordance with all applicable provisions of

state and federal law.

(c) The Owner shall provide the Department written notice at least fourteen (14) days prior to any building, filling, grading, mining or excavating in the Property [more than [ ] feet below the soil surface] [which will remove more than [ ] cubic yards of soil].

4.03 Prohibited Activities. ***[This paragraph will not be applicable to all sites. If not used, renumber accordingly. If there are groundwater restrictions, the basis must be in Paragraphs 1.03 and 1.04]*** The following activities shall not be conducted at the Property:

[Sample provisions]

(a) Raising of food (agricultural products intended for human consumption or use, including but not limited to food, cattle, fibers, including cotton).

(b) Drilling for [drinking irrigation] water, oil, or gas [without prior written approval by the Department].

[or] (b) Extraction of groundwater for purposes other than site remediation or construction dewatering.

[The following paragraphs are samples of restrictions that may be applicable when there is a cap, vapor and/or gas collection system, and/or groundwater monitoring system.]

4.04 Non-Interference with Cap [and Vapor Extraction System (VES)] and [Groundwater Capture System (GCS)].

[Sample provisions:]

(a) Activities that may disturb the Cap (e.g. excavation, grading, removal, trenching, filling, earth movement, or mining) shall not be permitted on or within _____ feet of the Capped Property without prior review and approval by the Department. ***[Similar restrictions may be appropriate for other ongoing remediation systems.]***

(b) All uses and development of the Capped Property shall preserve the integrity **[** ***(if appropriate:)*** **and physical accessibility]** of the Cap. ***[Extend to other systems as appropriate.]***

(c) The Cap shall not be altered without written approval by the Department.

(d) The Owner shall notify the Department of each of the following: (i) the type, cause, location and date of any damage to the Cap and (ii) the type and date of repair of such damage. Notification to the Department shall be made as provided below within ten (10) working days of both the discovery of any such disturbance and the completion of any repairs. Timely and accurate notification by any Owner or Occupant shall satisfy this requirement on behalf of all other Owners and Occupants. ***[Extend to other systems as appropriate.]***

4.05 Access for Department. The Department shall have reasonable right of entry and access to the Property for inspection, monitoring, and other activities consistent with the purposes of this Covenant as deemed necessary by the Department in order to protect the public health or safety, or the environment.

ARTICLE V

ENFORCEMENT

5.01 Enforcement. Failure of the Owner or Occupant to comply with any of the

Restrictions specifically applicable to include grounds for the Department to require that the Owner modify or remove any improvements ("Improvements" herein shall mean all buildings, roads, driveways, and paved parking areas), constructed or placed upon any portion of the Property in violation of the Restrictions. Violation of this Covenant by the Owner or Occupant may result in the imposition of civil and/or criminal remedies including nuisance or abatement against the Owner or Occupant as provided by law. The State of California shall have all remedies as provided at in California Civil Code Section 815.7 as that enactment may be from time to time amended.

ARTICLE VI

VARIANCE AND TERMINATION

6.01 Variance. The Owner, or with the Owner's consent, any Occupant, may apply to the Department for a written variance from the provisions of this Covenant. Such application shall be made in accordance with H&SC section 25233. The Department will grant the variance only after finding that such a variance would be protective of human, health, safety and the environment.

6.02 Termination. The Owner, or with the Owner's consent, any Occupant, may apply to the Department for a termination of the Restrictions or other terms of this Covenant as they apply to all or any portion of the Property. Such application shall be made in accordance with H&SC section 25234. No termination or other terms of this Covenant shall extinguish or modify the retained interest held by the United States.

ARTICLE VII

MISCELLANEOUS

7.01 No Dedication Intended. Nothing set forth in this Covenant shall be

construed to be a gift or dedication, or offer of a gift or dedication, of the Property, or any portion thereof to the general public or anyone else for any purpose whatsoever.

7.02 Recordation. The Covenantor shall record this Covenant, with all referenced Exhibits, in the County of [name of county] within ten (10) days of the Covenantor's receipt of a fully executed original.

7.03 Notices. Whenever any person gives or serves any Notice ("Notice" as used herein includes any demand or other communication with respect to this Covenant), each such Notice shall be in writing and shall be deemed effective: (1) when delivered, if personally delivered to the person being served or to an officer of a corporate party being served, or (2) three (3) business days after deposit in the mail, if mailed by United States mail, postage paid, certified, return receipt requested:

To Owner: *[include name and address of Owner and name of person to receive service]*

To Department: *[title and address of Regional Branch Chief.]*

Any party may change its address or the individual to whose attention a Notice is to be sent by giving written Notice in compliance with this paragraph.

7.04 Partial Invalidity. If any portion of the Restrictions or other term set forth herein is determined by a court of competent jurisdiction to be invalid for any reason, the surviving portions of this Covenant shall remain in full force and effect as if such portion found invalid had not been included herein.

7.05 Statutory References. All statutory references include successor provisions.

IN WITNESS WHEREOF, the Parties execute this Covenant.

Covenantor: ***[name of Covenantor]***

By: _____

Title: ***[signatory's name and title]***

Date: _____

Department of Toxic Substances Control

By: _____

Title: ***[signatory's name and title]***

Date: _____

Approved as to form:

Date: 9 March 00 By: Mary Kay Fanyan

Approved as to form:

Date: March 16, 2000 By: Arnold M Thomas

Ratification of Document endorsed 3-2-00

STATE OF CALIFORNIA)
)
COUNTY OF _____)

On this _____ day of _____, in the year _____,

before me _____, personally appeared

_____,

personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is /are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature _____

MODEL HAZARDOUS WASTE MANAGEMENT PROGRAM

DEED RESTRICTION

RECORDING REQUESTED BY:
[Covenantor's Name]
[Street Address]
[City], California **[Zip Code]**

WHEN RECORDED, MAIL TO:

Department of Toxic Substances Control
Region ___
[Street Address]
[City], California **[Zip Code]**
Attention: **[Name of Branch Chief]**, Chief
[Branch Designation]

SPACE ABOVE THIS LINE RESERVED FOR RECORDER'S USE

COVENANT TO RESTRICT USE OF PROPERTY

ENVIRONMENTAL RESTRICTION

(Re: *[Insert parcel number(s) and name of site property to be restricted.]*)

This Covenant and Agreement ("Covenant") is made by and between the United States of America acting by and through the Department of Navy or "DON" (the "Covenantor"), the current owner of certain property situated in *[city]*, County of _____, State of California, described in Exhibit "A", attached hereto and incorporated herein by this reference (the "Property"), and the State of California acting by and through the Department of Toxic Substances Control (the "Department"). Pursuant to Civil Code section 1471(c), the Department has determined that this Covenant is reasonably necessary to protect present or future human health or safety or the environment as a

result of the presence on the land of hazardous materials as defined in Health and Safety Code ("H&SC") section 25260. In addition, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104 (42 USC Section 9604), as delegated to the Covenantor by E.O. 12580, ratified by Congress in 10 USC Sec. 2701, et seq., and implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP – 40 CFR Part 300) and implementing guidances and policies, the Covenantor (DON) has also determined that this Covenant is reasonably necessary to protect present or future human health and safety and the environment as the result of the presence on the land of hazardous substances, pollutants and contaminants as defined in CERCLA Section 101 (42 USC Section 9601).

The Covenantor and the Department, collectively referred to as the "Parties", therefore intend that the use of the Property be restricted as set forth in this Covenant, in order to protect human health, safety and the environment.

The Covenantor retains sufficient legal title and interest in the subject property to insure continuing enforcement of the protective covenants and agreements contained within this Covenant to Restrict the Use of Property. Further in any subsequent transfers or conveyance of title to nonfederal entities the DON shall burden the property with additional deed covenants that insure that any subsequent deed or transfer contains the protective covenants and right of access and power to conduct monitoring interest contained herein and of wastes retained on site. Those covenants and agreements shall be enforceable against the servient estate in that those protective covenants shall run with the land to all successors and assigns.

ARTICLE I

STATEMENT OF FACTS

1.01 The Property, totaling approximately [acres] [— square yards] is more particularly described and depicted in Exhibit "A", attached hereto and incorporated herein by this reference. *[Exhibit "A" must include the legal description of the property used by the county recorder. This must include the particular description of the boundaries of the area to be subject to a specific use restriction. A survey may be required].* The Property is located in the area now generally bounded by *[include narrative description of the area; this will typically be street names: e.g. Main Street on the north, Maple Street on the east, etc.]* County of [ ], State of California.

1.02 *[Use this paragraph if imposing additional restrictions on a portion of the Property, for example on a capped portion, or if for any other reason it is necessary to precisely identify any portion of the property, such as an area with groundwater monitoring wells. The purpose of this paragraph is to give the precise location of such areas where use restrictions will apply. Renumber following paragraphs accordingly]* A limited portion of the Property is more particularly described in Exhibit "B" which is attached and incorporated by this reference ("Capped Property" or "[*other identified*] Property"). *[Exhibit B must include a legal description of the exact area(s) being restricted and any necessary diagram(s). This will generally require a legal survey and engineering drawing for the Cap or other area to be further restricted.].* The [Capped or {other identified}] Property is located in the area now generally bounded by _____. *[include language that generally describes the Capped or other identified Property]* The

[Capped or {other identified}] Property is also more specifically described as encompassing xxxx County Assessor's Parcel numbers —.

1.03 *[Briefly describe the regulatory oversight of the facility by the Department and the CERCLA decisions including any applicable Federal Facility Agreement (FFA) or Federal Facility site Remediation Agreement (FFSRA) and implementing activities of the Covenantor, the remedial activities that have occurred at the Property, including, if applicable, installation of a cap and construction and ongoing operation and maintenance of a groundwater treatment system. This paragraph should refer to the Closure Report or other decision document such as a ROD which approved the remedial activities at the Property and required this Covenant. The paragraph needs to identify the contaminants and physical remedial measures on the Property which necessitate this deed restriction.]*

Since [*date*] the Department [*or*, the Department's predecessor in interest (California Department of Health Services)] authorized this [treatment], [storage], [disposal] facility ("Facility") pursuant to an [interim status document] [permit]. Under this authorization the Site was a hazardous waste facility, regulated by the Department, subject to the requirements of the California Hazardous Waste Control Law ("HWCL"), at Health and Safety Code ("H&S Code") section 25100 et seq., and the federal Resource Conservation and Recovery Act ("RCRA"), at 42 U.S.C. section 6901 et seq. Pursuant to the closure requirements of the HWCL, including H&S Code section 25246 and post-closure notices provisions of Title 22 California Code of Regulations [section 66265.119(b) for interim status hazardous waste facilities] [*or* 66264.119(b) for permitted hazardous waste facilities]] [*or, if restrictions required for permit:* corrective

action requirements of the HWCL, including H&S Code Section 25200.10] the Department is requiring this Covenant as part of the [facility closure] [corrective action] [permitting] of the facility. The Department circulated a [Closure Plan] [Remedial Measures Study] [*other appropriate document*], which contained a Final Health Risk Assessment [and/or Remedial Goals document], together with a draft [Environmental Impact Report] [Negative Declaration] pursuant to the California Environmental Quality Act, Public Resources Code section 21000 et seq for public review and comment from [*date*] to [*date*]. Because hazardous wastes, which are also hazardous materials as defined in Health and Safety Code sections 25117 and 25260, including [list hazardous wastes] remain in the [soil] and [groundwater] at the Property, the [Closure Plan] [Remedial Measures Study] provided that a deed restriction would be required as part of the facility remediation. The Department approved the [Closure Plan] [Remedial Measures Study] [*other appropriate document*] together with the [*environmental document*] on [*date*].

Pursuant to these documents, the Property was [*describe remedial actions taken which relate to what is left on the property. This description must include installation of any physical remedial measures. The description must identify what contaminants remain on the Property.*]

SAMPLE: Hazardous wastes, which are also hazardous materials as defined in H&S Code sections 25117 and 25260, and are CERCLA hazardous substances, pollutants or contaminant, including xxxx and yyyy, remain in the soil and groundwater at the Property. Remediation includes installing and maintaining a synthetic membrane cover ("Cap") over the Capped Property. The Cap consists of a low permeability

synthetic membrane and other associated layers over the hazardous wastes and materials, as more particularly described in the engineering drawing attached as Exhibit "B" hereto. The Remedial Measure also includes the installation and operation of: (1) a passive gas collection system ("GCS") on the Capped Property which removes miscellaneous gas/vapors migrating upward from under the Cap, (2) a vapor extraction system ("VES"), which remediates certain volatile organic compound-impacted soils, and (3) groundwater monitoring wells ("Monitoring Wells"). The location of the GCS, VES and Monitoring Wells are shown on the map attached as exhibit "--". The operation and maintenance ("O&M") of the Cap, GCS, VES, and Monitoring Wells is pursuant to an O&M Manual incorporated into the O&M Agreement between [Covenantor] *[or name of other entity]* and the Department dated September 20, 1995. *[If an O&M Agreement has not been signed, the approval date for the O&M Manual or Plan should be referenced]*

1.04 *[This paragraph should set out specific information about the risk assessment findings relevant to the contaminants of concern remaining at the property, essentially the basis for the restrictions imposed by this covenant. The Restrictions in Paragraphs 4.01, and any requirement for Soil Management Activity and any Prohibited Activity must be linked to the contaminants and risk assessment as discussed in this paragraph. The following paragraph is given for purposes of illustration. Each site will have different facts; those should be developed in a manner similar to the sample paragraph given here. You must consult with the assigned toxicologist about what are the appropriate land uses.]*

SAMPLE: As detailed in the Final Health Risk Assessment *[or other appropriate*

document] as proposed by the Covenantor and approved by the Department on *[date]*, all or a portion of the surface and subsurface soils within 10 feet of the surface of the Property contain hazardous wastes and hazardous materials, as defined in H&S Code section 25117 and 25260, which include one or more of the following metal contaminants of concern in the ranges set forth below: arsenic (0.3 to 38.1 parts per million ("ppm"), beryllium (2.6 ppm), copper (4.6 to 756 ppm, and nickel (7.3-105 ppm). In addition, there are low pH soils. Based on the Final Risk Assessment the Department and the Covenantor have concluded that use of the Property as a residence, hospital, school for persons under the age of 21 or day care center would entail an unacceptable cancer risk to the users or occupants of such property. The Department and the Covenantor have further concluded that the Property, as remediated, and operated or occupied subject to the restrictions of this Covenant, does not present an unacceptable threat to human safety or the environment, if limited to *[as applicable:* commercial and industrial use, parks, open space, [or other appropriate] use*]*.

SAMPLE [Note: Groundwater restrictions in Paragraph 3.04 must be based on a discussion of what contaminants are found in groundwater at the site, and what drinking water standards are.]: Groundwater at the Property is first found at 15 to 20 feet below ground surface. Contaminants in the groundwater include benzene (50- 123 ppm), chromium (75- 213 ppm) and TCE (350-780 ppm). California drinking water standards are benzene at .08 ppm, chromium at 30 ppm and TCE at 5 ppm. The Department and the Covenantor concludes that the groundwater presents an unacceptable threat to human health and safety absent an environmental restriction to eliminate exposure to such levels of groundwater.

ARTICLE II

DEFINITIONS

2.01 Department. "Department" shall mean the State of California by and through the California Department of Toxic Substances Control and shall include its successor agencies, if any.

2.02 Owner. "Owner" shall include the Covenantor's successor's in interest, and their successors in interest, including heirs and assigns, during his or her ownership of all of any portion of the Property.

2.03 Occupant. "Occupant" shall mean Owners and any person or entity entitled by ownership, leasehold, or other legal relationship to the right to occupy any portion of the Property.

2.04 Covenantor. "Covenantor" shall mean the United States acting through the Department of the Navy (DON).

ARTICLE III

GENERAL PROVISIONS

3.01 Restrictions to Run With the Land. This Covenant sets forth protective provisions, covenants, restrictions, and conditions (collectively referred to as "Restrictions"), upon and subject to which the [Property] [Capped Property] [Restricted Property] and every portion thereof shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, and/or conveyed. These Restrictions are consistent with the separate restrictions placed in the deed by and in favor of the Covenantor, conveying the Property from the Covenantor to its successor in interest described above. Each and every one of the Restrictions: (a) shall run with the land in perpetuity pursuant to H&SC sections 25202.5, and 25202.6, and Civil Code section 1471; (b) shall inure to the benefit of and pass with each and every portion of the Property; (c) shall apply to and bind all subsequent Occupants of the Property; (d) are for the benefit of, and shall be enforceable by the State of California; and (e) are imposed upon the entire Property unless expressly stated as applicable only to a specific portion thereof.

3.02 Binding Upon Owners/Occupants. Pursuant to Health and Safety Code section 25202.5(b), this Covenant shall be binding upon all of owners of the land, their heirs, successors, and assignees, and the agents, employees, and lessees of the owners, heirs, successors, and assignees. Pursuant to Civil Code section 1471(b), all successive owners of the Property are expressly bound hereby for the benefit of the covenantee(s) herein.

3.03 Written Notice of Hazardous Substance Release. The Owner shall, prior to the sale, lease, or rental of the Property, give written notice to the subsequent

transferee that a release of hazardous substances has come to be located on or beneath the Property, pursuant to Health and Safety Code section 25359.7. Such written notice shall include a copy of this Covenant. *[This last sentence is optional, to be used at sites where it is important that buyers and tenants be specifically aware of the ongoing remediation and their obligations]*

3.04 Incorporation into Deeds and Leases. The Restrictions set forth herein shall be incorporated by reference in each and all deeds and leases for any portion of the Property.

3.05 Conveyance of Property Covenantor agrees that the Owner shall provide notice to the Department not later than thirty (30) days after any conveyance of any ownership interest in the Property (excluding mortgages, liens, and other non-possessory encumbrances). The Department shall not, by reason of this Covenant alone, have authority to approve, disapprove, or otherwise affect such conveyance. *[This paragraph is optional, to be used, for example, at sites with groundwater treatment systems that will require access by the Department and by the entity responsible for O&M.]*

ARTICLE IV

RESTRICTIONS

[The following examples are intended to be illustrative. Not all of them will be applicable. The restrictions for a particular property should have a direct relationship to what the Health Risk Assessment said was ok/appropriate for use at the site. The toxicologist must be involved with drafting the Restrictions. The restrictions must also protect the integrity of, and access to, any ongoing remediation facilities at the site.]

4.01 Prohibited Uses. The Property shall not be used for any of the following purposes: *[Note: These prohibitions must be based on the facts and Health Risk Assessment as set forth in Paragraph 1.04]*

[sample provisions]

(a) A residence, including any mobile home or factory built housing, constructed or installed for use as residential human habitation.

(b) A hospital for humans.

(c) A public or private school for persons under 21 years of age.

(d) A day care center for children.

4.02 Soil Management *[Note: The basis for the soil restrictions must be in Paragraph 1.04]*

[sample provisions]

(a) No activities which will disturb the soil *[*at or below xxx feet below grade*]* (e.g., excavation, grading, removal, trenching, filling, earth movement or mining) shall be permitted on the Property without a Soil Management Plan and a Health and Safety Plan submitted to the Department for review and approval.

(b) Any contaminated soils brought to the surface by grading, excavation, trenching or backfilling shall be managed in accordance with all applicable provisions of state and federal law.

(c) The Owner will provide the Department written notice at least fourteen (14) days prior to any building, filling, grading, mining or excavating in the Property [more than feet below the soil surface] [which will remove more than cubic yards of soil].

4.03 Prohibited Activities. *[This paragraph will not be applicable to all sites. If*

not used, renumber accordingly. If there are groundwater restrictions, the basis must be in Paragraph 1.04] The following activities shall not be conducted at the Property: *[sample provisions]*

(a) No raising of agricultural products intended for human consumption or use, including but not limited to food,cattle, fibers including, cotton) shall be permitted on the property.

(b) No drilling for *[*drinking/IRRIGATION *]* water, oil, or gas shall be permitted on the Property *[*without prior written approval by the Department*]*. *[or]* (b) No groundwater shall be extracted on the Property for purposes other than site remediation or construction dewatering. *[The following paragraphs are samples of restrictions that may be applicable when there is a cap, vapor and/ or gas collection system, and/or groundwater monitoring system.]*

4.04 <u>Non-Interference with Cap [and VES] and [GCS]</u>.

[sample provisions]

(a) No activities which will disturb the Cap (e.g. excavation, grading, removal, trenching, filling, earth movement, or mining) shall be permitted on or within _____feet of the Capped Property without prior review and approval by the Department. *[Similar restrictions may be appropriate for other ongoing remediation systems.]*

(b) All uses and development of the Capped Property shall preserve the integrity of the Cap. *[Extend to other systems as appropriate.]*

(c) Any proposed alteration of the Cap shall require written approval by the Department.

(d) The Owner shall notify the Department of each of the following: (I) The

type, cause, location and date of any disturbance to the Cap which could affect the ability of the Cap to contain subsurface hazardous wastes or hazardous materials in the Capped Property, and (ii) the type and date of repair of such disturbance. Notification to the Department shall be made as provided below within ten (10) working days of both the discovery of any such disturbance(s) and the completion of any repairs. Timely and accurate notification by any Owner or Occupant shall satisfy this requirement on behalf of all other Owners. *[Extend to other systems as appropriate.]*

4.05 Access for Department. The Department shall have reasonable right of entry and access to the Property for inspection, monitoring, and other activities consistent with the purposes of this Covenant as deemed necessary by the Department in order to protect the public health and safety and the environment.

ARTICLE V

ENFORCEMENT

5.01 Enforcement. Failure of the Owner or Occupant to comply with any of the Restrictions specifically applicable to it shall be grounds for the Department, by reason of this Covenant, to require that the Owner modify or remove any improvements ("Improvements" herein shall include all buildings, roads, driveways, and paved parking areas, constructed or placed upon any portion of the Property constructed in violation of the Restrictions). Violation of this Covenant by the Owner or Occupant may result in the imposition of civil and/or criminal remedies including nuisance or abatement against the Owner or Occupant as provided by law. The State of California shall have all remedies as provided in California Civil Code, Section 815.7, as that enactment may

be from time to time amended.

ARTICLE VI

MODIFICATION AND TERMINATION

6.01 Modification. Any Owner or, with the Owner's written consent, any Occupant of the Property or any portion thereof may apply to the Department for a written modification from the provisions of this Covenant. Such application shall be made in accordance with H&S Code section 25202.6. The Department will grant the modification only after finding that such a modification would be protective of human health, safety and the environment.

6.02 Termination. Any Owner, and/or, with the Owner's written consent, any Occupant of the Property, or any portion thereof, may apply to the Department for a termination of the Restrictions or other terms of this Covenant as they apply to all or any portion of the Property. Such application shall be made in accordance with H&S Code section 25202.6. The Department will grant the termination only after finding that such a termination would be protective of human health, safety and the environment. No termination of the Restrictions or other terms of this Covenant shall extinguish or modify the retained interest held by the United States.

ARTICLE VII

MISCELLANEOUS

7.01 No Dedication Intended. Nothing set forth in this Covenant shall be construed to be a gift or dedication, or offer of a gift or dedication, of the Property, or any portion thereof to the general public or anyone else for any purpose whatsoever.

7.02 Recordation In accordance with HSC Section 25235, the Department will record this Covenant, with all referenced Exhibits, in the County of [name of county] within ten (10) days of the Department's receipt of a fully executed original.

7.03 Notices. Whenever any person gives or serves any notice ("Notice" as used herein includes any demand or other communication with respect to this Covenant), each such Notice shall be in writing and shall be deemed effective: (1) when delivered, if personally delivered to the person being served or to an officer of a corporate party being served, or (2) three (3) business days after deposit in the mail, if mailed by United States mail, postage paid, certified, return receipt requested:

To Owner: *[include name and address of Owner and name of person to receive service]*

To Department: *[include name, address, and appropriate name of Department person to be served]*

Any party may change its address or the individual to whose attention a notice is to be sent by giving written notice in compliance with this paragraph.

7.04 Partial Invalidity. If any portion of the Restrictions or other term set forth herein is determined by a court of competent jurisdiction to be invalid for any reason, the surviving portions of this Covenant shall remain in full force and effect as if such portion found invalid had not been included herein.

7.05 Statutory References. All statutory references include successor provisions.

IN WITNESS WHEREOF, the Parties execute this Covenant.

"Covenantor"

Date:_____ By:_____

"Department"

Date:_____ By:_____

Approved as to form:

Date: 9 March 00 By: M X Fayer

Approved as to form:

Date: March 16, 2000 By: Harold M Thomas

Ratification of Document endorsed 3-2-00

STATE OF CALIFORNIA)
)
COUNTY OF _____)

On this _____ day of _____, in the year _____,

before me _____, personally appeared

_____,

personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is /are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature _____

California Regional Water Quality Control Board
San Francisco Bay Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov
1515 Clay Street, Suite 1400, Oakland, California 94612
Phone (510) 622-2300 • FAX (510) 622-2460

Gray Davis
Governor

Date: SEP 2 5 2003
File No. 2169.6032 (JSM)
PCA No.: 16525

Mr. Keith Forman
BRAC Environmental Coordinator
Naval Facilities Engineering Command
Southwest Division
1230 Columbia Street, Suite 1100
San Diego, CA 92101-8517

Subject: Concurrence that A-Aquifer Groundwater at the Hunters Point Naval Shipyard, San Francisco, Meet the Exemption Criteria in the SWRCB Sources of Drinking Water Resolution 88-63

Dear Mr. Forman:

Regional Water Quality Control Board (RWQCB) staff have reviewed your letter to Ms. Julie Menack dated August 11, 2003 regarding the Navy's request for written concurrence that groundwater in the A-aquifer at Hunters Point Naval Shipyard meets the exemption criteria for State Water Resources Control Board (SWRCB) Resolution No. 88-63. In your letter, the Navy evaluated existing and potential beneficial uses of groundwater at Hunters Point (see letter attached). Based on RWQCB staff review of the data provided, RWQCB staff find that the quality and the hydrogeologic conditions of A-aquifer groundwater beneath Hunters Point is such that this water is not a potential source of drinking water pursuant to SWRCB Resolution 88-63 and RWQCB Resolution No. 89-39.

If you have questions, please feel free to contact Julie Menack at (510) 622-2401 or by electronic mail at jsm@rb2.swrcb.ca.gov.

Sincerely,

Curtis T. Scott

Curtis T. Scott, Division Chief
Groundwater Protection and
Waste Containment Division

Attachment: Letter from Keith Forman (minus attachments)

Cc: Mailing list attached

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at http://www.swrcb.ca.gov.

Hunters Point Naval Shipyard
Mailing List

Marie Avery
Department of the Navy
Southwest Division/Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, CA 92131-5190

G. Patrick Brooks, Lead RPM
Naval Facilities Engineering Command
Southwest Division
1230 Columbia Street, Suite 1100
San Diego, CA 92101-8517

Michael Work (SFD 8-3)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Chein Kao
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Department of Public Health
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Tetra Tech EMI
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San Francisco, CA 94105

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at http://www.swrcb.ca.gov.

Anna E. Waden Library
5075 Third Street
San Francisco, CA 94124

Mr. Patrick Shea
Government Information Center, 5th Floor
100 Larkin Street
San Francisco, CA 94102

Mr. Gregg Olson
San Francisco Public Utilities Commission (PUC)
1155 Market Street, 4th Floor
San Francisco, CA 94103

Mr. Lynne Brown
HPSY RAB Co-Chair

Ms. Lea Loizos
HPSY RAB Technical Review Subcommittee
833 Market Street, Suite 1107
San Francisco, CA 94103

Groundwater Exemption Criteria.doc

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132 - 5190

5090
Ser 06CH.KF\1137
August 11, 2003

Ms. Julie Menack
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Dear Ms. Menack:

Subj: REQUEST FOR DRINKING WATER DETERMINATION A-AQUIFER EXEMPTION FROM CONSIDERATION AS A MUNICIPAL OR DOMESTIC WATER SUPPLY, HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

The A-aquifer groundwater beneath Hunters Point Shipyard (HPS) in San Francisco, California, is not of sufficient quality to be used as a potential drinking water source pursuant to State Water Resources Control Board (SWRCB) Sources of Drinking Water Policy Resolution 88-63 (SWRCB Resolution 88-63) and California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, Resolution 89-39. The Navy respectfully requests that RWQCB grant an exemption for the A-aquifer at HPS from consideration as a suitable or potentially suitable municipal or domestic water supply on the basis of criteria contained in SWRCB Resolution 88-63 and RWQCB Resolution 89-39.

The exemption being requested is for drinking water only; the Navy acknowledges that the A-aquifer recharges San Francisco Bay (the Bay), and we are committed to its protection. Groundwater discharge to San Francisco Bay will be evaluated to ensure protectiveness of potential ecological receptors. Additionally, volatile organic compounds in the A-aquifer will be evaluated as a potential human health risk because of their volatility and the potential for human exposure via indoor air. The requested exemption would help the Navy focus on evaluating groundwater remedial alternatives that are protective of the Bay and deeper groundwater found in the B-aquifer and bedrock water-bearing zone, and would help the Navy streamline the feasibility studies for Parcels C, D, and E, and the risk management review summary report for Parcel B. Resolution 88-63 states that "All surface and ground waters of the State are considered to be suitable, or potentially suitable for municipal or domestic water supply and should be so designated by the Regional Boards with the exception of surface and ground waters where:

- The total dissolved solids (TDS) exceed 3,000 mg/L (5,000 µS/cm, electrical conductivity) and it is not reasonably expected by Regional Boards to supply a public water system, or
- There is contamination, either by natural processes or by human activity (unrelated to the specific pollution incident), that cannot reasonably be treated for domestic use using either Best Management Practices or best economically achievable treatment practices, or
- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day."

The Navy finds that A-aquifer groundwater beneath HPS is not suitable as a drinking water source and meets the exemption criteria in SWRCB Resolution 88-63 and RWQCB Resolution 89-39 because:

- Total dissolved solids (TDS) concentrations in A-aquifer groundwater exceed 3,000 milligrams per liter (mg/L)
- Artificial fill comprises most of the A-aquifer
- Naturally occurring dissolved metals concentrations have been estimated (Hunters Point groundwater ambient levels [HGAL]), and some of these metals concentrations exceed drinking water maximum contaminant level (MCL) when the metal is at or below its HGAL
- There is no historical, present, or planned future use of groundwater at HPS
- Well construction requirements prohibit water supply wells in most parts of HPS
- Pumping would cause saltwater intrusion in areas where potable wells could conceivably be installed

The Navy has found that groundwater does not meet criteria for municipal and domestic water supply based on the hydrogeologic conditions and other limiting factors at the Navy Fleet and Industrial Supply Center Oakland (FISCO); the Alameda Annex in Oakland, California; and Naval Station Treasure Island, San Francisco, California. HPS and the sites listed above are Bay margin sites that should be evaluated similarly. RWQCB has written letters of concurrence that groundwater meets the exemption criteria in the SWRCB Resolution 88-63 for FISCO, the Alameda Annex, and Naval Station Treasure Island.

The following discussion describes the groundwater conditions at HPS and the factors that the Navy believes preclude the use of the A-aquifer as a suitable or potentially suitable municipal or domestic water supply.

GEOLOGY AND HYDROGEOLOGY

The peninsula forming HPS is within a northwest-trending belt of the Franciscan Complex bedrock known as the Hunters Point Shear zone. Six geologic units underlie HPS: five unconsolidated sedimentary deposits of Quaternary age and the Jurassic-Cretaceous-age Franciscan Complex bedrock. In general, the stratigraphic sequence of these geologic units, from youngest (shallowest) to oldest (deepest), is as follows: Artificial Fill, Slope Debris and Ravine Fill, Undifferentiated Upper Sand Deposits, Bay Mud Deposits, Undifferentiated Sedimentary Deposits, and the Franciscan Complex.

Three water-bearing units underlie the site. The shallowest water-bearing zone is referred to as the A-aquifer. The A-aquifer is essentially manmade and consists primarily of Artificial Fill material, but also includes Slope Debris and Undifferentiated Upper Sand Deposits. Of the 493 acres of land surface at HPS, about 400 acres were created by infilling the Bay with upland sediments. The A-aquifer was primarily created by removing soil from upland areas at HPS and depositing the soil in the Bay. Residuum of the Franciscan Formation is included in the fill. Depth to groundwater in the A-aquifer ranges from 2 to 17 feet below ground surface (bgs), and the thickness of the A-aquifer ranges from about 10 to 70 feet, but is most commonly 20 to 40 feet thick. Although groundwater flow is locally complex, groundwater in the A-aquifer generally flows toward the Bay, except where reversed due to the influence of leaking storm drains, sewer/ water supply lines.

The A-aquifer is separated from the deeper water-bearing zone, referred to as the B-aquifer, by the Bay Mud in most locations across the site. The B-aquifer consists of Undifferentiated Sedimentary Deposits underlying the Bay Mud. The bedrock water-bearing zone is present in the upper weathered portions of the Franciscan Complex Bedrock. In some areas, the A-aquifer directly overlies the bedrock water-bearing zone. Groundwater in the bedrock occurs in localized discrete fractures. Groundwater recharge at HPS occurs through infiltration of precipitation in the unpaved areas, lateral flow from topographically high areas (Parcel A), and piping system leakage from storm drains, potable water lines, and sanitary sewer lines.

GROUNDWATER QUALITY: TDS DISTRIBUTION

The average TDS concentration in the A-aquifer at HPS is greater than the 3,000-mg/L standard cited in SWRCB Resolution 88-63. The average TDS concentration was determined from analytical results of groundwater wells sampled as part of the groundwater data gaps investigation and other Comprehensive Environmental Response, Compensation, and Liability Act sampling events from 1990 through 2002. Figure 1 shows the average TDS concentrations at individual wells.

Table 1 presents TDS concentrations in groundwater samples from A-aquifer wells. Based on the average TDS concentration in A-aquifer wells shown on Figure 1, the average TDS concentration in the A-aquifer in Parcels B, C, D, and E is 7,219 mg/L.

Although the average TDS concentrations presented on Figure 1 used data collected from 1990 to 2002 without regard to season, a significant amount of time-discrete TDS data was collected during the groundwater data gaps investigation at Parcels C, D, and E, which allows evaluation of seasonal effects. Average TDS concentrations from Winter 2001 and Summer 2002 are presented in the table below:

Average TDS Concentrations in the A-Aquifer (2001-2002) at Parcels C, D, and E

February to March 2001 Average TDS Concentration (mg/L) [Number of Wells Used to Calculate Average]	July to August 2002 Average TDS Concentration (mg/L) [Number of Wells Used to Calculate Average]
6,243 [218]	6,818 [168]

Based on these average TDS values, it is clear that the average A-aquifer TDS concentration at HPS is well above the RWQCB standard of 3,000 mg/L. Much of HPS is reclaimed tideland, and the high TDS values are consistent with historical infilling of the Bay.

GROUNDWATER QUALITY: CONDUITS AND THEIR EFFECT ON TDS DISTRIBUTION

Underground utilities have the potential to affect TDS concentrations and water quality in the A-aquifer. Leaking potable water supply lines may reduce the TDS concentration by adding potable water to the A-aquifer. Leaking water supply lines may be the source of many of the isolated low TDS anomalies shown on Figure 1. For example, potable water lines are near the anomalies centered on wells IR36MW125A, IR34MW36A, IR39MW21A, IR17MW12A, and others. Leaking storm drain lines that are tidally influenced may add seawater to the A-aquifer, thereby increasing TDS.

Some groundwater leaks into sanitary sewer lines and is eventually pumped off the base as part of the sanitary sewer effluent. Removal of groundwater via the sanitary sewer causes the water table to be lowered in the area around the leaking lines. In some cases the water table elevation is below sea level. This allows seawater to intrude into the A-aquifer. Figure 2 shows the presence of sanitary sewer lines, and the yellow-shaded area along the border between Parcels D and E shows locations where the A-aquifer surface is below sea level.

GROUNDWATER QUALITY: NATURALLY OCCURRING DISSOLVED METALS

Antimony, arsenic, chromium, magnesium, nickel, thallium, zinc, and other metals are components of the Franciscan Formation bedrock and bedrock-derived fill that underlies HPS. The A-aquifer contains fill material and residuum derived from the Franciscan Formation. HGALs were estimated for naturally occurring metals concentrations during the remedial investigation (RI). Antimony, arsenic, and thallium concentrations exceed their primary MCLs, even when concentrations of these metals were are at or below

their HGALs, as shown on Figure 3 and in Table 2. The presence of naturally occurring dissolved metals coupled with high TDS concentrations in the A-aquifer suggests that the A-aquifer is nonpotable.

GROUNDWATER AND WELL YIELDS

Hydraulic characteristics of the A-aquifer have been determined across HPS during the RI activities through constant rate aquifer tests and slug testing. Aquifer properties derived from aquifer tests and slug tests at Parcels C and E presented in Table 3 reveal low yield conditions and poor storage capacities. In general, monitoring wells installed in the A-aquifer are low yielding, but are capable of producing at least 200 gallons per day. The Navy is not requesting an exemption based on well yield; however, if the A-aquifer were used as a municipal or domestic water supply, it can be reasonably expected that saltwater intrusion would increase TDS concentrations in A-aquifer groundwater.

HISTORICAL, CURRENT, AND POTENTIAL FUTURE GROUNDWATER USE

San Francisco and HPS's potable or drinking water supply is obtained from the Hetch Hetchy system operated by the San Francisco Water Department. There are no groundwater supply wells and there is no record of historical groundwater use at HPS. The only groundwater wells at HPS are monitoring wells related to environmental investigations of HPS. These monitoring wells cannot be used for water supply because the wells do not meet state well construction standards for water supply wells. Currently, the city prohibits the installation of domestic water supply wells. This City prohibition indicates a low potential for groundwater at HPS to be used as a drinking water source.

WELL CONSTRUCTION REQUIREMENTS

The California Department of Water Resources (DWR) has developed standard well construction requirements to prevent contamination of water supply wells by chemicals and biologic hazards related to point and nonpoint sources (DWR, "California Well Standards, 1991" Bulletin 74-90). The California Well Standards require that annular seals must extend at least 50 feet bgs for community and industrial water supply wells and at least 20 feet bgs for domestic, agricultural, and other types of water supply wells.

Assuming a minimum 10-foot-long well screen, an individual domestic well would extend to a minimum depth of 30 feet bgs, and domestic wells could be installed only where the A-aquifer is at least 30 feet thick. Assuming a minimum depth of 60 feet bgs for community and industrial supply wells, these wells could be installed in the A-aquifer only in areas where the A-aquifer is more than 60 feet thick. As noted above in the discussion of hydrogeology of HPS, the A-aquifer thickness ranges from about 10 to 70 feet, but is most commonly 20 to 40 feet.

The California Well Standards also require a minimum horizontal separation distance of 50 feet from sanitary, industrial, and storm sewer lines. HPS has an extensive network of sewer lines that further restrict the areas at HPS where domestic or municipal water supply wells could be installed. Given the thickness of the A-aquifer and the extensive utility line network at HPS, there are very few areas at HPS where wells could be installed meeting this criterion.

SALTWATER INTRUSION AND LAND SUBSIDENCE

HPS is adjacent to and juts into the San Francisco Bay. Before the creation of land at HPS, most of the current HPS land area was beneath the surface of the Bay. HPS is adjacent to and is underlain by saltwater. Long-term pumping of shallow groundwater from the Artificial Fill would induce further saltwater intrusion and would cause TDS concentrations to increase in the pumping well. Prolonged pumping of shallow groundwater at HPS would result in dewatering and compaction of the shallow sediments, which would result in land subsidence. Compaction would increase the potential for differential settlement of the soils and could lead to possible damage to overlying structures.

CONCLUSION AND RECOMMENDATIONS

The A-aquifer groundwater beneath HPS in San Francisco, California, is not of sufficient quality to be used as a potential drinking water source pursuant to SWRCB Resolution 88-63 and RWQCB Resolution 89-39.

The basis for this exemption request is summarized as follows. High TDS precludes the use of the A-aquifer for drinking water. The average TDS concentration in the A-aquifer is about 7,400 mg/L, and very few areas have A-aquifer TDS concentrations less than 3,000 mg/L, which makes the A-aquifer unsuitable for use as a municipal or domestic water supply. Furthermore, pumping would induce saltwater intrusion, which would increase TDS concentrations in pumping wells. Additionally the A-aquifer contains Franciscan Formation deposits with naturally occurring metals that are also found dissolved in A-aquifer groundwater at HPS at concentrations exceeding drinking water criteria. There is no historic or current use of groundwater at HPS, and potential future use of groundwater at HPS for a drinking water supply is limited by California well construction standards.

Finally, San Francisco HPS's potable drinking water supply is obtained from the Hetch Hetchy system operated by the San Francisco Water Department. The City of San Francisco prohibits the installation of domestic water supply wells at HPS.

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The Navy requests that the RWQCB provide written concurrence that A-aquifer groundwater at HPS meets the criteria for exemption from consideration as a suitable or potentially suitable municipal or domestic water supply in SWRCB Resolution 88-63 and RWQCB Resolution 89-39. Should you have any questions about this matter, please contact me at (619) 532-0913.

Sincerely,

KEITH FORMAN
BRAC Environmental Coordinator
By direction of the Commander

Enclosures:
1. Figure 1, Mean Total Dissolved Solids Concentrations in the A-Aquifer with Unsmoothed Interpretation of Salinity Zones
2. Figure 2, A-Aquifer Groundwater Elevations, February 20, 2002
3. Figure 3, Ambient Metals Concentrations in the A-Aquifer Exceeding Maximum Contaminant Levels
4. Table 1, Total Dissolved Solids: Analytical Results for Groundwater in the A-Aquifer
5. Table 2, Summary of Ambient Metals Analytical Results Exceeding Maximum Contaminant Levels in the A-Aquifer
6. Table 3, Hydraulic Conductivity Values for Parcels C and E

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APPENDIX D
COST SUMMARY

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ACRONYMS AND ABBREVIATIONS

CFR	*Code of Federal Regulations*
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
gpm	Gallon per minute
HPS	Hunters Point Shipyard
MLLW	Mean lower low water
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation and maintenance
OMB	Office of Management and Budget
OSWER	Office of Solid Waste and Emergency Response
PCB	Polychlorinated biphenyl
PV	Present value

D1.0 INTRODUCTION

This appendix presents cost estimates developed for the various alternatives evaluated for the Feasibility Study (FS) at Parcel F of Hunters Point Shipyard (HPS).

The remaining sections of this appendix are organized as follows:

- Section D2.0 describes the purpose of the estimates.
- Section D3.0 summarizes the components of the cost-estimating methods used.
- Section D4.0 describes the components of each alternative's cost estimate.
- Section D5.0 lists the references used in preparing the cost estimates.

Cost estimate tables are included at the end of this appendix following Section D5.0.

D2.0 PURPOSE OF ESTIMATES

Cost estimates developed during the detailed analysis phase are used to compare alternatives and support remedy selection. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) includes the following language in its description of the cost criterion for the detailed analysis and remedy selection:

> "The types of costs that shall be assessed include the following: (1) Capital costs, including both direct and indirect costs; (2) Annual operations and maintenance costs; and (3) Net present value of capital and O&M costs (Title 40 Code of Federal Regulations [CFR] 300.430 (e)(9)(iii)(G))" (EPA 2000).

D3.0 COST ESTIMATE COMPONENTS

Cost estimates for the remediation alternatives include capital costs, annual operations and maintenance (O&M) costs or periodic costs (or both), cost of capital, the present value (PV) of O&M costs or periodic costs, and contingency allowances. Each of these components is discussed in further detail in the following sections.

D3.1 CAPITAL COSTS

Capital costs include direct and indirect costs. Costs incurred for equipment, material, labor, construction, development and implementation of remedial technologies are included as direct costs. Indirect costs include health and safety items, site supervision, engineering, overhead and profit, and start up. Indirect costs are included in the estimate as either a separate line item or as a percentage of the direct capital cost.

D3.2 ANNUAL OPERATION AND MAINTENANCE AND/OR PERIODIC COSTS

Annual O&M costs include costs incurred after construction. These costs are necessary to assure the effectiveness of a remedial action. Annual O&M costs typically include labor, consumable materials, purchased services (for example, laboratory analyses), sampling, permit fees, annual reports, and site reviews.

Periodic costs occur once every few years or once during the entire O&M period. Examples include 5-year reviews, site closeout, and remedy failure and replacement.

D3.3 PRESENT VALUE ANALYSIS

Remedial action projects typically involve construction costs that are expended at the beginning of a project (capital costs) and costs in subsequent years (operation and maintenance or periodic costs). PV analysis is a method to evaluate expenditures that occur over different periods of time. This standard methodology allows for cost comparisons of various remedial alternatives on the basis of a single cost value for each alternative. This single value, referred to as the PV, is the amount needed to be set aside at the initial point in time (the base year) to assure that funds will be available in the future as they are needed. PV analysis uses a discount rate and period of analysis to calculate the PV of each expenditure.

D3.3.1 Discount Rate

A discount rate is the difference between interest and inflation rates. When inflation is neglected, the discount rate is simply an interest rate and is used to account for the time value of money. A dollar is worth more today than in the future because, if invested today, the dollar would earn interest. The choice of a discount rate is important because the rate selected directly affects the present value of a cost estimate, which is then used in making a remedy selection decision.

The U.S. Environmental Protection Agency (EPA) policy on the use of discount rates for cost analysis is stated in the preamble to the NCP (55FR8722) and in Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-20 (EPA 2000). Discount rates used in economic analysis by the federal government are specified in Office of Management and Budget (OMB) Circular A-94. The current discount rate for a 30-year stream of payments is 3.1 percent (OMB 2006).

D3.3.2 Present Value

The PV of a series of equal annual future payments such as annual O&M payments is calculated using the following equation:

$$PV = \sum_{t=1}^{n} \frac{x_t}{(1+i)^t}$$

where

PV	=	Present value
x_t	=	Payment in year t (t = 0 for present or base year)
i	=	Discount factor
t	=	Number of years after construction that expenditures start
n	=	Number of years that the stream of equal annual future payments will run

The PV of a single periodic future payment is calculated using the following equation:

$$PV = \frac{x_t}{(1+i)^t}$$

where

PV	=	Present value
x_t	=	Payment in year t (t = 0 for present or base year)
i	=	Discount factor
t	=	Number of years after construction that expenditures occur

The PV of a remedial alternative represents the sum of the present values of all future payments associated with the project. PV for this cost estimate is calculated using 2006 dollars.

D3.4 TYPES OF COST ESTIMATING METHODS

The cost estimates presented in this appendix were developed using both detailed and parametric approaches, both of which are accepted by EPA, as described below.

> "The detailed approach estimates cost on an item-by-item basis. Detailed methods typically rely on quantity take-offs and compiled sources of unit cost data for each item, taken from either a built-in database (if part of a software package, for example) or other sources (e.g., cost estimating references). This method, also known as 'bottom up' estimating, is used when design information is available" (EPA 2000).

"The parametric approach relies on relationships between cost and design parameters. These relationships are usually 'statistically-based' or 'model-based.' Statistically-based approaches rely on 'scaled-up' or 'scaled-down' versions of projects where historical cost data is available. Model-based approaches utilize a generic design that is linked to a cost database and adjusted by the user for site-specific information. This method, also known as 'top down' estimating, is used when design information is not available" (EPA 2000).

D3.5 METHODOLOGY

Cost estimates for this FS Report were prepared in accordance with the "Guide for Developing and Documenting Cost Estimates During the Feasibility Study" (EPA 2000). The Remedial Action Cost Engineering and Requirements System (RACER™) 2006 was the primary source of cost data (Earth Tech, Inc. 2006). Costs for unique line items not included in RACER™ were based on vendor quotes and Means Environmental Cost Estimating unit prices (Means 2005).

D3.6 CONTINGENCY ALLOWANCES

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the estimate is prepared. The two main types of contingency are scope and bid. Scope contingency covers unknown costs resulting from scope changes that may occur during design. Bid contingency covers unknown costs associated with constructing or implementing a given project scope. A 20 percent contingency was added to Alternatives 2, 3, 4, and 5.

D3.7 ESCALATION COSTS

RACER™ output costs are expressed in 2006 dollars (Earth Tech, Inc. 2006). Escalation costs are included to reflect the increase in project costs over time as a result of inflation.

D4.0 INDIVIDUAL COST ESTIMATE ASSUMPTIONS

This section identifies the assumptions and parameters used in developing the cost estimates. Table D-1 summarizes the total remedial costs for each remedial alternative. Figure D-1 provides a graphical comparison of the costs.

D4.1 ALTERNATIVE 2: REMOVAL AND OFF-SITE DISPOSAL

The major components of this alternative are (1) removal (by dredging or excavating) of contaminated sediment and (2) off-site disposal of the sediment. Table D-2 presents the costs for Alternative 2.

The cost assumptions for Alternative 2 are provided below.

- The remediation area is accessible, and no specialized equipment or services (aside from those described in this FS Report) would be necessary to gain access to the site.

- All activities would be performed using modified EPA Level D personal protective equipment.

Removal (Dredging) – Area III

- Approximately 27,300 cubic yards would be dredged from Area III, at a depth of 1 to 5 feet (see Figure 4-3 of the FS Report).

- Dredging would be conducted by clamshell-type dredging equipment outfitted with an environmental bucket. The dredging estimate is based on a vendor quote from Dutra Dredging, December 14, 2005, of approximately $18 per cubic yard for dredging, transport to shore, and unloading at HPS.

- No rocks are present that would require ripping or blasting. No drums or other debris would need to be removed.

- Initial dewatering of the dredged material would take place on the barge, with the water returned to the site within the silt curtain. Further onshore dewatering would be included. Water from the onshore dewatering operations would be disposed of in the sanitary sewer system after appropriate waste characterization analysis. If the water does not meet sanitary sewer discharge requirements, treatment or off-site disposal may be necessary, but is not included in the estimate.

- A silt curtain would be installed around the excavation area for the duration of the dredging operation.

- For cost estimating purposed it was assumed that confirmation samples would be collected on a 250-foot by 250-foot grid. In Area III, a total of six confirmation samples would be analyzed for copper, mercury, and total PCBs.

- The removal area would be backfilled with sand material. The backfill volume was calculated at 130 percent of the excavated volume. Costs for placing the backfill material are based on the costs for placing of the capping material in Alternatives 3, 4, and 5.

Removal (Excavating) – Area X

- The area would be dewatered using cofferdams and centrifugal pumps before excavation.

- Approximately 161,000 cubic yards would be excavated from Area X using conventional excavation equipment.

- Ten crane mats would be on site for the duration of excavation and site restoration activities.

- No rocks are present that would require ripping or blasting. No drums would need to be removed; dewatering is included for the duration of activities.

- A centralized area at HPS would be used for dewatering and characterization sampling (see dewatering area below).

- The excavation would be from 0.5 to 5 feet deep as shown on Figure 4-4 of the FS Report and would not require steel sheeting to protect sidewalls. The sediment type is a sand-silt/sand-clay mixture.

- None of the excavated sediment is expected to be suitable for use as backfill, and all backfill would come from an off-site source.

- Volume expected to be transported off site for disposal is 209,000 cubic yards based on a 30 percent bulking factor.

- For cost estimating purposes it was assumed that confirmation samples would be collected on a 250-foot by 250-foot grid. A total of 30 confirmation samples would be analyzed for total polychlorinated biphenyls (PCB), copper, and mercury for Area X.

- Dewatering the excavation area would consist of placement of 2,000 feet of 8-foot-high cofferdam (AquaDam) and operation of four 300-gallon per minute (gpm) pumps for approximately 2 weeks. An additional cofferdam would be placed in Yosemite Creek approximately 100 feet upstream of the excavation area. Aboveground piping is included to allow discharge into the bay. Minimal flow is expected during the dry season; however, two 300-gpm pumps would be on standby to pump out any water that may accumulate behind the cofferdams.

- Costs for cofferdam rental are based on a vendor quote from Water Structure Unlimited (December 6, 2006), as shown in the table below.

Item	Description	Quantity	Unit	Rate	Amount
Rental	AquaDam Rental 8-feet high x 2,000 feet long w/c	2,000	Feet	$58.80	$117,600
Installation	Includes pumps, hoses, etc. for installation; six days, three personnel	1	Each	$5,000.00	$5,000
		6	Day	$2,000.00	$12,000
Removal		1	Each	$16,000.00	$16,000
				Total	**$150,600**

Note: Additional labor and equipment needed for installation include an excavator and four to six laborers as needed. The costs shown above are unloaded costs; markups are applied in the cost estimate spreadsheets.

- Original contours would be maintained and, if appropriate, regraded to aid surface runoff. Replacement cover would be similar to existing material.

Decontamination Facilities

- A new decontamination pad would be constructed (medium equipment rating), measuring 800 square feet in area, using a flexible membrane liner. A pressure washer would be in use approximately 25 percent of the time, or one shift per day.
- Wastewater generated from the decontamination area would be contained, sampled, and transported for disposal into the wastewater collection system operated by the local publicly owned treatment works.
- Equipment decontamination operations would last 6 months.
- Personnel decontamination trailers and portable restrooms would be included on site for the duration of remediation activities.

Residual Waste Management

- Excavated and dewatered sediment would be tested for hazardous characteristics and disposed of at a Class 1 or Class 2 off-site landfill as appropriate. However, based on the available data, hazardous levels of chemicals are not expected, so the costs shown include disposal at a Class 2 landfill. The costs would be $30 per ton for disposal at a Class II facility (Altamont Landfill in Livermore, California).

Dewatering Facilities

- The dewatering pad would measure approximately 38,000 square feet in area and would consist of a lined, bermed containment cell. The cell would be graded to promote surface runoff toward a collection area, and water would be pumped to a collection tank.
- A 4,000-gallon wastewater collection tank would be installed for the collection of water. Wastewater generated from the dewatering area would be contained, sampled, and piped for disposal into the wastewater collection system operated by the local publicly owned treatment works.

Other

- Engineering (design, permitting, and manifesting) and professional management costs are calculated as a percent of the total direct labor cost, depending on the remedial alternative type.

D4.2 ALTERNATIVES 3A AND 3B: FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (3A) OR AQUABLOK CAP (3B) IN AREA III; IN SITU STABILIZATION IN AREA X; AND INSTITUTIONAL CONTROLS

The major components of this alternative are (1) focused removal (by dredging) and off-site disposal of contaminated sediment in areas above mean lower low water (MLLW) that are not amenable to capping in Area III; (2) an armored cap (Alternative 3A) or AquaBlok cap (Alternative 3B) in deeper areas in Area III; (3) in-situ stabilization of the top 1-foot of sediment in Area X; and (4) institutional controls. Tables D-3 and D-4 present the costs for Alternatives 3A and 3B.

The cost assumptions for Alternatives 3A and 3B are provided below.

- The remediation area is accessible, and no specialized equipment or services (aside from those described in this report) would be necessary to gain access to the site.
- All activities would be performed using modified EPA Level D personal protective equipment.

Focused Removal (Dredging) and Off-Site Disposal – Area III

- The focused removal in Area III would consist of approximately 4,920 cubic yards. The sediment type is a sand-silt/sand-clay mixture. Removal depth would be from 1 to 4 feet (see Figure 4-8 of the FS Report).
- The dredging unit would be outfitted with an environmental clamshell bucket.
- No rocks or other debris are present that would hinder dredging operations; dewatering would be included for the duration of activities.
- A centralized area at HPS would be used for temporary sediment storage, segregation, and characterization sampling (see waste staging area below).
- Volume expected to be transported off site for disposal would be 6,400 cubic yards based on a 30 percent bulking factor.
- For cost estimating purposes it was assumed that confirmation samples would be collected on a 250-foot grid for a total of four samples. Samples would be analyzed for copper, mercury, and total PCBs.
- The focused removal area would be backfilled with sand material. Costs for placing the backfill material are based on the costs for placing the capping material, scaled down to the volume of the focused removal area.

Capping – Area III

- An approximately 476,700-square foot area would be capped.
- Two types of caps are proposed:
  - Armor Cap: Consists of 1.5 feet of sand covered by 0.5 foot of armor stone.
  - AquaBlok Cap: Consists of 4.5 inches of AquaBlok covered by 0.5 foot of armor stone.
- Vendor quotes obtained from AquaBlok, Limited were used to develop costs for placement of the caps, as follows:

  Pre-Application Activities (vendor laboratory studies and design): $335,000

  Capping Materials (target 10-inch effective cap = 4.5 inches saltwater compatible Aquablok™ plus 6 inches of stone armor):

AquaBlock™ 4060W	$1,690,000	*
Armor (5"-6" agg.)	$424,000	**
Total	$2,114,000	

*Amount includes 5 percent additional material to allow for product loss during placement, transport, and so forth.
**Includes allowance for local freight, on-site storage, manufacture site rental, and manufacture site preparation.

  Application (Application using barge-based conveyor supplied with capping material from shore-based operations):

Equipment Mobilization (barges, work boat, telebelt, etc.)	$60,000
Application ~1/2 acre per day (25 days total) @ $20,000 day	$500,000
Material Staging	$50,000
Post-Application Quality Control and Documentation	$150,000
Total Cost for Application	$760,000
Total AquaBlok Costs	$3,209,000

- Cap repair costs are based on the assumption that one-fifth of the area would require repair within a 30-year period. The repair costs include equipment mobilization, application for 5 days, material staging and post-application quality control and documentation.

In-Situ Treatment – Area X

- Sediment contaminated with PCBs would be stabilized by adding 3.4 percent activated carbon to the top 1 foot of sediments.
- Approximately 53,800 cubic yards of sediment would be treated, requiring approximately 1,360,000 pounds of carbon (at a carbon density of 743 pounds per cubic yard).
- Costs for in-situ treatment are extrapolated from costs for pilot studies conducted by Stanford University (Environmental Security Technology Certification Program 2005). According to Dennis Smithenry of Stanford, Aquamog equipment was used during the initial pilot study to mix carbon into the sediments at a cost of $5,000 per day and a production rate of about 5,000 square feet per day. The cost for 30NS regenerated activated carbon is $1.88 per lb.
- A crane would be included for loading the carbon onto a barge for the duration of the project (291 days).

Decontamination Facilities, Residual Waste Management, and Dewatering Facilities

These parameters would be the same as described in Alternative 2.

D4.3 ALTERNATIVES 4A AND 4B – FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (4A) OR AQUABLOK CAP (4B) IN AREA III; MONITORED NATURAL RECOVERY IN AREA X; AND INSTITUTIONAL CONTROLS

The major components of this alternative are (1) focused removal (by dredging) and off-site disposal of contaminated sediment in areas above the MLLW that are not amenable to capping in Area III; (2) placement of an armored cap (Alternative 4A) or AquaBlok cap (Alternative 4B) in deeper areas in Area III; (3) monitored natural recovery in Area X; and (4) institutional controls. Tables D-5 and D-6 present the costs for Alternative 4A and 4B.

The cost assumptions for Alternatives 4A and 4B are provided below.

- The remediation area is accessible, and no specialized equipment or services (aside from those described in this report) would be necessary to gain access to the site.
- All activities would be performed using modified EPA Level D personal protective equipment.
- Activities are expected to last 6 months.

Focused Removal (Dredging), Off-Site Disposal, and Capping – Area III

- These activities would be the same as described for Alternatives 3A and 3B.

Monitored Natural Recovery – Area X

- Costs for deed restrictions include documentation, posting, and enforcement.

- Baseline monitoring would consist of a bathymetry survey and sediment core sampling using a vibracore sampler. Thirty fine-sediment cores would be collected and analyzed for copper, mercury, and total PCBs. A benthic survey also would be conducted.

- Costs for bathymetry surveys and vibracore sampling were obtained from vendor quote from TEG Ocean Services, January 9, 2006, as follows:

  Class I Hydrographic Surveys (DGPS HYPACK Survey software, 200 kHz single beam survey fathometer:

Area III:	$8,500
Area X:	$14,500

  Vibracore Sampling (The two areas will require different vessels and production in the outer areas will be likely be six to eight cores per day based on currents):

  Area III:

  1. Mob/Demobilization (Vibracore System no vessel mob. cost) $1,500
  2. Vibracoring Daily Rate (6 cores/day, includes vessel, DGPS positioning, coring system, personnel and per diems) $3,550/day
  3. Consumables (billed as used, includes core barrels, liners, etc.) estimated $400/day

  Area X:

  1. Mob/Demobilization (shallow water drill rig and tender vessel, vibracore system) $4,500
  2. Vibracoring Daily Rate (8-10 cores/day, includes vessel, DGPS positioning, coring system, personnel and per diems) $4,050/day
  3. Consumables (billed as used, includes core barrels, liners, etc.) estimated $400/day

- Annual monitoring would be conducted for the same parameters over a 30 years period. A 5-year review would be included.

Decontamination Facilities, Residual Waste Management, and Dewatering Facilities

These parameters would be the same as described in Alternative 2.

D4.4 ALTERNATIVES 5A AND 5B – FOCUSED REMOVAL, OFF-SITE DISPOSAL, AND ARMORED CAP (5A) OR AQUABLOK CAP (5B) IN AREA III; FOCUSED REMOVAL, OFF-SITE DISPOSAL (5A) OR ACTIVATED BACKFILL (5B), AND MONITORED NATURAL RECOVERY IN AREA X; AND INSTITUTIONAL CONTROLS

The major components of this alternative are (1) focused removal (by dredging) and off-site disposal of contaminated sediment in areas above the MLLW that are not amenable to capping in Area III; (3) placement of an armored cap (Alternative 5A) or AquaBlok cap (Alternative 5B) in deeper areas in Area III; (3) focused removal (by excavating) of contaminated sediment to a depth of 1.0 feet where chemical concentrations in sediment exceed the remediation goals in Area X; (4) off-site disposal (Alternative 5A) or placement of activated backfill (Alternative 5B) in Area X; (5) monitored natural recovery in remaining areas in Area X; and (6) institutional controls. Tables D-7 and D-8 present the costs for Alternative 5A and 5B.

The cost assumptions for Alternative 5 are provided below.

- The remediation area is accessible, and no specialized equipment or services (aside from those described in this report) would be necessary to gain access to the site.
- All activities would be performed using modified EPA Level D personal protective equipment.

Focused Removal (Dredging), Off-Site Disposal, and Capping – Area III

These activities would be the same as described for Alternative 3.

Focused Removal (Excavation), Off-Site Disposal, or Activated Backfill – Area X

- The area would be dewatered using cofferdams and centrifugal pumps before excavation of sediment.
- Approximately 46,990 cubic yards would be excavated from Area X using conventional excavation equipment.
- Ten crane mats would be on site for the duration of excavation and site restoration activities.
- No rocks are present that would require ripping or blasting. No drums would need to be removed; dewatering is included for the duration of activities.
- A centralized area at HPS would be used for dewatering and characterization sampling (see dewatering area below).

- The excavation would be 1 foot deep as shown on Figure 4-15 of the FS Report, and would not require steel sheeting to protect sidewalls. The sediment type is a sand-silt/sand-clay mixture.

- None of the excavated sediment is expected to be suitable for use as backfill, and all backfill would come from an off-site source.

- Volume expected to be transported off site for disposal is 61,170 cubic yards based on a 30 percent bulking factor.

- For cost estimating purposes it was assumed that confirmation samples would be collected on a 250-foot by 250-foot grid. For Area III, a total of 20 confirmation samples would be analyzed for copper, mercury, and total PCBs.

- Dewatering the excavation area would consist of placement of 2,000 feet of 8-foot high cofferdam (Aquadam) and operation of four 300-gpm pumps for approximately 2 weeks. An additional cofferdam would be placed in Yosemite Creek approximately 100 feet upstream of the excavation area. Aboveground piping would be included to allow discharge into the bay. Minimal flow is expected during the dry season; however, two 300-gpm pumps would be placed on standby to pump out any water that may accumulate behind the cofferdams.

- Original contours would be maintained and, if appropriate, regraded to aid surface runoff.

- Replacement cover would be similar to existing material, with the addition of activated carbon to the backfill material.

Monitored Natural Recovery – Area X

- Costs for deed restrictions include documentation, posting, and enforcement.

- Baseline monitoring would consist of a bathymetry survey and sediment core sampling using a Vibracore sampler. Thirty sediment cores would be collected and analyzed for copper, mercury, and total PCBs. A benthic survey also would be conducted.

- Annual monitoring would be conducted for the same parameters over a 30 years period. A 5-year review would be included.

Decontamination Facilities, Residual Waste Management, Dewatering Facilities

These parameters would be the same as described in Alternative 2.

D5.0 REFERENCES

Earth Tech, Inc. 2006. Remedial Action Cost Engineering and Requirements System (RACER) Cost Database Software, Version 8.1.0.

Environmental Security Technology Certification Program. 2005. "Demonstration Plan for Field Testing of Activated Carbon Mixing and In Situ Stabilization of PCBs in Sediment at Hunters Point Shipyard Parcel F San Francisco Bay, California." November 17.

Means. 2005. "Means Environmental Remediation Cost Data – Unit Cost Book, 2005."

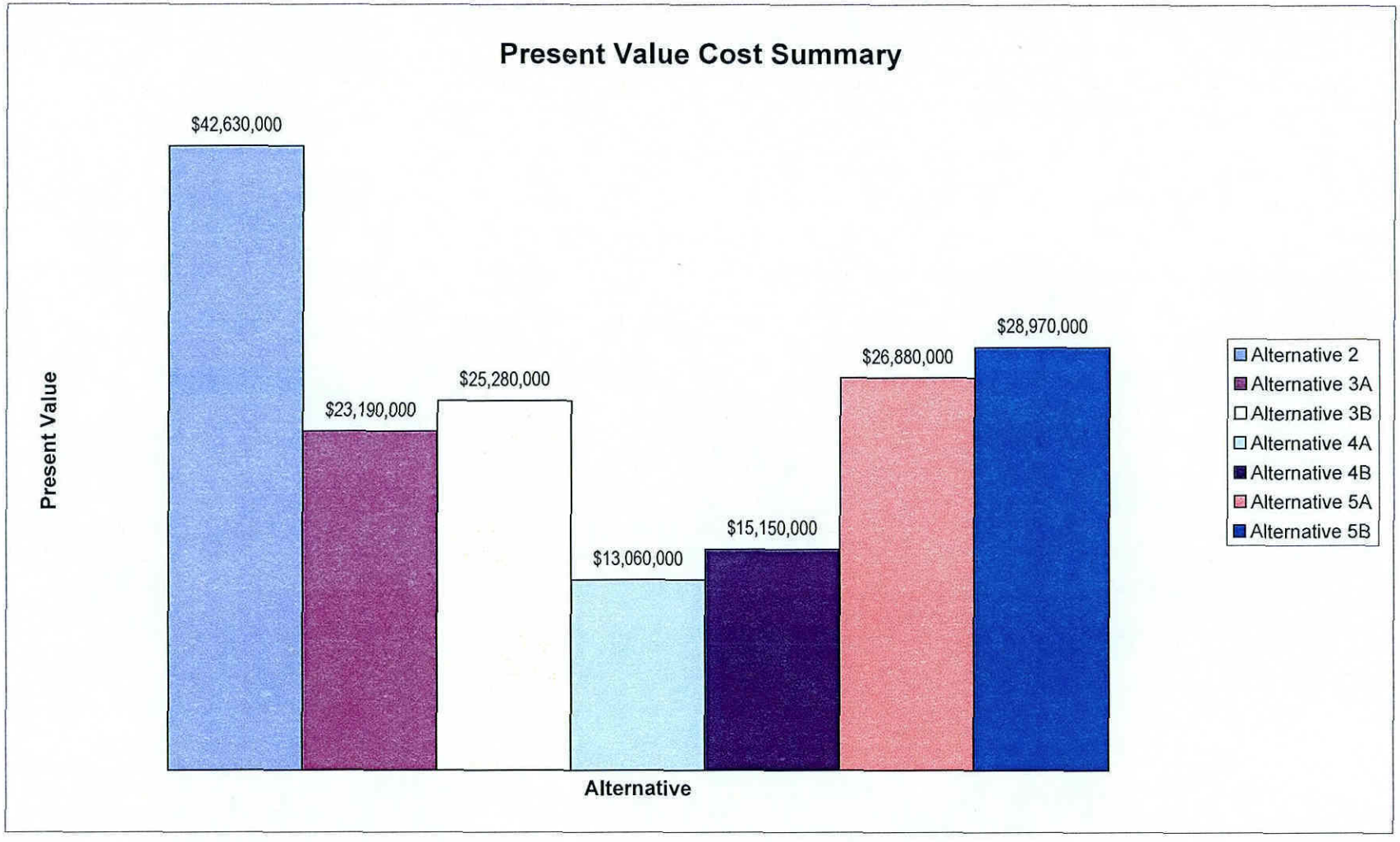
Office of Management and Budget. 2006. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs." Circular A-94. Revised January.

U.S. Environmental Protection Agency (EPA). 2000. "A Guide to Developing and Documenting Cost Estimates during the Feasibility Study." EPA 540-R-00-002, OSWER 9355.0-75. July.

FIGURES

Figure D-1: Present Value Cost Summary

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California



TABLES

TABLE D-1: PRESENT VALUE COST SUMMARY FOR REMEDIAL ALTERNATIVES

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

	Description	Base Cost[1]	30-Year O&M	Total
Alternative 2	Removal and Off-Site Disposal	$42,630,000	$0	$42,630,000
Alternative 3A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	$20,310,000	$2,880,000	$23,190,000
Alternative 3B	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; In-Situ Stabilization in Area X; and Institutional Controls	$22,520,000	$2,760,000	$25,280,000
Alternative 4A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	$10,070,000	$2,990,000	$13,060,000
Alternative 4B	Focused Removal, Off-Site Disposal, and AquaBlok Cap in Area III; Monitored Natural Recovery in Area X; and Institutional Controls	$12,270,000	$2,880,000	$15,150,000
Alternative 5A	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Off-Site Disposal, and Monitored Natural Recovery in Area X; and Institutional Controls	$23,990,000	$2,890,000	$26,880,000
Alternative 5B	Focused Removal, Off-Site Disposal, and Armored Cap in Area III; Focused Removal, Activated Carbon Backfill, and Monitored Natural Recovery in Area X; and Institutional Controls	$26,190,606	$2,779,394	$28,970,000

Note:

1. Base costs include remedial design and construction.

O&M Operation and maintenance

TABLE D-2: COST ESTIMATE -- ALTERNATIVE 2

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 2:	Location Modifiers	
Area III: Removal and Off-Site Disposal	Material:	1.152
Area X: Removal and Off-Site Disposal	Labor:	1.67
	Equipment:	1.076
	Contingency on Direct Costs:	20%
Prepared by: M. Berry - BAI, September 2006	Options	
Checked by: S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
	Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
REMOVAL (EXCAVATION) - AREA X								
COFFER DAM - SOUTH BASIN (2,000 linear feet)								
• Construction Labor	240.00	HR	0.00	101.21	0.00	$101.21	$24,290	1
• Maintenance Labor	120.00	HR	0.00	101.21	0.00	$101.21	$12,145	1
• Crawler-mounted, 2.0 CY, 235	48.00	HR	0.00	137.97	206.56	$344.53	$16,537	1
• Hydraulic Excavator								1
• 4" Diameter Contractor's Trash	253.00	DAY	87.42	60.30	0.00	$147.72	$37,373	1
• Pump, 300 GPM								1
• 4", Class 150, PVC Piping	1,000.00	LF	3.12	18.25	0.94	$22.31	$22,310	1
• AquaDam Rental	2,000.00	LF	0.00	0.00	97.27	$97.27	$194,540	2
• Mobilization AquaDam	2.00	EACH	8,199.05	0.00	0.00	$8,199.05	$16,398	2
• Installation AquaDam	6.00	DAY	3,279.62	0.00	0.00	$3,279.62	$19,678	2
						Subtotal	**$343,272**	
COFFER DAM - YOSEMITE CREEK (1,000 linear feet)								
• Construction Labor	40.00	HR	0.00	101.21	0.00	$101.21	$4,048	1
• Crawler-mounted, 2.0 CY, 235	8.00	HR	0.00	137.97	206.56	$344.53	$2,756	1
• Hydraulic Excavator								1
• 4" Diameter Contractor's Trash	60.00	DAY	87.42	60.30	0.00	$147.72	$8,863	1
• Pump, 300 GPM								1
• 4", Class 150, PVC Piping	1,000.00	LF	3.12	18.25	0.94	$22.31	$22,310	1
• AquaDam Rental	150.00	LF	0.00	0.00	97.27	$97.27	$14,591	2
• Mobilization AquaDam	1.00	EACH	1,639.81	0.00	0.00	$1,639.81	$1,640	2
• Installation AquaDam	1.00	DAY	3,279.62	0.00	0.00	$3,279.62	$3,280	2
						Subtotal	**$57,488**	
EXCAVATION AND BACKFILL (161,000 cubic yards)								
• 4 CY, Crawler-mounted, Hydraulic Excavator	161,000.00	CY	0.00	2.29	3.47	$5.76	$927,360	1
• Delivered & Dumped, Backfill	37,037.04	BCY	44.01	1.99	1.48	$47.48	$1,758,519	1
• Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	203,713.70	CY	10.54	4.56	3.05	$18.15	$3,697,404	1
• Synthetic covers over waste piles, 130 lb. tear strength	1,716,084.00	SF	0.21	0.08	0.00	$0.29	$497,664	1
• Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	1.00	EA	0.00	1,072.83	0.00	$1,072.83	$1,073	1
• Crane Mats	10.00	EACH	3,852.82	0.00	0.00	$3,852.82	$38,528	1
						Subtotal	**$6,920,548**	
CONFIRMATION SAMPLING								
• Surface Soil Sampling Equipment	1.00	EA	658.43	0.00	0.00	$658.43	$658	1
• Analysis, mercury (7041)	36.00	EA	46.93	0.00	0.00	$46.93	$1,689	1
• Analysis, lead (6010)	36.00	EA	20.34	0.00	0.00	$20.34	$732	1
• Analysis, copper (6010)	36.00	EA	20.34	0.00	0.00	$20.34	$732	1
• Analysis PCBs, (8081/8082)	36.00	EA	306.06	0.00	0.00	$306.06	$11,018	1
• Field Technician	32.00	HR	0.00	171.18	0.00	$171.18	$5,478	1
• Surveying - 2-man Crew	5.00	DAY	0.00	2,288.95	383.39	$2,672.34	$13,362	1
						Subtotal	**$33,670**	
RESIDUAL WASTE MANAGEMENT (including disposal of sediment at Altamont Landfill)								
• Secondary containment and storage, loading hazardous waste for shipment into 5,000 gal. bulk tank truck	12.00	EA	0.00	1,055.18	394.82	$1,450.00	$17,400	1
• Secondary containment and storage, loading hazardous waste for shipment on disposal truck	18.00	EA	0.00	10.81	1.80	$12.61	$227	1
• Subcontracted shipping of hazardous wa transport drums of solid hazardous waste, 80 55 gal. drums	70.00	MI	3.26	0.00	0.00	$3.26	$228	1

TABLE D-2: COST ESTIMATE -- ALTERNATIVE 2 (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 2:	Location Modifiers	
Area III: Removal and Off-Site Disposal	Material:	1.152
Area X: Removal and Off-Site Disposal	Labor:	1.67
	Equipment:	1.076
	Contingency on Direct Costs:	20%
Prepared by: M. Berry - BAI, September 2006	Options	
Checked by: S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
	Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
• Subcontracted shipping of hazardous waste, transport bulk solid hazardous waste, 20 C.Y.	823,970.00	MI	3.26	0.00	0.00	$3.26	$2,686,142	1
• Commercial RCRA landfills, additional landfill disposal costs, waste stream evaluation, 50% rebate on first	3.00	EA	793.09	0.00	0.00	$793.09	$2,379	1
• Commercial RCRA landfills, drummed waste disposal, solid, non-hazardous, 55 gal drums	18.00	EA	13.50	0.00	0.00	$13.50	$243	1
• Commercial RCRA landfills, bulk waste, solid, non-hazardous, based on less than 2,000 lb/CY	211,862.00	CY	46.34	0.00	0.00	$46.34	$9,817,685	3
						Subtotal	**$12,524,305**	
DEWATERING PAD								
• Grub and stack, 140 H.P. dozer	212.00	CY	0.00	6.75	2.29	$9.04	$1,916	1
• Excavating, trench, normal soil, to 2 to 6 deep, excavate by hand, piled only	212.00	BCY	0.00	165.78	0.00	$165.78	$35,145	1
• 953, 2.0 CY, Track Loader	1,000.00	HR	0.00	119.96	104.04	$224.00	$224,000	1
• Backfill Trench, Borrow Material, Delivered & Dumped Only	136.00	CY	10.16	4.46	1.89	$16.51	$2,245	1
• 18" x 18" Underground French Drain	753.39	LF	6.15	3.81	0.58	$10.54	$7,941	1
• Pump, pedestal sump, single stage, 75 GPM, 1-1/2 H.P., 2" discharge	1.00	EA	4,242.65	1,769.93	0.00	$6,012.58	$6,013	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 550 gallon	1.00	EA	2,570.88	1,067.48	0.00	$3,638.36	$3,638	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 6" NP, 4,000 gallon	1.00	EA	6,685.01	1,673.48	0.00	$8,358.49	$8,358	1
• Polymeric Liner Anchor Trench, 3'x1.5'	792.00	LF	0.06	4.45	0.42	$4.93	$3,905	1
• Secure burial cell construction, polymeric liner and cover system, polyvinyl chloride (PVC), 40 mil	38,259.00	SF	0.59	0.93	0.04	$1.56	$59,684	1
• Waste Pile Cover, 135 Lb Tear,	3,742.00	SY	2.88	0.83	0.00	$3.71	$13,883	1
• Sewage connection charge	1.00	EA	1,370.32	0.00	0.00	$1,370.32	$1,370	1
• Wastewater Disposal Fee	434.00	KGA	3.06	0.00	0.00	$3.06	$1,328	1
• Pump, submersible sump, automatic, 15 GPM, 1-1/2" discharge, 15' head	1.00	EA	1,336.83	286.89	0.00	$1,623.72	$1,624	1
• Operator, dewatering pad	800.00	HR	0.00	171.00	0.00	$171.00	$136,800	1
						Subtotal	**$507,851**	
DECONTAMINATION FACILITIES								
• Pad Subgrade Preparation	35.56	CY	0.00	12.01	1.96	$ 13.97	$ 497	1
• Excavating, trench, medium soil, 4' to 6' deep, 1 C.Y. bucket, gradall	1.78	BCY	0.00	1.73	0.44	$ 2.17	$ 4	1
• Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	35.56	ECY	0.00	5.28	0.20	$ 5.48	$ 195	1
• Dry Roll Gravel, Steel Roller	106.67	SY	0.00	1.55	0.44	$ 1.99	$ 212	1
• Gravel, Delivered & Dumped	14.81	CY	36.68	6.64	2.67	$ 45.99	$ 681	1
• Gravel (90%) & Sand Base (10%), with Calcium Chloride 3/4 - 1 lb/cy	14.81	CY	29.44	6.68	3.45	$ 39.57	$ 586	1
• Asphalt Curb 8" W x 6" H	120.00	LF	2.59	7.63	5.83	$ 16.05	$1,926	1
• Prime Coat	88.89	SY	0.53	0.08	0.02	$ 0.63	$ 56	1
• Asphalt Wearing Course, 1 Pass (Line Item Includes 5% Waste)	19.33	TON	55.11	16.17	3.73	$ 75.01	$1,450	1
• 26" x 26", 5' Deep Area Drain with Grate	1.00	EA	1,663.98	4,663.80	71.06	$6,398.84	$6,399	1
• 5' x 5' x 5' Reinforced Concrete Sump	1.00	EA	2,277.14	7,663.76	83.78	$10,024.68	$10,025	1
• 12" x 12" CIP Concrete In-Ground Trench Drain with Metal Grate	20.00	LF	66.78	151.37	0.49	$ 218.64	$4,373	1
• Storage Tanks, steel, above ground single wall, 1,500 gallon, incl. cradles, coating & fittings, excl. foundation, pumps or piping	1.00	EA	4,776.17	1,173.24	0.00	$5,949.41	$5,949	1
• Polymeric Liner Anchor Trench, 3'x15'	144.00	LF	0.06	4.45	0.42	$ 4.93	$ 710	1

TABLE D-2: COST ESTIMATE – ALTERNATIVE 2 (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 2:		Location Modifiers	
Area III:	Removal and Off-Site Disposal	Material:	1.152
Area X:	Removal and Off-Site Disposal	Labor:	1.67
		Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
• 8 oz/sy Erosion Control/Drainage Filter Fabric (80 mil)	106.67	SY	1.27	1.57	0.04	$ 2.88	$ 307	1
• Secure burial cell construction, polymeric liner and cover system rough textured H.D. polyethylene (HDPE), 40 mil	960.00	SF	0.53	0.50	0.02	$ 1.05	$1,008	1
• Spray washers, electric, 1800 psi, 4.8 GPM, pressure washer, 50' hose	1.00	EA	2,988.01	0.00	0.00	$2,988.01	$2,988	1
• Decontamination trailers, 2 showers, 2 wall fans (monthly rental), 8' x 36'	5.00	MO	4,129.47	0.00	0.00	$4,129.47	$20,647	1
• Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	200.00	HR	11.73	150.95	0.00	$ 162.68	$32,536	1
• DOT steel drums, 55 gal., open, 17C	18.00	EA	145.97	0.00	0.00	$ 145.97	$2,627	1
• Field Technician	800.00	HR	0.00	171.18	0.00	$ 171.18	$136,944	1
• High Sump Level Switch for Avoiding Overflow	1.00	EA	386.54	503.57	0.00	$ 890.11	$ 890	1
• (2 1/2", 4") PVC Double-wall, piping/fittir	30.00	LF	38.15	77.03	0.00	$ 115.18	$3,455	1
• Pump, pedestal sump, single stage, 25 GPM, 1 H.P., 1-1/2" discharge and personnel	1.00	EA	4,011.30	1,474.94	0.00	$5,486.24	$5,486	1
						Subtotal	$239,952	
PROFESSIONAL LABOR MANAGEMENT - REMOVAL AREA X								
• Project Management Labor Cost	1.00	LS	0.00	1,271,252.5	0.00	$1,271,252.48	$1,271,252	1
• Planning Documents Labor Cost	1.00	LS	0.00	1,220,402.4	0.00	$1,220,402.42	$1,220,402	1
• Construction Oversight Labor	1.00	LS	0.00	2,135,704.3	0.00	$2,135,704.26	$2,135,704	1
• Reporting Labor Cost	1.00	LS	0.00	254,250.49	0.00	$254,250.49	$254,250	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	254,250.49	0.00	$254,250.49	$254,250	1
• Public Notice Labor Cost	1.00	LS	0.00	15,255.03	0.00	$15,255.03	$15,255	1
• Permitting Labor Cost	1.00	LS	0.00	508,500.98	0.00	$508,500.98	$508,501	1
						Subtotal	$5,659,616	
						SUBTOTAL AREA X	$26,286,702	
REMOVAL (DREDGING) - AREA III								
DREDGING (27,300 cubic yards)								
• Testing, turbidity	20.00	EA	23.58	0.00	0.00	$23.58	$472	1
• Mechanical Dredging	27,300.00	CY	31.23	0.00	0.00	$31.23	$852,579	4
						Subtotal	$853,051	
BACKFILL PLACEMENT								
• Sand Capping - Materials	35,480.00	CY	58.03	0.00	0.00	$58.03	$2,058,904	5
• Cap Application - Barge	1.00	EACH	2,608,016.00	0.00	0.00	$2,608,016.00	$2,608,016	5
						Subtotal	$4,666,920	
CONFIRMATION SAMPLING								
• Analysis, mercury (7041)	7.00	EA	52.80	0.00	0.00	$52.80	$370	1
• Pesticides/PCBs (SW	7.00	EA	306.06	0.00	0.00	$306.06	$2,142	1
• Analysis, copper (6010)	7.00	EA	20.34	0.00	0.00	$20.34	$142	1
• Bathymetry Survey - Area III	1.00	EACH	13,131.00	0.00	0.00	$13,131.00	$13,131	6
• Vibracore mob/demobilization - Area III	1.00	EACH	2,317.23	0.00	0.00	$2,317.23	$2,317	6
• Vibracore daily rate - Area III	2.00	DAY	5,484.12	0.00	0.00	$5,484.12	$10,968	6
• Vibracore consumables	2.00	DAY	617.93	0.00	0.00	$617.93	$1,236	6
						Subtotal	$30,307	
LOAD AND HAUL - SEDIMENT DISPOSAL (35,480 cubic yards disposed at Altamont Landfill)								
• Dump Charges	35,480.00	CY	50.90	0.00	0.00	$50.90	$1,805,932	3
• 988, 7.0 CY, Wheel Loader	113.00	HR	0.00	139.10	287.75	$426.85	$48,234	1
• 32 CY, Semi Dump	5,172.00	HR	0.00	109.77	128.84	$238.61	$1,234,091	1
						Subtotal	$3,088,257	

TABLE D-2: COST ESTIMATE -- ALTERNATIVE 2 (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

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Prepared by: M. Berry - BAI, September 2006	Options	
Checked by: S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
	Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
DEWATERING PAD								
• Grub and stack, 140 H.P. dozer	186.00	CY	0.00	6.75	2.29	$9.04	$1,681	1
• Excavating, trench, normal soil, to 2 to 6 deep, excavate by hand, piled only	212.00	BCY	0.00	165.78	0.00	$165.78	$35,145	1
• 953, 2.0 CY, Track Loader	506.00	HR	0.00	119.96	104.04	$224.00	$113,344	1
• Backfill Trench, Borrow Material, Delivered & Dumped Only	119.00	CY	10.16	4.46	1.89	$16.51	$1,965	1
• 4" Extra-strength Vitrified Clay Pipe, Class 200, Premium Joints	1,000.00	LF	4.24	20.43	3.32	$27.99	$27,990	1
• 18" x 18" Underground French Drain	644.45	LF	6.15	3.81	0.58	$10.54	$6,793	1
• Pump, pedestal sump, single stage, 75 GPM, 1-1/2 H.P., 2" discharge	1.00	EA	4,242.65	1,769.93	0.00	$6,012.58	$6,013	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 550 gallons	1.00	EA	2,570.88	1,067.48	0.00	$3,638.36	$3,638	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 6" NP, 4,000 gallons	1.00	EA	6,685.01	1,673.48	0.00	$8,358.49	$8,358	1
• Polymeric Liner Anchor Trench, 3'x15'	701.00	LF	0.06	4.45	0.42	$4.93	$3,456	1
• Secure burial cell construction, polymeric liner and cover system, polyvinyl chloride (PVC), 40mil	29,968.00	SF	0.59	0.93	0.04	$1.56	$46,750	
• Waste Pile Cover, 135 Lb Tear,	2,881.00	SY	2.88	0.83	0.00	$3.71	$10,689	1
• Sewage connection charge	1.00	EA	1,370.32	0.00	0.00	$1,370.32	$1,370	1
• Wastewater Disposal Fee	343.00	KGA	3.06	0.00	0.00	$3.06	$1,050	1
• Pump, submersible sump, automatic, 15 GPM, 1-1/2" discharge, 15' head	1.00	EA	1,336.83	286.89	0.00	$1,623.72	$1,624	1
						Subtotal	**$269,866**	
DECONTAMINATION FACILITIES								
• Pad Subgrade Preparation	35.56	CY	0.00	12.01	1.96	$13.97	$497	1
• Excavating, trench, medium soil, 4' to 6' deep, 1 C.Y. bucket, gradall, excludes sheeting or dewatering	1.78	BCY	0.00	1.73	0.44	$2.17	$4	1
• Compaction, subgrade, 18"	35.56	ECY	0.00	5.28	0.20	$5.48	$195	1
• wide, 8" lifts, walk behind, vibrating plate Dry Roll Gravel, Steel Roller	106.67	SY	0.00	1.55	0.44	$1.99	$212	1
• Gravel, Delivered & Dumped	14.81	CY	36.68	6.64	2.67	$45.99	$681	1
• Gravel (90%) & Sand Base (10%), with Calcium Chloride 3/4 - 1 Lb/CY	14.81	CY	29.44	6.68	3.45	$39.57	$586	1
• Asphalt Curb 8" W x 6" H	120.00	LF	2.59	7.63	5.83	$16.05	$1,926	1
• Prime Coat	88.89	SY	0.53	0.08	0.02	$0.63	$56	1
• Asphalt Wearing Course, 1 Pass (Line Item Includes 5% Waste)	19.33	TON	55.11	16.17	3.73	$75.01	$1,450	1
• 26" x 26", 5' Deep Area Drain with Grate	1.00	EA	1,663.98	4,663.80	71.06	$6,398.84	$6,399	1
• 5' x 5' x 5' Reinforced Concrete Sump	1.00	EA	2,277.14	7,663.76	83.78	$10,024.68	$10,025	1
• 12" x 12" CIP Concrete In-Ground Trench Drain with Metal Grate	20.00	LF	66.78	151.37	0.49	$218.64	$4,373	1
• Storage Tanks, steel, above ground, single wall, 1,500 gallon, incl. cradles, coating & fittings, excl. foundation, pumps or piping	1.00	EA	4,776.17	1,173.24	0.00	$5,949.41	$5,949	1
• Polymeric Liner Anchor Trench, 3' x 1.5'	144.00	LF	0.06	4.45	0.42	$4.93	$710	1
• 8 oz/sy Erosion Control/Drainage Filter Fabric (80 Mil)	106.67	SY	1.27	1.57	0.04	$2.88	$307	1
• Secure burial cell construction, polymeric liner and cover system, rough textured H.D. polyethylene (HDPE), 40 mil	960.00	SF	0.53	0.50	0.02	$1.05	$1,008	1
• Spray washers, cold water, electric, 1800 psi, 5 GPM, 5 HP, rent/month	1.00	MO	1,970.89	0.00	0.00	$1,970.89	$1,971	1

TABLE D-2: COST ESTIMATE -- ALTERNATIVE 2 (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 2:	Location Modifiers	
Area III: Removal and Off-Site Disposal	Material:	1.152
Area X: Removal and Off-Site Disposal	Labor:	1.67
	Equipment:	1.076
	Contingency on Direct Costs:	20%
Prepared by: M. Berry - BAI, September 2006	Options	
Checked by: S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
	Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
• Decontamination trailers, 4 showers, HVAC, 2 sinks (monthly rental), 8' x 24'	1.00	MO	4,411.02	0.00	0.00	$4,411.02	$4,411	1
• Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	40.00	HR	11.73	150.95	0.00	$162.68	$6,507	1
• DOT steel drums, 55 gal., open, 17C	7.00	EA	145.97	0.00	0.00	$145.97	$1,022	1
• Field Technician	300.00	HR	0.00	171.18	0.00	$171.18	$51,354	1
• High Sump Level Switch for Avoiding Overflow	1.00	EA	386.54	503.57	0.00	$890.11	$890	1
• (2 1/2", 4") PVC Double-wall Piping, with Fittings	30.00	LF	38.15	77.03	0.00	$115.18	$3,455	1
• Pump, pedestal sump, single stage, 25 GPM, 1 H.P., 1-1/2" discharge	1.00	EA	4,011.30	1,474.94	0.00	$5,486.24	$5,486	1
						Subtotal	**$109,474**	
PROFESSIONAL LABOR MANAGEMENT - REMOVAL AREA III								
• Project Management Labor Cost	1.00	LS	0.00	995,921.82	0.00	$995,921.82	$995,922	1
• Planning Documents Labor Cost	1.00	LS	0.00	995,921.82	0.00	$995,921.82	$995,922	1
• Construction Oversight Labor Cost	1.00	LS	0.00	1,244,902.27	0.00	$1,244,902.27	$1,244,902	1
• Reporting Labor Cost	1.00	LS	0.00	124,490.23	0.00	$124,490.23	$124,490	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	124,490.23	0.00	$124,490.23	$124,490	1
• Public Notice Labor Cost	1.00	LS	0.00	17,428.63	0.00	$17,428.63	$17,429	1
• Permitting Labor Cost	1.00	LS	0.00	1,244,902.27	0.00	$1,244,902.27	$1,244,902	1
						Subtotal	**$4,748,057**	
						SUBTOTAL AREA III	**$13,765,932**	

REMEDIAL DESIGN

Phase Name	Design Approach	Total Capital	%	Design
• Dredging - Area III	Ex Situ Removal - Off-site Treatment or Disposal	$ 9,017,875	10%	$901,787
• Excavation - Area X	Ex Situ Removal - Off-site Treatment or Disposal	$20,627,085	10%	$2,062,709
			Subtotal Design	**$2,964,496**
			Base Cost	$43,017,129
			30-Year O&M	$0
			Total Future Cost	$43,017,129

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$2,964,496	0	2006	1	1	$2,964,496
Remedial Action Construction	$40,052,633	1	2007	1.021	0.970	$39,664,150
	$40,020,000					$42,628,646
					TOTAL PRESENT VALUE- ALTERNATIVE 2	**$42,628,646**

Sources:
1. Racer 2005 Database
2. Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3. Altamont Landfill tipping fee, non-hazardous material.
4. Vendor Quote - Dutra Dredging, 12/14/05.
5. Vendor Quote - AquaBlok Limited, 12/13/05.
6. Vendor Quote - TEG Ocean Services, 1/9/06.

[c]Annual Discount Rate (i) = 3.10%

Notes:
a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-3: COST ESTIMATE -- ALTERNATIVE 3A

Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	1.152
	Placement of Armored Cap	Labor:	1.67
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
IN-SITU STABILIZATION WITH ACTIVATED CARBON - AREA X								
IN-SITU STABILIZATION (33-acre treatment area)								
• 22 Ton 4WD Rough Terrain Hydr Crane	2,000.00	HR	0.00	0.00	137.04	$ 137.04	$274,080	1
• Equip. Operators, Crane/Shovel	2,000.00	HR	0.00	133.29	0.00	$ 133.29	$266,580	1
• Crane Mats	10.00	EACH	3,852.82	0.00	0.00	$3,852.82	$38,528	1
• Activated Carbon	1,360,000.00	LB	2.90	0.00	0.00	$ 2.90	$3,944,000	7
• Mixing carbon into sediment with Aquamog equipment	1,453,000.00	SF	1.54	0.00	0.00	$ 1.54	$2,237,620	7
						Subtotal	**$6,760,808**	
LONG-TERM MONITORING - IN-SITU STABILIZATION								
Includes annual monitoring for the first five years, and monitoring at five-year intervals for years 5 through 30								
Five-Year Review								
• Project Manager	35.00	HR	0.00	232.33	0.00	$ 232.33	$8,132	1
• Project Engineer	67.00	HR	0.00	225.30	0.00	$ 225.30	$15,095	1
• Project Scientist	33.00	HR	0.00	260.79	0.00	$ 260.79	$8,606	1
• Staff Scientist	55.00	HR	0.00	193.29	0.00	$ 193.29	$10,631	1
• Draftsman/CADD	24.00	HR	0.00	131.14	0.00	$ 131.14	$3,147	1
						Subtotal	**$45,611**	
Monitoring - Sample Collection								
• Analysis, mercury (7041)	30.00	EA	40.15	0.00	0.00	$ 40.15	$1,205	1
• Analysis, copper (6010)	30.00	EA	17.40	0.00	0.00	$ 17.40	$ 522	1
• Analysis PCBs (8081/8082)	30.00	EA	314.19	0.00	0.00	$ 314.19	$9,426	1
• Bathymetry Survey - Area IX-X	1.00	EACH	19,162.18	0.00	0.00	$19,162.18	$19,162	6
• Vibracore mob/demob, shallow water drill barge/tender	1.00	EACH	5,946.89	0.00	0.00	$5,946.89	$5,947	6
• Vibracore daily rate - Area IX-X	5.00	DAY	5,352.20	0.00	0.00	$5,352.20	$26,761	6
• Vibracore consumables	5.00	DAY	528.61	0.00	0.00	$ 528.61	$2,643	6
• Benthic analysis	30.00	EACH	330.38	0.00	0.00	$ 330.38	$9,911	1
General Monitoring and Reporting								
• Sample collection, vehicle mileage	100.00	MI	0.49	0.00	0.00	$ 0.49	$ 49	1
• Project Manager	4.00	HR	0.00	232.33	0.00	$ 232.33	$ 929	1
• Project Engineer	30.00	HR	0.00	225.30	0.00	$ 225.30	$6,759	1
• Project Scientist	44.00	HR	0.00	260.79	0.00	$ 260.79	$11,475	1
• Staff Scientist	81.00	HR	0.00	193.29	0.00	$ 193.29	$15,656	1
• Field Technician	2.00	HR	0.00	144.00	0.00	$ 144.00	$ 288	1
• Word Processing/Clerical	13.00	HR	0.00	100.31	0.00	$ 100.31	$1,304	1
• Draftsman/CADD	9.00	HR	0.00	131.14	0.00	$ 131.14	$1,180	1
						Subtotal	**$113,218**	
				Annual Monitoring for First Four Years			**$452,870**	
				Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30			**$952,972**	
DECONTAMINATION FACILITIES (See Alternative 3A, Area X for details						**Subtotal**	**$239,952**	
RESIDUAL WASTE MANAGEMENT - DECON WASTES								
• Utilities Hook-up Fee	1.00	EA	4,639.22	0.00	0.00	$4,639.22	$4,639	1
• Wastewater Disposal Fee	60.00	KGA	3.36	0.00	0.00	$ 3.36	$ 202	1
• Secondary containment and storage, loading hazardous waste for shipment into 5,000 gal. bulk tank truck	12.00	EA	0.00	1,158.99	433.66	$1,592.65	$19,112	1
• Subcontracted shipping of hazardous waste, transport bulk sludge/liquid hazardous waste, 5000 gal.	18.00	EA	0.00	11.87	1.97	$ 13.84	$ 249	1
• Subcontracted shipping of hazardous wast transport drums of solid hazardous waste, 80 55 gal. drums	60.00	MI	3.26	0.00	0.00	$ 3.26	$ 196	1
• Commercial RCRA landfills, additional costs, waste stream evaluation, 50% rebate on first	2.00	EA	871.12	0.00	0.00	$ 871.12	$1,742	1
• Commercial RCRA landfills, liquid/sludge, non-fuel, non-hazardous 55 gal drums	18.00	EA	13.50	0.00	0.00	$ 13.50	$ 243	1
						Subtotal	**$26,383**	
PROFESSIONAL LABOR MANAGEMENT - IN SITU STABILIZATION								
• Project Management Labor Cost	1.00	LS	0.00	674,987.44	0.00	$674,987.44	$674,987	1
• Planning Documents Labor Cost	1.00	LS	0.00	674,987.44	0.00	$674,987.44	$674,987	1
• Construction Oversight Labor Cost	1.00	LS	0.00	843,734.32	0.00	$843,734.32	$843,734	1
• Reporting Labor Cost	1.00	LS	0.00	84,373.43	0.00	$84,373.43	$84,373	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	84,373.43	0.00	$84,373.43	$84,373	1
• Public Notice Labor Cost	1.00	LS	0.00	11,812.28	0.00	$11,812.28	$11,812	1
• Permitting Labor Cost	1.00	LS	0.00	843,734.32	0.00	$843,734.32	$843,734	1
						Subtotal	**$3,218,003**	
				SUBTOTAL IN-SITU STABILIZATION - AREA X			**$11,650,988**	

TABLE D-3: COST ESTIMATE -- ALTERNATIVE 3A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment Placement of Armored Cap	Material:	1.152
Area X:	In-Situ Stabilization with Activated Carbon	Labor:	1.67
		Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
FOCUSED REMOVAL - AREA III								
DREDGING								
• Mechanical Dredging	4,920.00	CY	31.23	0.00	0.00	$ 31.23	$153,652	4
						Subtotal	**$153,652**	
BACKFILL PLACEMENT								
• Sand Capping - Materials	4,900.00	CY	58.03	0.00	0.00	$ 58.03	$284,347	5
• Cap Application - Barge	1.00	EACH	652,004.04	0.00	0.00	$652,004.04	$652,004	5
						Subtotal	**$936,351**	
LOAD AND HAUL - SEDIMENT DISPOSAL								
• Dump Charges, Class II facility, Altamont	6,400.00	CY	50.90	0.00	0.00	$ 50.90	$325,760	3
• 966, 4.0 CY, Wheel Loader	33.00	HR	0.00	131.77	129.72	$ 261.49	$8,629	1
• 26 CY, Semi Dump	1,153.00	HR	0.00	109.77	122.70	$ 232.47	$268,038	1
						Subtotal	**$602,427**	
CONFIRMATION SAMPLING								
• Testing, turbidity	10.00	EA	21.00	0.00	0.00	$ 21.00	$ 210	1
• Analysis, mercury (7041)	5.00	EA	52.80	0.00	0.00	$ 52.80	$ 264	1
• Analysis PCBs (8081/8082)	5.00	EA	306.06	0.00	0.00	$ 306.06	$1,530	1
• Analysis, lead (6010)	5.00	EA	20.34	0.00	0.00	$20.34	$ 102	1
• Analysis, copper (6010)	5.00	EA	20.34	0.00	0.00	$ 20.34	$ 102	1
• Bathymetry Survey - Area III	1.00	EACH	13,131.00	0.00	0.00	$13,131.00	$13,131	6
• Vibracore mob/demobilization - Area III	1.00	EACH	2,317.23	0.00	0.00	$2,317.23	$2,317	6
• Vibracore daily rate - Area III	1.00	DAY	5,484.12	0.00	0.00	$5,484.12	$5,484	6
• Vibracore consumables	1.00	DAY	617.93	0.00	0.00	$ 617.93	$ 618	6
						Subtotal	**$23,758**	
DEWATERING PAD								
• Grub and stack, 140 H.P. dozer	186.00	CY	0.00	6.75	2.29	$ 9.04	$1,681	1
• Excavating, trench, normal soil, to 2' - 6' deep	212.00	BCY	0.00	165.78	0.00	$ 165.78	$35,145	1
• 953, 2.0 CY, Track Loader	506.00	HR	0.00	119.96	104.04	$ 224.00	$113,344	1
• Backfill Trench, Borrow Material, Delivered & Dumped Only	119.00	CY	10.16	4.46	1.89	$ 16.51	$1,965	1
• 4" Extra-strength Vitrified Clay Pipe, Class 200, Premium Joints	1,000.00	LF	4.24	20.43	3.32	$ 27.99	$27,990	1
• 18" x 18" Underground French Drain	644.45	LF	6.15	3.81	0.58	$ 10.54	$6,793	1
• Pump, pedestal sump, single stage, 75 GPM, 1-1/2 H.P., 2" discharge	1.00	EA	4,242.65	1,769.93	0.00	$6,012.58	$6,013	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 550 gallons	1.00	EA	2,570.88	1,067.48	0.00	$3,638.36	$3,638	1
• Storage Tanks, plastic, ground level, horizontal cylinder, 4000 gallons	1.00	EA	6,685.01	1,673.48	0.00	$8,358.49	$8,358	1
• Polymeric Liner Anchor Trench, 3'x15'	701.00	LF	0.06	4.45	0.42	$ 4.93	$3,456	1
• Secure burial cell construction, polymeric liner and cover system, polyvinyl chloride (PVC), 40mil	29,968.00	SF	0.59	0.93	0.04	$ 1.56	$46,750	
• Waste Pile Cover, 135 Lb Tear	2,881.00	SY	2.88	0.83	0.00	$ 3.71	$10,689	1
• Sewage connection charge	1.00	EA	1,370.32	0.00	0.00	$1,370.32	$1,370	1
• Wastewater Disposal Fee	62.00	KGA	3.06	0.00	0.00	$ 3.06	$ 190	1
• Pump, submersible sump, automatic, 15 GPM, 15' head	1.00	EA	1,336.83	286.89	0.00	$1,623.72	$1,624	1
• Operator, dewatering pad	120.00	HR	0.00	171.00	0.00	$171.00	$20,520	
						Subtotal	**$289,526**	
DECONTAMINATION FACILITIES (See Alternative 3A, Area III for details								
• Decon pad for heavy equipment and personnel						**Subtotal**	**$239,952**	1
RESIDUAL WASTE MANAGEMENT - DECON								
• Secondary containment and storage, loading hazardous waste for shipment into 5,000 gal. bulk tank truck	2.00	EA	0.00	1,158.99	433.66	$1,592.65	$3,185	1
• Subcontracted shipping of hazardous waste, transport bulk sludge/liquid hazardous waste, 5000 gal.	140.00	MI	3.26	0.00	0.00	$ 3.26	$ 456	1
• Commercial RCRA landfills, additional landfill disposal costs, waste stream evaluation, 50% rebate on first	1.00	EA	871.12	0.00	0.00	$ 871.12	$ 871	1
• Commercial RCRA landfills, liquid/sludge, non-fuel, non-hazardous	6,000.00	GAL	4.06	0.00	0.00	$ 4.06	$24,360	1
						Subtotal	**$28,873**	

TABLE D-3: COST ESTIMATE -- ALTERNATIVE 3A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	1.152
	Placement of Armored Cap	Labor:	1.67
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
PROFESSIONAL LABOR MANAGEMENT - FOCUSED REMOVAL AREA II								
• Project Management Labor Cost	1.00	LS	0.00	182,534.83	0.00	$182,534.83	$182,535	1
• Planning Documents Labor Cost	1.00	LS	0.00	182,534.83	0.00	$182,534.83	$182,535	1
• Construction Oversight Labor Cost	1.00	LS	0.00	228,168.54	0.00	$228,168.54	$228,169	1
• Reporting Labor Cost	1.00	LS	0.00	22,816.85	0.00	$22,816.85	$22,817	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	22,816.85	0.00	$22,816.85	$22,817	1
• Public Notice Labor Cost	1.00	LS	0.00	3,194.36	0.00	$3,194.36	$3,194	1
• Permitting Labor Cost	1.00	LS	0.00	228,168.54	0.00	$228,168.54	$228,169	1
						Subtotal	**$870,235**	
				SUBTOTAL FOCUSED REMOVAL - AREA III			**$3,144,773**	
ARMOR CAP - AREA II								
ARMORED CAPPING (11-acre cap, 1.5 feet sand and 0.5 foot armor stone								
• Sand Capping - Materials	26,485.00	CY	58.03	0.00	0.00	$ 58.03	$1,536,925	5
• Armor Stone Capping - Materials	14,135.00	TON	51.47	0.00	0.00	$ 51.47	$727,528	5
• Cap Application - Barge	1.00	EACH	1,647,168.10	0.00	0.00	$1,647,168.10	$1,647,168	5
						Subtotal	**$3,911,621**	
CONSTRUCTION QC MONITORING								
• Geotechnical Characteristics Analysis	6.00	EA	173.14	0.00	0.00	$ 173.14	$1,039	1
• Water Quality Parameter Testing Device, DO, Temp., pH, Conductivity, Salinity, Turbidity, Daily Rent	5.00	DAY	122.43	0.00	0.00	$ 122.43	$ 612	1
• Testing, turbidity	20.00	EA	21.00	0.00	0.00	$ 21.00	$ 420	1
• Analysis, mercury (7041)	10.00	EA	20.34	0.00	0.00	$ 20.34	$ 203	1
• Analysis, lead (6010)	10.00	EA	52.80	0.00	0.00	$ 52.80	$ 528	1
• Analysis, copper (6010)	10.00	EA	52.80	0.00	0.00	$ 52.80	$ 528	1
• Analysis PCBs (8081/8082)	10.00	EA	306.06	0.00	0.00	$ 306.06	$3,061	1
• Bathymetry Survey - Area III	1.00	EACH	13,131.00	0.00	0.00	$13,131.00	$13,131	6
						Subtotal	**$19,522**	
PROFESSIONAL LABOR MANAGEMENT - CAPPING								
• Project Management Labor Cost	1.00	LS	0.00	332,149.53	0.00	$332,149.53	$332,150	1
• Planning Documents Labor Cost	1.00	LS	0.00	332,149.53	0.00	$332,149.53	$332,150	1
• Construction Oversight Labor Cost	1.00	LS	0.00	415,186.91	0.00	$415,186.91	$415,187	1
• Reporting Labor Cost	1.00	LS	0.00	41,518.69	0.00	$41,518.69	$41,519	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	41,518.69	0.00	$41,518.69	$41,519	1
• Public Notice Labor Cost	1.00	LS	0.00	5,812.62	0.00	$5,812.62	$5,813	1
• Permitting Labor Cost	1.00	LS	0.00	415,186.91	0.00	$415,186.91	$415,187	1
						Subtotal	**$1,583,523**	
LONG TERM MONITORING - ARMOR CAP								
Five-Year Review								
• Project Manager	35.00	HR	0.00	232.33	0.00	$ 232.33	$8,132	1
• Project Engineer	67.00	HR	0.00	225.30	0.00	$ 225.30	$15,095	1
• Project Scientist	33.00	HR	0.00	260.79	0.00	$ 260.79	$8,606	1
• Staff Scientist	55.00	HR	0.00	193.29	0.00	$ 193.29	$10,631	1
• Draftsman/CADD	24.00	HR	0.00	131.14	0.00	$ 131.14	$3,147	1
						Subtotal	**$45,611**	
Monitoring - Sample Collection								
• Analysis, mercury (7041)	6.00	EA	49.01	0.00	0.00	$ 49.01	$ 294	1
• Analysis, lead (6010)	6.00	EA	21.24	0.00	0.00	$ 21.24	$ 127	1
• Analysis, copper (6010)	6.00	EA	21.24	0.00	0.00	$ 21.24	$ 127	1
• Analysis PCBs (8081/8082)	6.00	EA	383.53	0.00	0.00	$ 383.53	$2,301	1
• Bathymetry Survey - Area III	1.00	EACH	13,712.01	0.00	0.00	$13,712.01	$13,712	6
• Vibracore mob/demobilization - Area III	1.00	EACH	2,419.77	0.00	0.00	$2,419.77	$2,420	6
• Vibracore daily rate - Area III	2.00	DAY	5,726.78	0.00	0.00	$5,726.78	$11,454	6
• Vibracore consumables	2.00	DAY	645.27	0.00	0.00	$ 645.27	$1,291	6
General Monitoring and Reporting								
• Sample collection, vehicle mileage	100.00	MI	0.49	0.00	0.00	$ 0.49	$ 49	1
• Project Manager	4.00	HR	0.00	281.40	0.00	$ 281.40	$1,126	1
• Project Engineer	30.00	HR	0.00	272.88	0.00	$ 272.88	$8,186	1
• Project Scientist	44.00	HR	0.00	315.87	0.00	$ 315.87	$13,898	1
• Staff Scientist	81.00	HR	0.00	234.11	0.00	$ 234.11	$18,963	1
• Field Technician	2.00	HR	0.00	174.41	0.00	$ 174.41	$ 349	1
• Word Processing/Clerical	13.00	HR	0.00	121.50	0.00	$ 121.50	$1,580	1
• Draftsman/CADD	9.00	HR	0.00	158.84	0.00	$ 158.84	$1,430	1
						Subtotal	**$77,306**	
						Annual Monitoring for First Four Years	**$309,224**	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 3(	**$737,503**	

TABLE D-3: COST ESTIMATE -- ALTERNATIVE 3A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment Placement of Armored Cap	Material:	1.152
		Labor:	1.67
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
CAP REPAIR (Year 10)								
• Sand Capping - Materials	400.00	CY	48.36	0.00	0.00	$ 48.36	$19,344	1
• Armor Stone Capping - Materials	500.00	TON	42.90	0.00	0.00	$ 42.90	$21,450	6
• Armor cap repair - application	1.00	EACH	421,800.86	0.00	0.00	$421,800.86	$421,801	5
• Bathymetry Survey - Area III	1.00	EACH	12,153.58	0.00	0.00	$12,153.58	$12,154	6
						Subtotal	**$474,748**	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR								
• Project Management Labor Cost	1.00	LS	0.00	75,179.75	0.00	$75,179.75	$75,180	1
• Planning Documents Labor Cost	1.00	LS	0.00	70,167.77	0.00	$70,167.77	$70,168	1
• Construction Oversight Labor Cost	1.00	LS	0.00	60,143.80	0.00	$60,143.80	$60,144	1
• Reporting Labor Cost	1.00	LS	0.00	10,023.97	0.00	$10,023.97	$10,024	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	10,023.97	0.00	$10,023.97	$10,024	1
• Public Notice Labor Cost	1.00	LS	0.00	3,007.19	0.00	$3,007.19	$3,007	1
• Permitting Labor Cost	1.00	LS	0.00	100,239.67	0.00	$100,239.67	$100,240	1
						Subtotal	**$328,786**	
						SUBTOTAL ARMOR CAP - AREA III	**$7,364,927**	

DESIGN COSTS

Phase Name	Design Approach	Total Capital	%	Design Cost
• In Situ Stabilization - Area X	In Situ Containment	$7,039,958	12%	$844,795
• Focused Removal - Area III	Ex Situ Removal - Off-site	$2,253,029	10%	$225,303
• Armored Capping - Area III	In Situ Containment	$3,930,628	12%	$471,675
• Cap Repair	In Situ Containment	$474,745	10%	$ 47,475
			Subtotal Design	**$1,589,248**

Total Capital Costs	$20,493,833
30-Year O&M	$3,256,103
Total Future Costs	$23,749,936

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$ 1,589,248	0	2006	1	1	$ 1,589,248
Remedial Action Construction	$ 18,904,585	1	2007	1.021	0.970	$ 18,721,223
Monitoring	$ 190,524	2	2008	1.042	0.941	$ 186,840
Monitoring	$ 190,524	3	2009	1.064	0.912	$ 185,028
Monitoring	$ 190,524	4	2010	1.087	0.885	$ 183,242
Monitoring	$ 190,524	5	2011	1.110	0.858	$ 181,461
Monitoring, 5-Year Review	$ 281,746	6	2012	1.133	0.833	$ 265,741
Monitoring, cap repair, 5-Yr review	$ 1,085,280	11	2017	1.257	0.715	$ 974,907
Monitoring, 5-Year Review	$ 281,746	16	2022	1.395	0.614	$ 241,067
Monitoring, 5-Year Review	$ 281,746	21	2027	1.547	0.527	$ 229,600
Monitoring, 5-Year Review	$ 281,746	26	2032	1.717	0.452	$ 218,676
Monitoring, 5-Year Review	$ 281,746	31	2037	1.905	0.388	$ 208,278
	$ 23,749,936					$ 23,185,310

TOTAL PRESENT VALUE- ALTERNATIVE 3A: $23,185,310

Soucces:
1 Racer 2005 Database
2 Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3 Altamont Landfill tipping fee, non-hazardous material.
4 Vendor Quote - Dutra Dredging, 12/14/05.
5 Vendor Quote - AquaBlok Limited, 12/13/05.
6 Vendor Quote - TEG Ocean Services, 1/9/06.
7 Carbon application costs were extrapolated from the 2005 Parcel F pilot test conducted by Stanford University.

[c]Annual Discount Rate (i) = 3.10%

Notes:
a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-4: COST ESTIMATE -- ALTERNATIVE 3B
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3B:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Placement of AquaBlok Cap and Armor Stone	Labor:	1.67
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
IN-SITU STABILIZATION WITH ACTIVATED CARBON - AREA X (See Alternative 3A for details)								
IN SITU STABILIZATION (33-acre treatment area)						Subtotal	$6,760,808	
LONG TERM MONITORING - IN SITU STABILIZATION								
Includes annual monitoring for the first five years, and monitoring at five-year intervals for years 5 through 30.								
Five-Year Review						Subtotal	$45,611	
Monitoring - Sample Collection						Subtotal	$113,218	
						Annual Monitoring for First Four Years	$452,870	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	$952,972	
DECONTAMINATION FACILITIES						Subtotal	$239,952	
RESIDUAL WASTE MANAGEMENT - DECON WASTES						Subtotal	$26,383	
PROFESSIONAL LABOR MANAGEMENT - IN SITU STABILIZATION						Subtotal	$3,218,003	
						SUBTOTAL IN SITU STABILIZATION - AREA X	$11,650,988	
FOCUSED REMOVAL - AREA III (See Alternative 3A for details)								
						SUBTOTAL FOCUSED REMOVAL - AREA III	$3,144,773	
AQUABLOK CAP - AREA III								
AQUABLOK CAPPING (11-acre cap, 4.5 inches of AquaBlok and 6 inches armor stone)								
• AquaBlok Capping Material	6,260.00	TON	463.27	0.00	0.00	$ 463.27	$2,900,070	5
• Armor Stone Capping Material	14,135.00	TON	51.47	0.00	0.00	$ 51.47	$727,528	5
• Cap Application - Barge	1.00	EACH	1,304,008.08	0.00	0.00	$1,304,008.08	$1,304,008	5
• Pre-Application Activities	1.00	EACH	574,793.04	0.00	0.00	$574,793.04	$574,793	5
						Subtotal	$5,506,400	
CONSTRUCTION QC MONITORING								
• Geotechnical Characteristics Analysis	6.00	EA	173.14	0.00	0.00	$ 173.14	$1,039	1
• Water Quality Parameter Testing Device, DO, Temp., pH, Conductivity, Salinity, Turbidity, Daily Rent	5.00	DAY	122.43	0.00	0.00	$ 122.43	$ 612	1
• Testing, turbidity	20.00	EA	21.00	0.00	0.00	$ 21.00	$ 420	1
• Analysis, mercury (7041)	10.00	EA	20.34	0.00	0.00	$ 20.34	$ 203	1
• Analysis, lead (6010)	10.00	EA	52.80	0.00	0.00	$ 52.80	$ 528	1
• Analysis, copper (6010)	10.00	EA	52.80	0.00	0.00	$ 52.80	$ 528	1
• Analysis PCBs (8081/8082)	10.00	EA	306.06	0.00	0.00	$ 306.06	$3,061	1
Bathymetry Survey - Area III	1.00	EACH	13,131.00	0.00	0.00	$13,131.00	$13,131	6
						Subtotal	$19,522	
PROFESSIONAL LABOR MANAGEMENT - CAPPING								
Project Management Labor Cost	1.00	LS	0.00	416,515.04	0.00	$416,515.04	$416,515	1
Planning Documents Labor Cost	1.00	LS	0.00	416,515.04	0.00	$416,515.04	$416,515	1
Construction Oversight Labor Cost	1.00	LS	0.00	520,643.81	0.00	$520,643.81	$520,644	1
Reporting Labor Cost	1.00	LS	0.00	52,064.38	0.00	$ 52,064.38	$ 52,064	1
As-Built Drawings Labor Cost	1.00	LS	0.00	52,064.38	0.00	$ 52,064.38	$ 52,064	1
Public Notice Labor Cost	1.00	LS	0.00	7,289.01	0.00	$ 7,289.01	$ 7,289	1
Permitting Labor Cost	1.00	LS	0.00	520,643.81	0.00	$520,643.81	$520,644	1
						Subtotal	$1,985,735	
LONG-TERM MONITORING - ARMOR CAP								
Five-Year Review								
• Project Manager	35.00	HR	0.00	232.33	0.00	$ 232.33	$8,132	1
• Project Engineer	67.00	HR	0.00	225.30	0.00	$ 225.30	$15,095	1
• Project Scientist	33.00	HR	0.00	260.79	0.00	$ 260.79	$8,606	1
• Staff Scientist	55.00	HR	0.00	193.29	0.00	$ 193.29	$10,631	1
• Draftsman/CADD	24.00	HR	0.00	131.14	0.00	$ 131.14	$3,147	1
						Subtotal	$45,611	
Monitoring - Sample Collection								
• Analysis, mercury (7041)	6.00	EA	49.01	0.00	0.00	$ 49.01	$ 294	1
• Analysis, lead (6010)	6.00	EA	21.24	0.00	0.00	$ 21.24	$ 127	1
• Analysis, copper (6010)	6.00	EA	21.24	0.00	0.00	$ 21.24	$ 127	1
• Analysis PCBs (8081/8082)	6.00	EA	383.53	0.00	0.00	$ 383.53	$2,301	1
• Bathymetry Survey - Area III	1.00	EACH	13,712.01	0.00	0.00	$13,712.01	$13,712	6
• Vibracore mob/demobilization - Area III	1.00	EACH	2,419.77	0.00	0.00	$2,419.77	$2,420	6

TABLE D-4: COST ESTIMATE – ALTERNATIVE 3B (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3B:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Placement of AquaBlok Cap and Armor Stone	Labor:	1.67
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
• Vibracore daily rate - Area III	2.00	DAY	5,726.78	0.00	0.00	$5,726.78	$11,454	6
• Vibracore consumables	2.00	DAY	645.27	0.00	0.00	$ 645.27	$1,291	6
General Monitoring and Reporting								
• Sample collection, vehicle mileage	100.00	MI	0.49	0.00	0.00	$ 0.49	$ 49	1
• Project Manager	4.00	HR	0.00	281.40	0.00	$ 281.40	$1,126	1
• Project Engineer	30.00	HR	0.00	272.88	0.00	$ 272.88	$8,186	1
• Project Scientist	44.00	HR	0.00	315.87	0.00	$ 315.87	$13,898	1
• Staff Scientist	81.00	HR	0.00	234.11	0.00	$ 234.11	$18,963	1
• Field Technician	2.00	HR	0.00	174.41	0.00	$ 174.41	$ 349	1
• Word Processing/Clerical	13.00	HR	0.00	121.50	0.00	$ 121.50	$1,580	1
• Draftsman/CADD	9.00	HR	0.00	158.84	0.00	$ 158.84	$1,430	1
						Subtotal	**$77,306**	
						Annual Monitoring for First Four Years	**$309,224**	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	**$737,503**	
CAP REPAIR (Year 10)								
• AquaBlok Cap	250.00	TON	386.06	0.00	0.00	$ 386.06	$ 96,515	5
• Armor Stone Capping - Materials	500.00	TON	42.90	0.00	0.00	$ 42.90	$ 21,450	5
• AquaBlok cap repair - application	1.00	EACH	217,334.68	0.00	0.00	$217,334.68	$217,335	5
• Bathymetry Survey - Area III	1.00	EACH	12,153.58	0.00	0.00	$ 12,153.58	$ 12,154	6
						Subtotal	**$347,453**	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR								
• Project Management Labor Cost	1.00	LS	0.00	75,179.75	0.00	$75,179.75	$75,180	1
• Planning Documents Labor Cost	1.00	LS	0.00	70,167.77	0.00	$70,167.77	$70,168	1
• Construction Oversight Labor Cost	1.00	LS	0.00	60,143.80	0.00	$60,143.80	$60,144	1
• Reporting Labor Cost	1.00	LS	0.00	10,023.97	0.00	$10,023.97	$10,024	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	10,023.97	0.00	$10,023.97	$10,024	1
• Public Notice Labor Cost	1.00	LS	0.00	3,007.19	0.00	$3,007.19	$3,007	1
• Permitting Labor Cost	1.00	LS	0.00	100,239.67	0.00	$100,239.67	$100,240	1
						Subtotal	**$328,786**	
						SUBTOTAL AQUABLOK CAP - AREA III	**$9,280,235**	

DESIGN COSTS

Phase Name	Design Approach	Total Capital	%	Design Cost
• In Situ Stabilization - Area X	In Situ Containment	$7,039,958	12%	$844,795
• Focused Removal - Area III	Ex Situ Removal - Off-site	$2,253,029	10%	$225,303
• AquaBlok Capping - Area III	In Situ Containment	$5,506,431	12%	$660,772
• Cap Repair	In Situ Containment	$474,745	10%	$ 47,475
			Subtotal Design	**$1,778,344**

Base Cost	$22,725,531
30-Year O&M	$3,128,808
Total Future Cost	$25,854,340

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$ 1,778,344	0	2006	1	1	$ 1,778,344
Remedial Action Construction	$ 20,947,187	1	2007	1.021	0.970	$ 20,744,014
Monitoring	$ 190,524	2	2008	1.042	0.941	$ 186,840
Monitoring	$ 190,524	3	2009	1.064	0.912	$ 185,028
Monitoring	$ 190,524	4	2010	1.087	0.885	$ 183,242
Monitoring	$ 190,524	5	2011	1.110	0.858	$ 181,461
Monitoring, 5-Year Review	$ 281,746	6	2012	1.133	0.833	$ 265,741
Monitoring, cap repair, 5-Yr review	$ 957,985	11	2017	1.257	0.715	$ 860,557
Monitoring, 5-Year Review	$ 281,746	16	2022	1.395	0.614	$ 241,067
Monitoring, 5-Year Review	$ 281,746	21	2027	1.547	0.527	$ 229,600
Monitoring, 5-Year Review	$ 281,746	26	2032	1.717	0.452	$ 218,676
Monitoring, 5-Year Review	$ 281,746	31	2037	1.905	0.388	$ 208,278
	$ 25,854,340					$ 25,282,847

TOTAL PRESENT VALUE- ALTERNATIVE 3B: $25,282,847

TABLE D-4: COST ESTIMATE -- ALTERNATIVE 3B (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 3B:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	*1.152*
	Placement of AquaBlok Cap and Armor Stone	Labor:	*1.67*
Area X:	In-Situ Stabilization with Activated Carbon	Equipment:	*1.076*
		Contingency on Direct Costs:	*20%*
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source

Sources:

1 Racer 2005 Database
2 Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3 Altamont Landfill tipping fee, non-hazardous material.
4 Vendor Quote - Dutra Dredging, 12/14/05.
5 Vendor Quote - AquaBlok Limited, 12/13/05.
6 Vendor Quote - TEG Ocean Services, 1/9/06.
7 Carbon application costs were extrapolated from the 2005 Parcel F pilot test conducted by Stanford University.

[c]Annual Discount Rate (i) = 3.10%

Notes:

a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-5: COST ESTIMATE -- ALTERNATIVE 4A
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 4A:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Capping with Sand and Armor Stone	Labor:	1.67
Area X:	Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
MONITORED NATURAL RECOVERY - AREA X								
ADMINISTRATIVE LAND USE CONTROLS								
Planning Docs								
• Project Manager	120.00	HR	0.00	226.48	0.00	$ 226.48	$27,178	1
• Project Engineer	300.00	HR	0.00	219.62	0.00	$ 219.62	$65,886	1
• Staff Engineer	600.00	HR	0.00	192.19	0.00	$ 192.19	$115,314	1
• QA/QC Officer	80.00	HR	0.00	185.23	0.00	$ 185.23	$14,818	1
• Word Processing/Clerical	400.00	HR	0.00	97.78	0.00	$ 97.78	$39,112	1
• Draftsman/CADD	400.00	HR	0.00	127.83	0.00	$ 127.83	$51,132	1
• Attorney, Partner, Real Estate	30.00	HR	0.00	200.00	0.00	$ 200.00	$ 6,000	1
• Other Direct Costs	1.00	LS	4,367.26	0.00	0.00	$ 4,367.26	$ 4,367	1
						Subtotal	**$323,807**	
Planning Meetings								
• Per Diem (per person)	16.00	DAY	194.00	0.00	0.00	$ 194.00	$ 3,104	1
• Project Manager	160.00	HR	0.00	226.48	0.00	$ 226.48	$36,237	1
• Project Engineer	128.00	HR	0.00	219.62	0.00	$ 219.62	$28,111	1
• Word Processing/Clerical	128.00	HR	0.00	97.78	0.00	$ 97.78	$12,516	1
• Draftsman/CADD	64.00	HR	0.00	127.83	0.00	$ 127.83	$ 8,181	1
• Other Direct Costs	1.00	LS	906.62	0.00	0.00	$ 906.62	$ 907	1
						Subtotal	**$89,056**	
Implementation								
• Overnight Delivery, 8 oz Letter	18.00	EA	22.21	0.00	0.00	$ 22.21	$ 400	1
• Project Manager	82.00	HR	0.00	226.48	0.00	$ 226.48	$18,571	1
• Project Engineer	140.00	HR	0.00	219.62	0.00	$ 219.62	$30,747	1
• Staff Engineer	180.00	HR	0.00	192.19	0.00	$ 192.19	$34,594	1
• QA/QC Officer	51.00	HR	0.00	185.23	0.00	$ 185.23	$ 9,447	1
• Word Processing/Clerical	140.00	HR	0.00	97.78	0.00	$ 97.78	$13,689	1
• Draftsman/CADD	200.00	HR	0.00	127.83	0.00	$ 127.83	$25,566	1
• Computer Data Entry	160.00	HR	0.00	87.86	0.00	$ 87.86	$14,058	1
• Attorney, Sr Associate, Real Estate	8.00	HR	0.00	175.00	0.00	$ 175.00	$ 1,400	1
• Paralegal, Real Estate	8.00	HR	0.00	100.00	0.00	$ 100.00	$ 800	1
• Other Direct Costs	1.00	LS	2,034.38	0.00	0.00	$ 2,034.38	$ 2,034	1
• Construction Signs	10.00	SF	21.35	0.00	0.00	$ 21.35	$ 214	1
• Surveying - 3-man Crew	4.00	DAY	0.00	2,696.95	390.12	$ 3,087.07	$12,348	1
• Portable GPS Set with Mapping	1.00	MO	1,161.52	0.00	0.00	$ 1,161.52	$ 1,162	1
• Local Fees	2.00	LS	308.96	0.00	0.00	$ 308.96	$ 618	1
						Subtotal	**$165,647**	
Modification/Termination								
• Project Manager	40.00	HR	0.00	226.48	0.00	$ 226.48	$ 9,059	
• Project Engineer	60.00	HR	0.00	219.62	0.00	$ 219.62	$13,177	1
• Staff Engineer	80.00	HR	0.00	192.19	0.00	$ 192.19	$15,375	1
• QA/QC Officer	10.00	HR	0.00	185.23	0.00	$ 185.23	$ 1,852	1
• Word Processing/Clerical	40.00	HR	0.00	97.78	0.00	$ 97.78	$ 3,911	1
• Draftsman/CADD	24.00	HR	0.00	127.83	0.00	$ 127.83	$ 3,068	1
• Other Direct Costs	1.00	LS	759.08	0.00	0.00	$ 759.08	$ 759	1
						Subtotal	**$47,202**	
LONG-TERM MONITORING - MONITORED NATURAL RECOVERY								
Five-Year Review								
• Project Manager	35.00	HR	0.00	232.33	0.00	$ 232.33	$8,132	1
• Project Engineer	67.00	HR	0.00	225.30	0.00	$ 225.30	$15,095	1
• Project Scientist	33.00	HR	0.00	260.79	0.00	$ 260.79	$8,606	1
• Staff Scientist	55.00	HR	0.00	193.29	0.00	$ 193.29	$10,631	1
• Draftsman/CADD	24.00	HR	0.00	131.14	0.00	$ 131.14	$3,147	1
						Subtotal	**$45,611**	
Sample Collection								
• Analysis, mercury (7041)	30.00	EA	46.93	0.00	0.00	$ 46.93	$ 1,408	1
• Analysis, copper (6010)	30.00	EA	20.34	0.00	0.00	$ 20.34	$ 610	1
• Analysis PCBs, (8081/8082)	30.00	EA	367.28	0.00	0.00	$ 367.28	$11,018	1
• Bathymetry Survey - Area X	1.00	EACH	22,399.93	0.00	0.00	$22,399.93	$22,400	6
• Vibracore mob/demob, shallow	1.00	EACH	6,951.70	0.00	0.00	$ 6,951.70	$ 6,952	6
• water drill barge/tender								
• Vibracore daily rate - Area X	5.00	DAY	6,256.53	0.00	0.00	$ 6,256.53	$31,283	6
• Vibracore consumables	5.00	DAY	617.93	0.00	0.00	$ 617.93	$ 3,090	6
• Benthic analysis	30.00	EACH	386.21	0.00	0.00	$ 386.21	$11,586	1

TABLE D-5: COST ESTIMATE -- ALTERNATIVE 4A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 4A:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Capping with Sand and Armor Stone	Labor:	1.67
Area X:	Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
General Monitoring and Reporting								
• Sample collection, vehicle mileage	100.00	MI	0.49	0.00	0.00	$ 0.49	$ 49	1
• Project Manager	4.00	HR	0.00	276.19	0.00	$ 276.19	$ 1,105	1
• Project Engineer	30.00	HR	0.00	267.83	0.00	$ 267.83	$ 8,035	1
• Project Scientist	40.00	HR	0.00	310.02	0.00	$ 310.02	$12,401	1
• Staff Scientist	60.00	HR	0.00	229.78	0.00	$ 229.78	$13,787	1
• Field Technician	2.00	HR	0.00	171.18	0.00	$ 171.18	$ 342	1
• Word Processing/Clerical	13.00	HR	0.00	119.25	0.00	$ 119.25	$ 1,550	1
• Draftsman/CADD	9.00	HR	0.00	155.90	0.00	$ 155.90	$ 1,403	1
						Subtotal	$127,019	
				Annual Monitoring for First Four Years			$508,075	
			Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30				$1,035,778	
PROFESSIONAL LABOR MANAGEMENT - MONITORED NATURAL RECOVERY								
• Project Management Labor Cost	1.00	LS	0.00	29,703.06	0.00	$29,703.06	$29,703	1
• Planning Documents Labor Cost	1.00	LS	0.00	23,762.45	0.00	$23,762.45	$23,762	1
• Construction Oversight Labor Cost	1.00	LS	0.00	19,306.99	0.00	$19,306.99	$19,307	1
• Reporting Labor Cost	1.00	LS	0.00	4,455.46	0.00	$ 4,455.46	$ 4,455	1
• As-Built Drawings Labor Cost	1.00	LS	0.00	4,455.46	0.00	$ 4,455.46	$ 4,455	1
• Public Notice Labor Cost	1.00	LS	0.00	1,485.15	0.00	$ 1,485.15	$ 1,485	1
• Permitting Labor Cost	1.00	LS	0.00	29,703.06	0.00	$29,703.06	$29,703	1
						Subtotal	$112,872	
			SUBTOTAL MONITORED NATURAL RECOVERY - AREA X				$2,282,437	
FOCUSED REMOVAL - AREA III (See Alternative 3A for details)								
			SUBTOTAL FOCUSED REMOVAL - AREA III				$3,144,773	
ARMOR CAP - AREA III (See Alternative 3A for details)								
ARMORED CAPPING (11-acre cap, 1.5 feet sand and 0.5 foot armor stone)						Subtotal	$3,911,621	
CONSTRUCTION QC MONITORING						Subtotal	$19,522	
PROFESSIONAL LABOR MANAGEMENT - CAPPING						Subtotal	$1,583,523	
LONG TERM MONITORING - ARMOR CAP								
Five-Year Review						Subtotal	$45,611	
Monitoring						Subtotal	$77,306	
				Annual Monitoring for First Four Years			$309,224	
			Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30				$737,503	
CAP REPAIR (Year 10)						Subtotal	$474,748	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR						Subtotal	$328,786	
				SUBTOTAL ARMOR CAP - AREA III			$7,364,927	

DESIGN COSTS				
Phase Name	Design Approach	Total Capital	%	Design Cost
• Monitored Natural Recovery - Area X	Natural Attenuation	$172,630	8%	$13,810
• Focused Removal - Area III	Ex Situ Removal - Off-site	$2,274,539	10%	$227,454
• Armored Capping - Area III	In Situ Containment	$3,931,143	12%	$471,737
• Cap Repair	In Situ Containment	$474,748	10%	$47,475
			Subtotal Design	$760,476
			Base Cost	$10,158,500
			30-Year O&M	$3,394,115
			Total Future Cost	$13,552,614

TABLE D-5: COST ESTIMATE – ALTERNATIVE 4A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 4A:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	*1.152*
	Capping with Sand and Armor Stone	Labor:	*1.67*
Area X:	Monitored Natural Recovery	Equipment:	*1.076*
		Contingency on Direct Costs:	*20%*
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
PRESENT VALUE								

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$ 760,476	0	2006	1	1	$ 760,476
Remedial Action Construction	$ 9,398,023	1	2007	1.021	0.970	$ 9,306,869
Monitoring	$ 204,325	2	2008	1.042	0.941	$ 200,374
Monitoring	$ 204,325	3	2009	1.064	0.912	$ 198,431
Monitoring	$ 204,325	4	2010	1.087	0.885	$ 196,515
Monitoring	$ 204,325	5	2011	1.110	0.858	$ 194,606
Monitoring, 5-Year Review	$ 295,547	6	2012	1.133	0.833	$ 278,758
Monitoring, cap repair, 5-Yr review	$ 1,099,081	11	2017	1.257	0.715	$ 987,304
Monitoring, 5-Year Review	$ 295,547	16	2022	1.395	0.614	$ 252,875
Monitoring, 5-Year Review	$ 295,547	21	2027	1.547	0.527	$ 240,847
Monitoring, 5-Year Review	$ 295,547	26	2032	1.717	0.452	$ 229,388
Monitoring, 5-Year Review	$ 295,547	31	2037	1.905	0.388	$ 218,480
	$ 13,552,614					$ 13,064,923

TOTAL PRESENT VALUE - ALTERNATIVE 4A: $13,064,923

Sources:

1. Racer 2005 Database
2. Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3. Altamont Landfill tipping fee, non-hazardous material.
4. Vendor Quote - Dutra Dredging, 12/14/05.
5. Vendor Quote - AquaBlok Limited, 12/13/05.
6. Vendor Quote - TEG Ocean Services, 1/9/06.

[c]Annual Discount Rate (i) = 3.10%

Notes:

a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-6: COST ESTIMATE -- ALTERNATIVE 4B
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 4B:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	1.152
	Placement of AquaBlok Cap and Armor Stone	Labor:	1.67
Area IX:	Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
MONITORED NATURAL RECOVERY - AREA X (see Alternative 4B for details)								
ADMINISTRATIVE LAND USE CONTROLS								
Planning Docs						Subtotal	$323,807	
Planning Meetings						Subtotal	$89,056	
Implementation						Subtotal	$165,647	
Modification/Termination						Subtotal	$47,202	
LONG-TERM MONITORING - MONITORED NATURAL RECOVERY								
Five-Year Review						Subtotal	$45,611	
Sample Collection						Subtotal	$127,019	
						Annual Monitoring for First Four Years	$508,075	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	$1,035,778	
PROFESSIONAL LABOR MANAGEMENT - MONITORED NATURAL RECOVERY						Subtotal	$112,872	
						SUBTOTAL MONITORED NATURAL RECOVERY - AREA X	$2,282,437	
FOCUSED REMOVAL - AREA III (see Alternative 3B for details)								
						SUBTOTAL FOCUSED REMOVAL - AREA III	$3,144,773	
AQUABLOK CAP - AREA III (see Alternative 3B for details)								
AQUABLOK CAPPING (11-acre cap, 4.5 inches of AquaBlok and 6 inches armor stone						Subtotal	$5,506,400	
CONSTRUCTION QC MONITORING						Subtotal	$19,522	
PROFESSIONAL LABOR MANAGEMENT - CAPPING						Subtotal	$1,985,735	
LONG-TERM MONITORING - ARMOR CAP								
Five-Year Review						Subtotal	$45,611	
Monitoring - Sample Collection						Subtotal	$77,306	
						Annual Monitoring for First Four Years	$309,224	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	$737,503	
CAP REPAIR (Year 10)						Subtotal	$347,453	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR						Subtotal	$328,786	
						SUBTOTAL AQUABLOK CAP - AREA III	$9,280,235	

DESIGN COSTS

Phase Name	Design Approach	Total Capital	%	Design Cost
• Monitored Natural Recovery - Area X	Natural Attenuation	$172,630	8%	$13,810
• Focused Removal - Area III	Ex Situ Removal - Off-site	$2,274,539	10%	$227,454
• AquaBlok Capping - Area III	In Situ Containment	$5,525,922	12%	$663,111
• Cap Repair	In Situ Containment	$347,453	10%	$34,745
			Subtotal Design	$939,120

Base Cost	$12,379,746
30-Year O&M	$3,266,819
Total Future Cost	$15,646,565

TABLE D-6: COST ESTIMATE -- ALTERNATIVE 4B (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 4B:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment Placement of AquaBlok Cap and Armor Stone	Material:	1.152
Area IX:	Monitored Natural Recovery	Labor:	1.67
		Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$ 939,120	0	2006	1	1	$ 939,120
Remedial Action Construction	$ 11,440,626	1	2007	1.021	0.970	$ 11,329,659
Monitoring	$ 204,325	2	2008	1.042	0.941	$ 200,374
Monitoring	$ 204,325	3	2009	1.064	0.912	$ 198,431
Monitoring	$ 204,325	4	2010	1.087	0.885	$ 196,515
Monitoring	$ 204,325	5	2011	1.110	0.858	$ 194,606
Monitoring, 5-Year Review	$ 295,547	6	2012	1.133	0.833	$ 278,758
Monitoring, cap repair, 5-Yr review	$ 971,786	11	2017	1.257	0.715	$ 872,955
Monitoring, 5-Year Review	$ 295,547	16	2022	1.395	0.614	$ 252,875
Monitoring, 5-Year Review	$ 295,547	21	2027	1.547	0.527	$ 240,847
Monitoring, 5-Year Review	$ 295,547	26	2032	1.717	0.452	$ 229,388
Monitoring, 5-Year Review	$ 295,547	31	2037	1.905	0.388	$ 218,480
	$ 15,646,565					$ 15,152,009

TOTAL PRESENT VALUE - ALTERNATIVE 4B $15,152,009

Sources:
1. Racer 2005 Database
2. Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3. Altamont Landfill tipping fee, non-hazardous material.
4. Vendor Quote - Dutra Dredging, 12/14/05.
5. Vendor Quote - AquaBlok Limited, 12/13/05.
6. Vendor Quote - TEG Ocean Services, 1/9/06.

[c]Annual Discount Rate (i) = 3.10%

Notes:
a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-7: COST ESTIMATE -- ALTERNATIVE 5A
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	1.152
	Placement of Armored Cap	Labor:	1.67
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
MONITORED NATURAL RECOVERY - PARTIAL AREA X								
ADMINISTRATIVE LAND USE CONTROLS								
Planning Docs								
• Project Manager	130.00	HR	0.00	226.48	0.00	$ 226.48	$29,442	1
• Project Engineer	360.00	HR	0.00	219.62	0.00	$ 219.62	$79,063	1
• Staff Engineer	820.00	HR	0.00	192.19	0.00	$ 192.19	$157,596	1
• QA/QC Officer	121.00	HR	0.00	185.23	0.00	$ 185.23	$22,413	1
• Word Processing/Clerical	520.00	HR	0.00	97.78	0.00	$ 97.78	$50,846	1
• Draftsman/CADD	550.00	HR	0.00	127.83	0.00	$ 127.83	$70,307	1
• Attorney, Partner, Real Estate	30.00	HR	0.00	200.00	0.00	$ 200.00	$ 6,000	1
• Other Direct Costs	1.00	LS	4,367.26	0.00	0.00	$ 4,367.26	$ 4,367	1
						Subtotal	**$420,034**	
Planning Meetings								
• Per Diem (per person)	16.00	DAY	194.00	0.00	0.00	$ 194.00	$ 3,104	1
• Project Manager	160.00	HR	0.00	226.48	0.00	$ 226.48	$36,237	1
• Project Engineer	128.00	HR	0.00	219.62	0.00	$ 219.62	$28,111	1
• Word Processing/Clerical	128.00	HR	0.00	97.78	0.00	$ 97.78	$12,516	1
• Draftsman/CADD	64.00	HR	0.00	127.83	0.00	$ 127.83	$ 8,181	1
• Other Direct Costs	1.00	LS	906.62	0.00	0.00	$ 906.62	$ 907	1
						Subtotal	**$89,056**	
Implementation								
• Overnight Delivery, 8 oz Letter	18.00	EA	22.21	0.00	0.00	$ 22.21	$ 400	1
• Project Manager	82.00	HR	0.00	226.48	0.00	$ 226.48	$18,571	1
• Project Engineer	180.00	HR	0.00	219.62	0.00	$ 219.62	$39,532	1
• Staff Engineer	220.00	HR	0.00	192.19	0.00	$ 192.19	$42,282	1
• QA/QC Officer	51.00	HR	0.00	185.23	0.00	$ 185.23	$ 9,447	1
• Word Processing/Clerical	165.00	HR	0.00	97.78	0.00	$ 97.78	$16,134	1
• Draftsman/CADD	370.00	HR	0.00	127.83	0.00	$ 127.83	$47,297	1
• Computer Data Entry	200.00	HR	0.00	87.86	0.00	$ 87.86	$17,572	1
• Attorney, Senior Associate, Real Estate	8.00	HR	0.00	175.00	0.00	$ 175.00	$ 1,400	1
• Paralegal, Real Estate	8.00	HR	0.00	100.00	0.00	$ 100.00	$ 800	1
• Other Direct Costs	1.00	LS	2,034.38	0.00	0.00	$ 2,034.38	$ 2,034	1
• Construction Signs	96.00	SF	21.35	0.00	0.00	$ 21.35	$ 2,050	1
• Surveying - 3-man Crew	4.00	DAY	0.00	2,696.95	390.12	$ 3,087.07	$12,348	1
• Portable GPS Set with Mapping	1.00	MO	1,161.52	0.00	0.00	$ 1,161.52	$ 1,162	1
• Local Fees	2.00	LS	308.96	0.00	0.00	$ 308.96	$ 618	1
						Subtotal	**$211,646**	
Modification/Termination								
• Project Manager	56.00	HR	0.00	226.48	0.00	$ 226.48	$12,683	1
• Project Engineer	104.00	HR	0.00	219.62	0.00	$ 219.62	$22,840	1
• Staff Engineer	120.00	HR	0.00	192.19	0.00	$ 192.19	$23,063	1
• QA/QC Officer	19.00	HR	0.00	185.23	0.00	$ 185.23	$ 3,519	1
• Word Processing/Clerical	46.00	HR	0.00	97.78	0.00	$ 97.78	$ 4,498	1
• Draftsman/CADD	36.00	HR	0.00	127.83	0.00	$ 127.83	$ 4,602	1
• Other Direct Costs	1.00	LS	759.08	0.00	0.00	$ 759.08	$ 759	1
						Subtotal	**$71,964**	
LONG-TERM MONITORING - MNR								
Five-Year Review								
• Project Manager	35.00	HR	0.00	232.33	0.00	$ 232.33	$8,132	1
• Project Engineer	67.00	HR	0.00	225.30	0.00	$ 225.30	$15,095	1
• Project Scientist	33.00	HR	0.00	260.79	0.00	$ 260.79	$8,606	1
• Staff Scientist	55.00	HR	0.00	193.29	0.00	$ 193.29	$10,631	1
• Draftsman/CADD	24.00	HR	0.00	131.14	0.00	$ 131.14	$3,147	1
						Subtotal	**$45,611**	

TABLE D-7: COST ESTIMATE -- ALTERNATIVE 5A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	*1.152*
	Placement of Armored Cap	Labor:	*1.67*
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	*1.076*
		Contingency on Direct Costs:	*20%*
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
Sample Collection								
• Analysis, mercury (7041)	24.00	EA	46.93	0.00	0.00	$ 46.93	$ 1,126	*1*
• Analysis, copper (6010)	24.00	EA	20.34	0.00	0.00	$ 20.34	$ 488	*1*
• Analysis PCBs, (8081/8082)	24.00	EA	367.28	0.00	0.00	$ 367.28	$ 8,815	*1*
• Bathymetry Survey - Area X	1.00	EACH	22,399.93	0.00	0.00	$22,399.93	$22,400	*6*
• Vibracore mob/demob, shallow water drill barge/tender	1.00	EACH	6,951.70	0.00	0.00	$ 6,951.70	$ 6,952	*6*
• Vibracore daily rate - Area X	3.00	DAY	6,256.53	0.00	0.00	$ 6,256.53	$18,770	*6*
• Vibracore consumables	3.00	DAY	617.93	0.00	0.00	$ 617.93	$ 1,854	*6*
• Benthic analysis	24.00	EACH	386.21	0.00	0.00	$ 386.21	$ 9,269	*1*
General Monitoring and Reporting								
• Sample collection, vehicle mileage	100.00	MI	0.49	0.00	0.00	$ 0.49	$ 49	*1*
• Project Manager	4.00	HR	0.00	276.19	0.00	$ 276.19	$ 1,105	*1*
• Project Engineer	30.00	HR	0.00	267.83	0.00	$ 267.83	$ 8,035	*1*
• Project Scientist	47.00	HR	0.00	310.02	0.00	$ 310.02	$14,571	*1*
• Staff Scientist	81.00	HR	0.00	229.78	0.00	$ 229.78	$18,612	*1*
• Field Technician	2.00	HR	0.00	171.18	0.00	$ 171.18	$ 342	*1*
• Word Processing/Clerical	13.00	HR	0.00	119.25	0.00	$ 119.25	$ 1,550	*1*
• Draftsman/CADD	9.00	HR	0.00	155.90	0.00	$ 155.90	$ 1,403	*1*
						Subtotal	**$115,341**	
				Annual Monitoring for First Four Years			**$461,363**	
		Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30					**$965,711**	
PROFESSIONAL LABOR MANAGEMENT - MNR								
• Project Management Labor Cost	1.00	LS	0.00	29,703.06	0.00	$29,703.06	$29,703	*1*
• Planning Documents Labor Cost	1.00	LS	0.00	23,762.45	0.00	$23,762.45	$23,762	*1*
• Construction Oversight Labor Cost	1.00	LS	0.00	19,306.99	0.00	$19,306.99	$19,307	*1*
• Reporting Labor Cost	1.00	LS	0.00	4,455.46	0.00	$ 4,455.46	$ 4,455	*1*
• As-Built Drawings Labor Cost	1.00	LS	0.00	4,455.46	0.00	$ 4,455.46	$ 4,455	*1*
• Public Notice Labor Cost	1.00	LS	0.00	1,485.15	0.00	$ 1,485.15	$ 1,485	*1*
• Permitting Labor Cost	1.00	LS	0.00	29,703.06	0.00	$29,703.06	$29,703	*1*
						Subtotal	**$112,872**	
			SUBTOTAL MONITORED NATURAL RECOVERY - AREA X				**$2,332,645**	
FOCUSED REMOVAL - AREA X								
COFFER DAM - SOUTH BASIN								
• Construction Labor	240.00	HR	0.00	101.21	0.00	$ 101.21	$24,290	*1*
• Maintenance Labor	80.00	HR	0.00	101.21	0.00	$ 101.21	$ 8,097	*1*
• Crawler-mounted, 2.0 CY, 235 Hydraulic Excavator	48.00	HR	0.00	137.97	206.56	$ 344.53	$16,537	*1*
• 4" Diameter Contractor's Trash Pump, 300 GPM	139.00	DAY	87.42	60.30	0.00	$ 147.72	$20,533	*1*
• 4", Class 150, PVC Piping	1,000.00	LF	3.12	18.25	0.94	$ 22.31	$22,310	*1*
• AquaDam Rental	2,000.00	LF	0.00	0.00	97.27	$ 97.27	$194,540	*2*
• Mobilization AquaDam	2.00	EACH	8,199.05	0.00	0.00	$ 8,199.05	$16,398	*2*
• Installation AquaDam	6.00	DAY	3,279.62	0.00	0.00	$ 3,279.62	$19,678	*2*
						Subtotal	**$322,384**	
COFFER DAM - YOSEMITE CREEK								
• Construction Labor	40.00	HR	0.00	95.35	0.00	$ 95.35	$ 3,814	*1*
• Crawler-mounted, 2.0 CY, 235 Hydraulic Excavator	8.00	HR	0.00	129.98	194.59	$ 324.57	$ 2,597	*1*
• 4" Diameter Contractor's Trash Pump, 300 GPM	60.00	DAY	82.35	56.81	0.00	$ 139.16	$ 8,350	*1*
• 4", Class 150, PVC Piping	1,000.00	LF	2.94	17.19	0.88	$ 21.01	$21,010	*1*
• AquaDam Rental	150.00	LF	0.00	0.00	91.64	$ 91.64	$13,746	*2*
• Mobilization AquaDam	1.00	EACH	1,544.82	0.00	0.00	$ 1,544.82	$ 1,545	*2*
• Installation AquaDam	1.00	DAY	3,089.65	0.00	0.00	$ 3,089.65	$ 3,090	*2*
						Subtotal	**$54,151**	

TABLE D-7: COST ESTIMATE – ALTERNATIVE 5A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment Placement of Armored Cap	Material:	1.152
Area X:	Focused Removal and Monitored Natural Recovery	Labor:	1.67
		Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
EXCAVATION AND BACKFILL								
• 4 CY, Crawler-mounted,	46,990.00	CY	0.00	2.29	3.47	$ 5.76	$270,662	1
• Hydraulic Excavator								1
• Delivered & Dumped, Backfill	15,663.00	BCY	44.01	1.99	1.48	$ 47.48	$743,679	1
• Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	58,744.00	CY	10.54	4.56	3.05	$ 18.15	$1,066,204	1
• 2" Diameter Trash Pump, 75 gpm	80.00	DAY	70.73	29.50	0.00	$ 100.23	$ 8,018	1
• Spray washing, decontaminate heavy equipment,	1.00	EA	0.00	1,072.83	0.00	$ 1,072.83	$ 1,073	1
• 2" Polyethylene, flexible piping, SDR15, 125 psi	100.00	LF	2.18	0.00	0.00	$ 2.18	$ 218	1
• Crane Mats	10.00	EACH	3,852.82	0.00	0.00	$ 3,852.82	$38,528	1
						Subtotal	**$2,128,383**	
ADD ACTIVATED CARBON TO BACKFILL								
• Activated Carbon - Coal Derived	1,574.00	Cy	1,668.36	86.32	47.90	$ 1,802.58	$2,837,261	7
• Soil Tilling, D3 Dozer with Tiller Attachn	40.00	HR	0.00	126.64	72.86	$ 199.50	$ 7,980	1
• Broadcast carbon using tractor spreade	33.00	ACRE	85.18	20.41	0.00	$ 105.59	$ 3,484	1
• Spray washers & decontamination for li	1.00	EA	0.00	362.08	0.00	$ 362.08	$ 362	1
• Spray washing, decontaminate med eq	1.00	EA	0.00	724.16	0.00	$ 724.16	$ 724	1
• Standby D3 Bulldozer with Tiller	30.00	HR	0.00	0.00	14.98	$ 14.98	$ 449	1
						Subtotal	**$2,850,261**	
CONFIRMATION SAMPLING								
• Analysis, mercury (7041)	36.00	EA	46.93	0.00	0.00	$ 46.93	$ 1,689	1
• Analysis, copper (6010)	36.00	EA	20.34	0.00	0.00	$ 20.34	$ 732	1
• Analysis, PCBs (8081/8082)	36.00	EA	306.06	0.00	0.00	$ 306.06	$11,018	1
• Surveying - 2-man Crew	5.00	DAY	0.00	2,288.95	383.39	$2,672.34	$13,362	1
• Field Technician	16.00	HR	0.00	171.18	0.00	$ 171.18	$ 2,739	1
						Subtotal	**$29,540**	
RESIDUAL WASTE MANAGEMENT - SEDIMENT AND DECON WASTE DISPOSAL								
• Secondary containment and storage, loading hazardous waste for shipment into 5,000 gal. bulk tank truck	13.00	EA	0.00	1,055.18	394.82	$ 1,450.00	$18,850	1
• Secondary containment and storage, loading hazardous waste for shipment	18.00	EA	0.00	10.81	1.80	$ 12.61	$ 227	1
• Subcontracted shipping of haz. waste, transport drums of solid hazardous waste, 80 55 gal. drums	60.00	MI	3.26	0.00	0.00	$ 3.26	$ 196	1
• Subcontracted shipping of hazardous waste, transport bulk solid hazardous waste, 20 C.Y.	200,700.00	MI	3.26	0.00	0.00	$ 3.26	$654,282	1
• Subcontracted shipping of hazardous waste, transport bulk sludge/liquid hazardous waste, 5000 gal.	26.00	MI	3.26	0.00	0.00	$ 3.26	$ 85	1
• Commercial RCRA landfills, additional costs, waste stream evaluation, 50% rebate on first	3.00	EA	793.09	0.00	0.00	$ 793.09	$ 2,379	1
• Commercial RCRA landfills, drummed waste disposal, solid, non-hazardous, 55 gal drums	18.00	EA	13.50	0.00	0.00	$ 13.50	$ 243	1
• Commercial RCRA landfills, liquid/sludge, non-fuel, non-hazardous	61,170.00	CY	46.34	0.00	0.00	$ 46.34	$2,834,618	3
• Commercial RCRA landfills, liquid/sludge, non-fuel, non-hazardous	60,100.00	GAL	3.69	0.00	0.00	$ 3.69	$221,769	1
						Subtotal	**$3,732,648**	

TABLE D-7: COST ESTIMATE -- ALTERNATIVE 5A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	*1.152*
	Placement of Armored Cap	Labor:	*1.67*
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	*1.076*
		Contingency on Direct Costs:	*20%*
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
DEWATERING PAD								
• Grub and stack, 140 H.P. dozer	212.00	CY	0.00	6.75	2.29	$ 9.04	$ 1,916	*1*
• Excavating, trench, normal soil, to 2' - 6' deep, excavate by hand, piled only	212.00	BCY	0.00	165.78	0.00	$ 165.78	$35,145	*1*
• 953, 2.0 CY, Track Loader	500.00	HR	0.00	119.96	104.04	$ 224.00	$112,000	*1*
• Backfill Trench, Borrow Material, Delivered & Dumped Only	136.00	CY	10.16	4.46	1.89	$ 16.51	$ 2,245	*1*
• 18" x 18" Underground French Drain	753.39	LF	6.15	3.81	0.58	$ 10.54	$ 7,941	*1*
• Pump, pedestal sump, single stage, 75 GPM, 1-1/2 H.P., 2" discharge	1.00	EA	4,242.65	1,769.93	0.00	$ 6,012.58	$ 6,013	*1*
• Storage Tanks, plastic, ground level, horizontal cylinder, 550 gallons	1.00	EA	2,570.88	1,067.48	0.00	$ 3,638.36	$ 3,638	*1*
• Storage Tanks, plastic, ground level, horizontal cylinder, 6" NP conn., 4,000 gal	1.00	EA	6,685.01	1,673.48	0.00	$ 8,358.49	$ 8,358	*1*
• Polymeric Liner Anchor Trench, 3'x1.5'	792.00	LF	0.06	4.45	0.42	$ 4.93	$ 3,905	*1*
• Secure burial cell construction, polymeric liner and cover system, polyvinyl chloride (PVC), 40 mil	38,259.00	SF	0.59	0.93	0.04	$ 1.56	$59,684	*1*
• Waste Pile Cover, 135 Lb Tear,	3,742.00	SY	2.88	0.83	0.00	$ 3.71	$13,883	*1*
• Pump, submersible sump, automatic, 15 GPM, 1-1/2" discharge, 15' head	1.00	EA	1,336.83	286.89	0.00	$ 1,623.72	$ 1,624	*1*
• Operator, dewatering pad	340.00	HR	0.00	171.00	0.00	$171.00	$58,140	
						Subtotal	**$256,353**	
DECONTAMINATION FACILITIES								
• Decon pad for heavy equipment and personnel							$108,130	*1*
						Subtotal	**$108,130**	
PROFESSIONAL LABOR MANAGEMENT - FOCUSED REMOVAL AREA IX->								
• Project Management Labor Cost	1.00	LS	0.00	721,646.02	0.00	$721,646.02	$721,646	*1*
• Planning Documents Labor Cost	1.00	LS	0.00	793,810.63	0.00	$793,810.63	$793,811	*1*
• Construction Oversight Labor Cost	1.00	LS	0.00	1,082,469.0	0.00	$1,082,469.00	$1,082,469	*1*
• Reporting Labor Cost	1.00	LS	0.00	120,274.33	0.00	$120,274.33	$120,274	*1*
• As-Built Drawings Labor Cost	1.00	LS	0.00	120,274.33	0.00	$120,274.33	$120,274	*1*
• Public Notice Labor Cost	1.00	LS	0.00	12,027.43	0.00	$12,027.43	$12,027	*1*
• Permitting Labor Cost	1.00	LS	0.00	601,371.67	0.00	$601,371.67	$601,372	*1*
						Subtotal	**$3,451,873**	
						SUBTOTAL FOCUSED REMOVAL - AREA X	**$12,933,723**	
FOCUSED REMOVAL - AREA III (See Alternative 3A for details)								
						SUBTOTAL FOCUSED REMOVAL - AREA III	**$3,144,773**	
ARMOR CAP - AREA III (See Alternative 3A for details)								
ARMORED CAPPING (11-acre cap, 1.5 feet sand and 0.5 foot armor stone)						**Subtotal**	**$3,911,621**	
CONSTRUCTION QC MONITORING						**Subtotal**	**$19,522**	
PROFESSIONAL LABOR MANAGEMENT - CAPPING						**Subtotal**	**$1,583,523**	
LONG TERM MONITORING - ARMOR CAP								
Five-Year Review						**Subtotal**	**$45,611**	
Monitoring - Sample Collection						**Subtotal**	**$77,306**	
						Annual Monitoring for First Four Years	**$309,224**	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	**$737,503**	
CAP REPAIR (Year 10)						**Subtotal**	**$474,748**	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR						**Subtotal**	**$328,786**	
						SUBTOTAL ARMOR CAP - AREA III	**$7,364,927**	

TABLE D-7: COST ESTIMATE – ALTERNATIVE 5A (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5A:		Location Modifiers	
Area III:	Focused Removal and Off-Site Disposal of Sediment	Material:	*1.152*
	Placement of Armored Cap	Labor:	*1.67*
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	*1.076*
		Contingency on Direct Costs:	*20%*
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
DESIGN COSTS								
Phase Name	**Design Approach**			**Total Capital**		**%**	**Design Cost**	
• Monitored Natural Recovery - Area X	Natural Attenuation			$172,630		8%	$13,810	
• Focused Removal - Area X	Ex Situ Removal - Off-site			$9,481,849		10%	$948,185	
• Focused Removal - Area III	Ex Situ Removal - Off-site			$2,274,539		10%	$227,454	
• Armored Capping - Area III	In Situ Containment			$3,931,143		12%	$471,737	
• Cap Repair	In Situ Containment			$474,748		10%	$47,475	
						Subtotal Design	**$1,708,661**	
						Base Cost	$24,207,394	
						30-Year O&M	$3,277,335	
						Total Future Cost	$27,484,729	

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[a]	Discount Factor[b]	Total Present Value Cost
Design	$ 1,708,661	0	2006	1	1	$ 1,708,661
Remedial Action Construction	$ 22,498,733	1	2007	1.021	0.970	$ 22,280,511
Monitoring	$ 192,647	2	2008	1.042	0.941	$ 188,922
Monitoring	$ 192,647	3	2009	1.064	0.912	$ 187,090
Monitoring	$ 192,647	4	2010	1.087	0.885	$ 185,284
Monitoring	$ 192,647	5	2011	1.110	0.858	$ 183,483
Monitoring, 5-Year Review	$ 283,869	6	2012	1.133	0.833	$ 267,744
Monitoring, cap repair, 5-Yr review	$ 1,087,403	11	2017	1.257	0.715	$ 976,814
Monitoring, 5-Year Review	$ 283,869	16	2022	1.395	0.614	$ 242,883
Monitoring, 5-Year Review	$ 283,869	21	2027	1.547	0.527	$ 231,330
Monitoring, 5-Year Review	$ 283,869	26	2032	1.717	0.452	$ 220,324
Monitoring, 5-Year Review	$ 283,869	31	2037	1.905	0.388	$ 209,847
	$ 27,484,729					$ 26,882,893

TOTAL PRESENT VALUE - ALTERNATIVE 5A: $26,882,893

Sources:
1. Racer 2005 Database
2. Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3. Altamont Landfill tipping fee, non-hazardous material.
4. Vendor Quote - Dutra Dredging, 12/14/05.
5. Vendor Quote - AquaBlok Limited, 12/13/05.
6. Vendor Quote - TEG Ocean Services, 1/9/06.
7. Carbon application costs were extrapolated from the 2005 Parcel F pilot test conducted by Stanford University.

[c]Annual Discount Rate (i) = 3.10%

Notes:
a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

TABLE D-8: COST ESTIMATE -- ALTERNATIVE 5B
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5B:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Capping with AquaBlok and Armor Stone	Labor:	1.67
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source
MONITORED NATURAL RECOVERY - PARTIAL AREA X (See Alternative 5A for details)								
ADMINISTRATIVE LAND USE CONTROLS								
Planning Docs						Subtotal	$420,034	
Planning Meetings						Subtotal	$89,056	
Implementation						Subtotal	$211,646	
Modification/Termination						Subtotal	$71,964	
LONG-TERM MONITORING - MONITORED NATURAL RECOVERY								
Five-Year Review						Subtotal	$45,611	
Sampling						Subtotal	$115,341	
						Annual Monitoring for First Four Years	$461,363	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	$965,711	
PROFESSIONAL LABOR MANAGEMENT - MONITORED NATURAL RECOVERY						Subtotal	$112,872	
						SUBTOTAL MONITORED NATURAL RECOVERY - AREA X	$2,332,645	
FOCUSED REMOVAL - AREA X (See Alternative 5A for details)								
						SUBTOTAL FOCUSED REMOVAL - AREA X	$12,933,723	
FOCUSED REMOVAL - AREA III (see Alternative 3A for details)								
						SUBTOTAL FOCUSED REMOVAL - AREA III	$3,144,773	
AQUABLOK CAP - AREA III (see Alternative 3B for details)								
AQUABLOK CAPPING (11-acre cap, 4.5 inches of AquaBlok and 6 inches armor stone						Subtotal	$5,506,400	
CONSTRUCTION QC MONITORING						Subtotal	$19,522	
PROFESSIONAL LABOR MANAGEMENT - CAPPING							$1,985,735	
LONG TERM MONITORING - ARMOR CAP								
Five-Year Review						Subtotal	$45,611	
Monitoring						Subtotal	$77,306	
						Annual Monitoring for First Four Years	$309,224	
						Monitoring Every 5 Years and 5-yr Review Cost for Years 5 through 30	$737,503	
CAP REPAIR (Year 10)						Subtotal	$347,453	
PROFESSIONAL LABOR MANAGEMENT - CAP REPAIR						Subtotal	$328,786	
						SUBTOTAL AQUABLOK CAP - AREA III	$9,280,235	

DESIGN COSTS

Phase Name	Design Approach	Total Capital	%	Design Cost
• Monitored Natural Recovery - Area X	Natural Attenuation	$172,630	8%	$13,810
• Focused Removal - Area X	Ex Situ Removal - Off-site	$9,481,849	10%	$948,185
• Focused Removal - Area III	Ex Situ Removal - Off-site	$2,274,539	10%	$227,454
• AquaBlok Capping - Area III	In Situ Containment	$5,525,922	12%	$663,111
• Cap Repair	In Situ Containment	$347,453	10%	$34,745
			Subtotal Design	$1,887,305
			Base Cost	$26,428,640
			30-Year O&M	$3,150,040
			Total Future Cost	$29,578,680

TABLE D-8: COST ESTIMATE -- ALTERNATIVE 5B (CONTINUED)
Revised Feasibility Study Report for Parcel F, Hunters Point Shipyard, San Francisco, California

Alternative 5B:		Location Modifiers	
Area III:	Focused Removal of Sediment	Material:	1.152
	Capping with AquaBlok and Armor Stone	Labor:	1.67
Area X:	Focused Removal and Monitored Natural Recovery	Equipment:	1.076
		Contingency on Direct Costs:	20%
Prepared by:	M. Berry - BAI, September 2006	Options	
Checked by:	S. Delhomme - Tetra Tech, December 2006	RACER Database:	Modified System
		Cost Database Date:	2006

Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Unit Cost	Extended Cost	Source

PRESENT VALUE

Description	Total Cost	Year From Start	Calendar Year	Escalation Factor[1]	Discount Factor[2]	Total Present Value Cost
Design	$ 1,887,305	0	2006	1	1	$ 1,887,305
Remedial Action Construction	$ 24,541,335	1	2007	1.021	0.970	$ 24,303,301
Monitoring	$ 192,647	2	2008	1.042	0.941	$ 188,922
Monitoring	$ 192,647	3	2009	1.064	0.912	$ 187,090
Monitoring	$ 192,647	4	2010	1.087	0.885	$ 185,284
Monitoring	$ 192,647	5	2011	1.110	0.858	$ 183,483
Monitoring, 5-Year Review	$ 283,869	6	2012	1.133	0.833	$ 267,744
Monitoring, cap repair, 5-Yr review	$ 960,108	11	2017	1.257	0.715	$ 862,465
Monitoring, 5-Year Review	$ 283,869	16	2022	1.395	0.614	$ 242,883
Monitoring, 5-Year Review	$ 283,869	21	2027	1.547	0.527	$ 231,330
Monitoring, 5-Year Review	$ 283,869	26	2032	1.717	0.452	$ 220,324
Monitoring, 5-Year Review	$ 283,869	31	2037	1.905	0.388	$ 209,847
	$ 32,160,000					$ 28,969,978

TOTAL PRESENT VALUE - ALTERNATIVE 5B: $28,969,978

Sources:

1. Racer 2005 Database
2. Vendor Quote - Aquadam - Water Structures Unlimited, 12/6/05
3. Altamont Landfill tipping fee, non-hazardous material.
4. Vendor Quote - Dutra Dredging, 12/14/05.
5. Vendor Quote - AquaBlok Limited, 12/13/05.
6. Vendor Quote - TEG Ocean Services, 1/9/06.

[c]Annual Discount Rate (i) = 3.10%

Notes:

a. Escalation factors from RACER 2005.
b. Annual discount factor = 1/(1+i)t, where i = 3.10% and t=year.
c. Annual discount rate obtained from OMB Circular No. A-94, 2005.

ATTACHMENT 1
FIGURES FROM FSDG TECHNICAL MEMORANDUM
(PREPARED BY BATTELLE)

ATTACHMENT 1 – FIGURES FROM FSDG TECHNICAL MEMORANDUM

THIS ATTACHMENT IS COMPLETE AS SUBMITTED

FOR ADDITIONAL INFORMATION, CONTACT:

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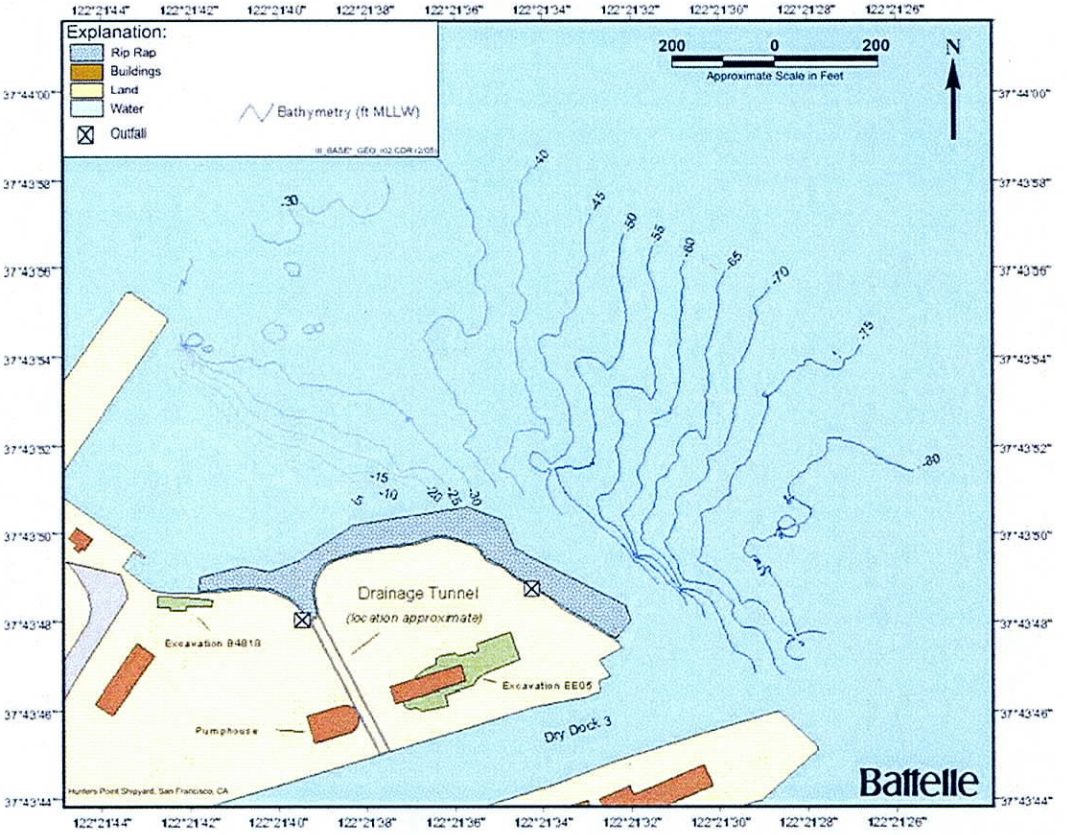


Figure 1-5. Overview of Point Avisadero (Area III) with Offshore Sample Locations

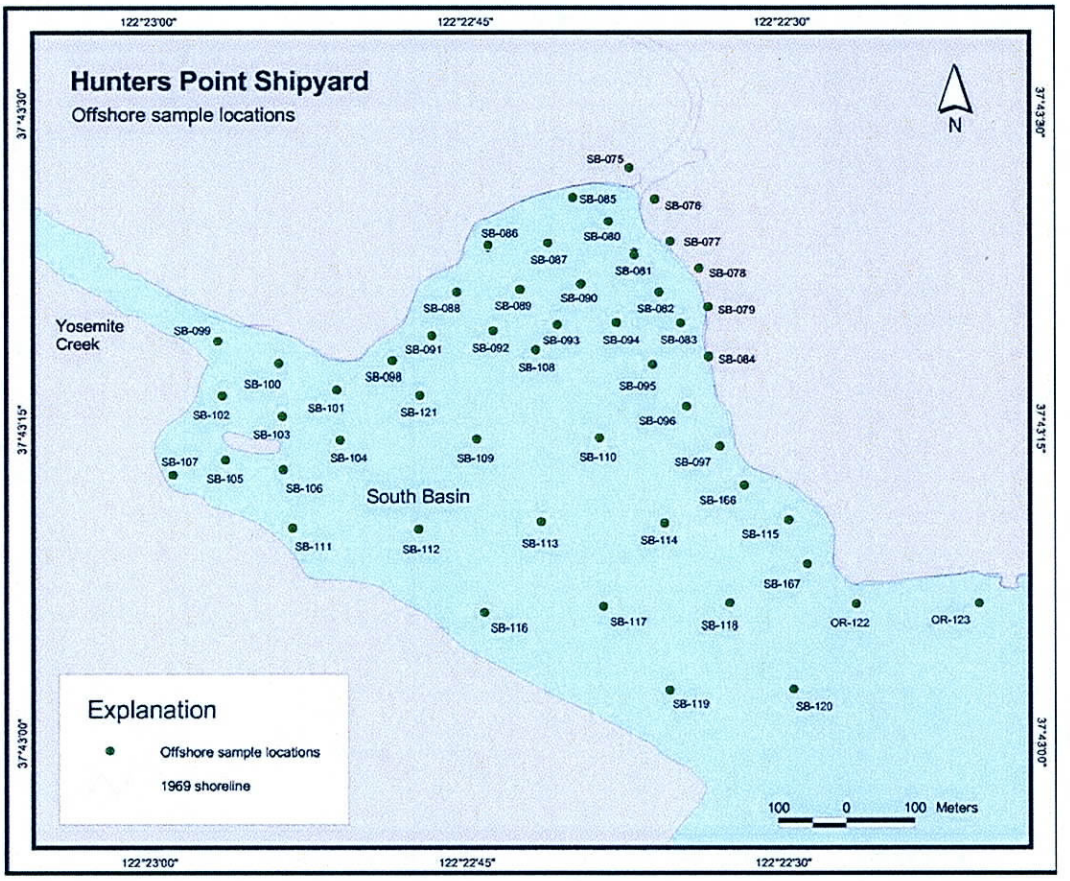


Figure 2-1. Parcel F FS Data Gaps Sample Stations in South Basin

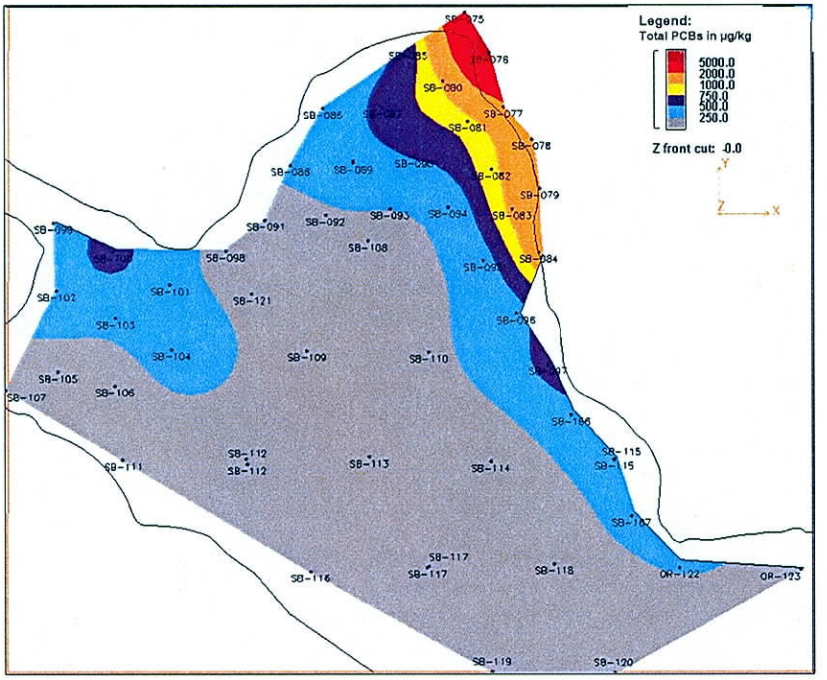


Figure 2-4a. Total PCB Distribution in Surface Sediment (2003)

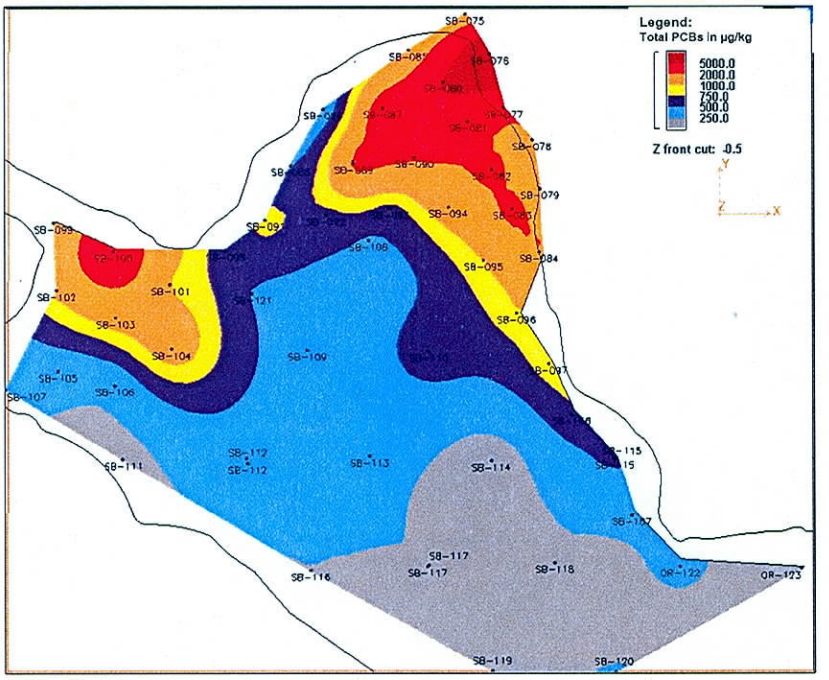


Figure 2-4b. Total PCB Distribution at a Depth of 0.5 ft (2003)

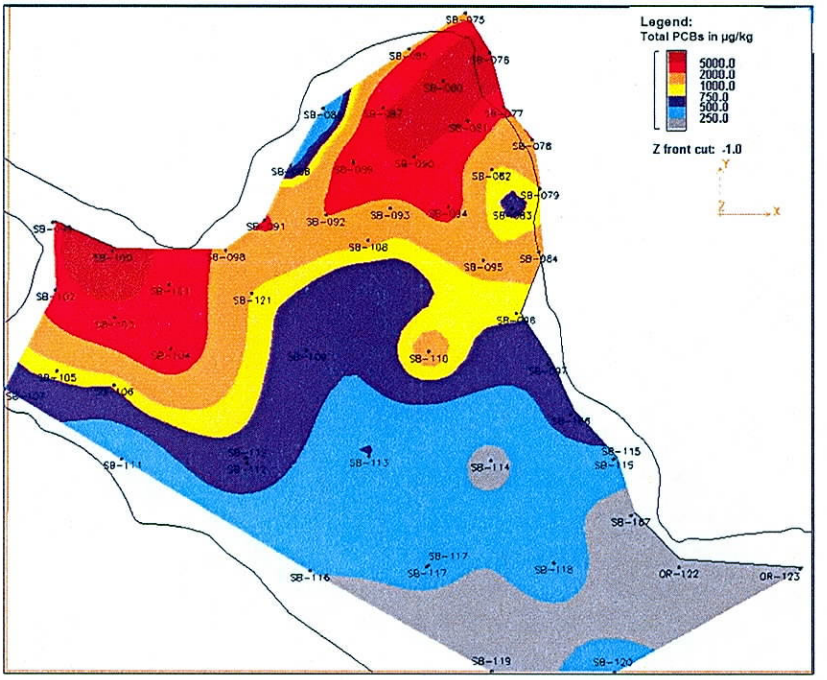


Figure 2-4c. Total PCB Distribution at a Depth of 1 ft (2003)

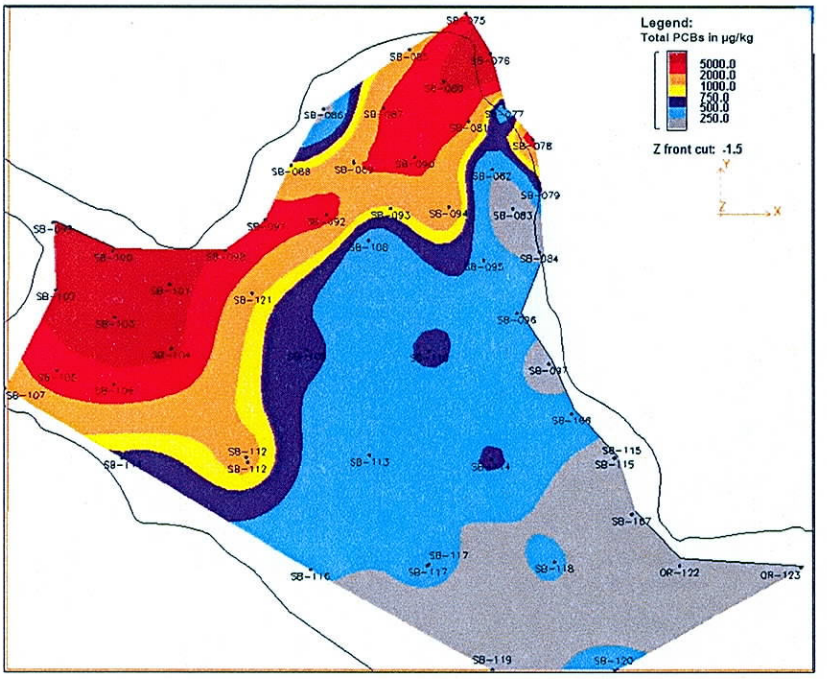


Figure 2-4d. Total PCB Distribution at a Depth of 1.5 ft (2003)

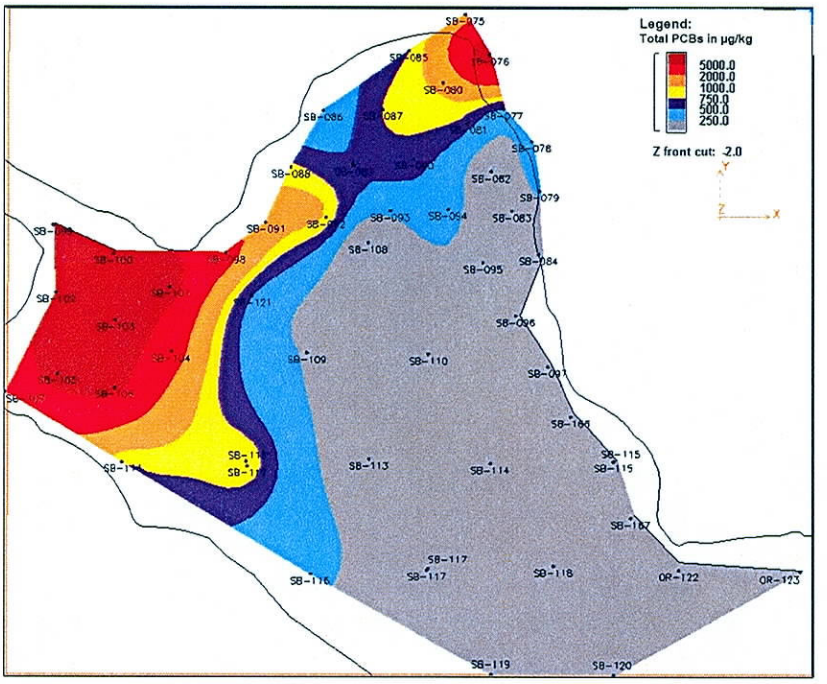


Figure 2-4e. Total PCB Distribution at a Depth of 2 ft (2003)

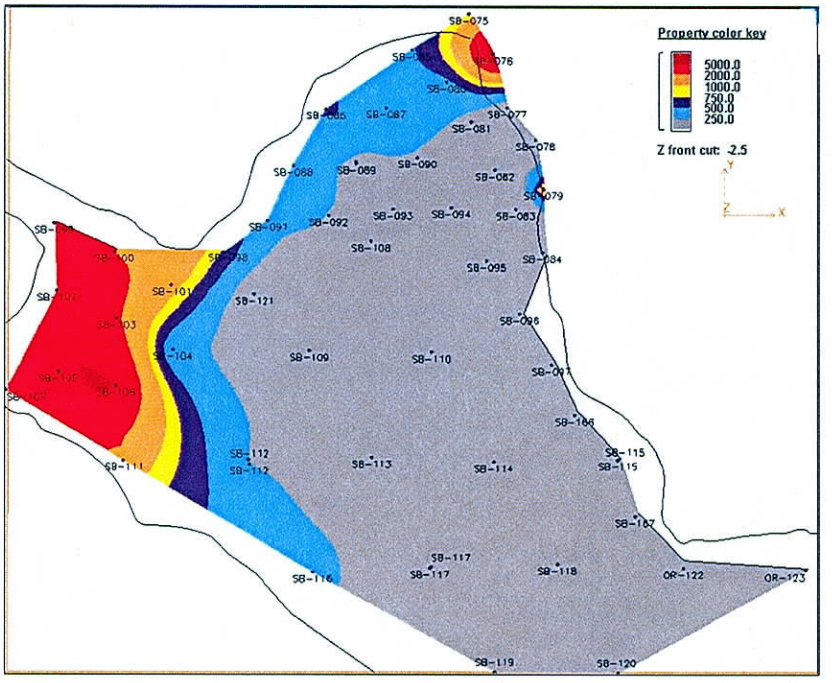
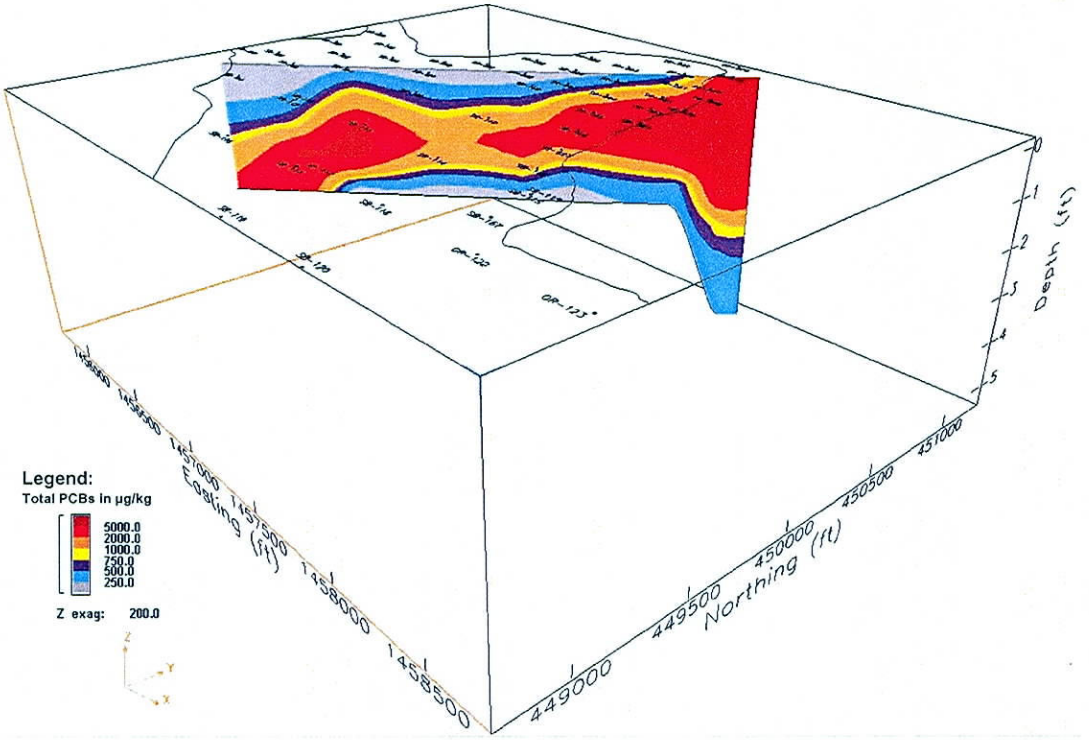


Figure 2-4f. Total PCB Distribution at a Depth of 2.5 ft (2003)

A-A'



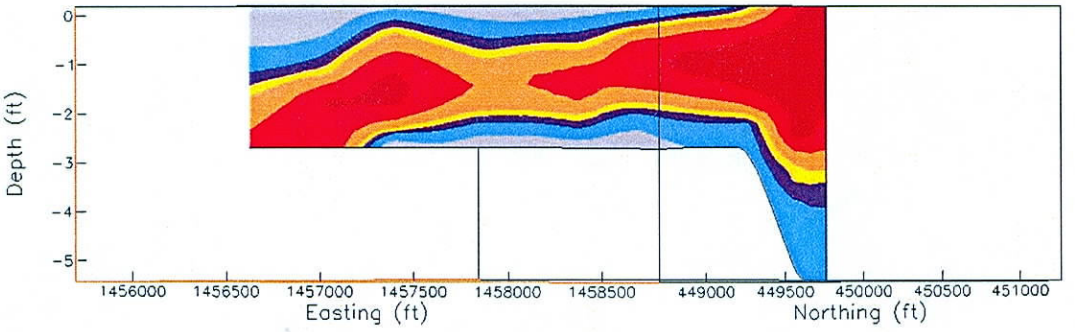
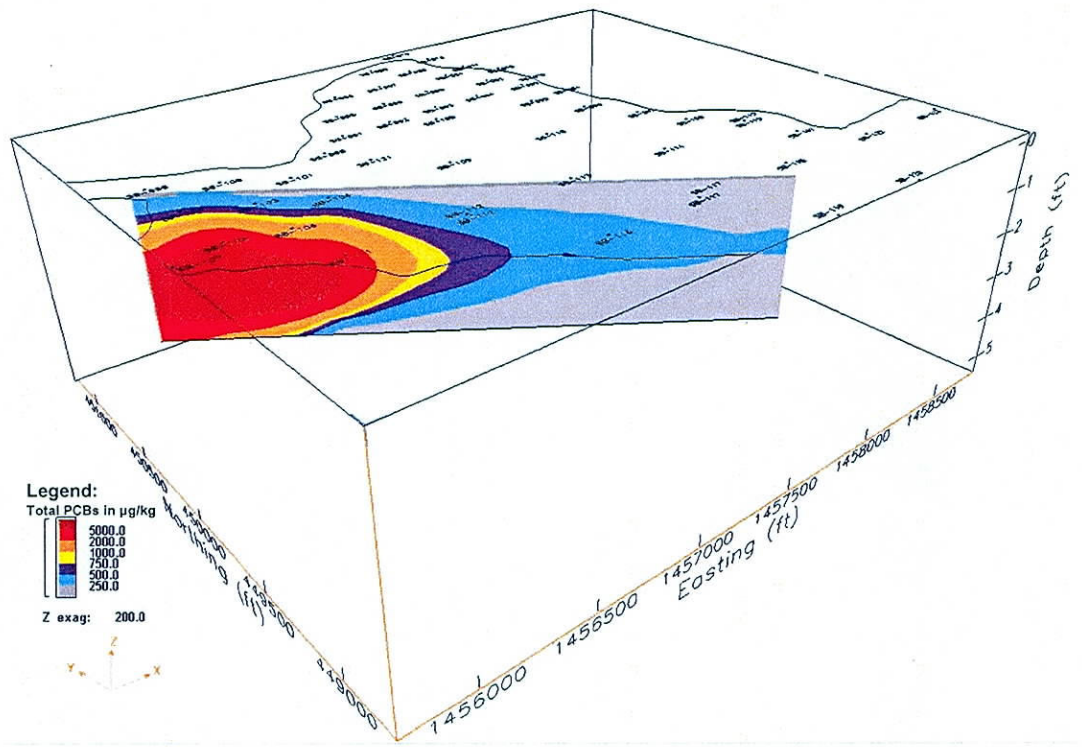


Figure 2-5a. South Basin Cross Section A-A'

B-B'



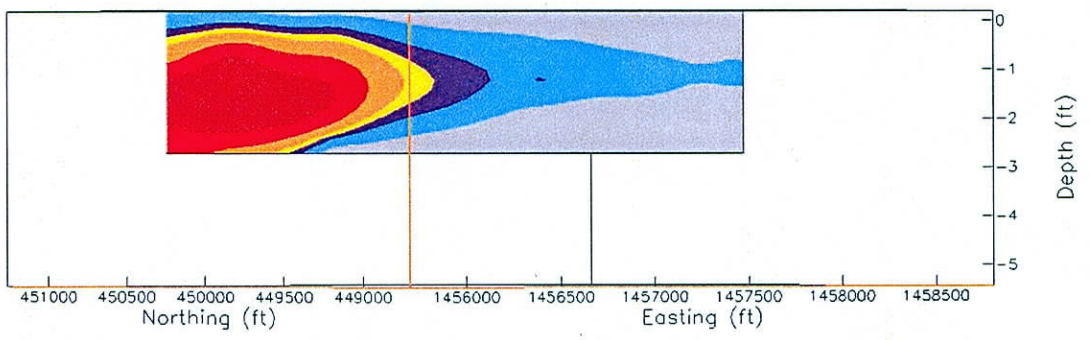


Figure 2-5b. South Basin Cross Section B-B′

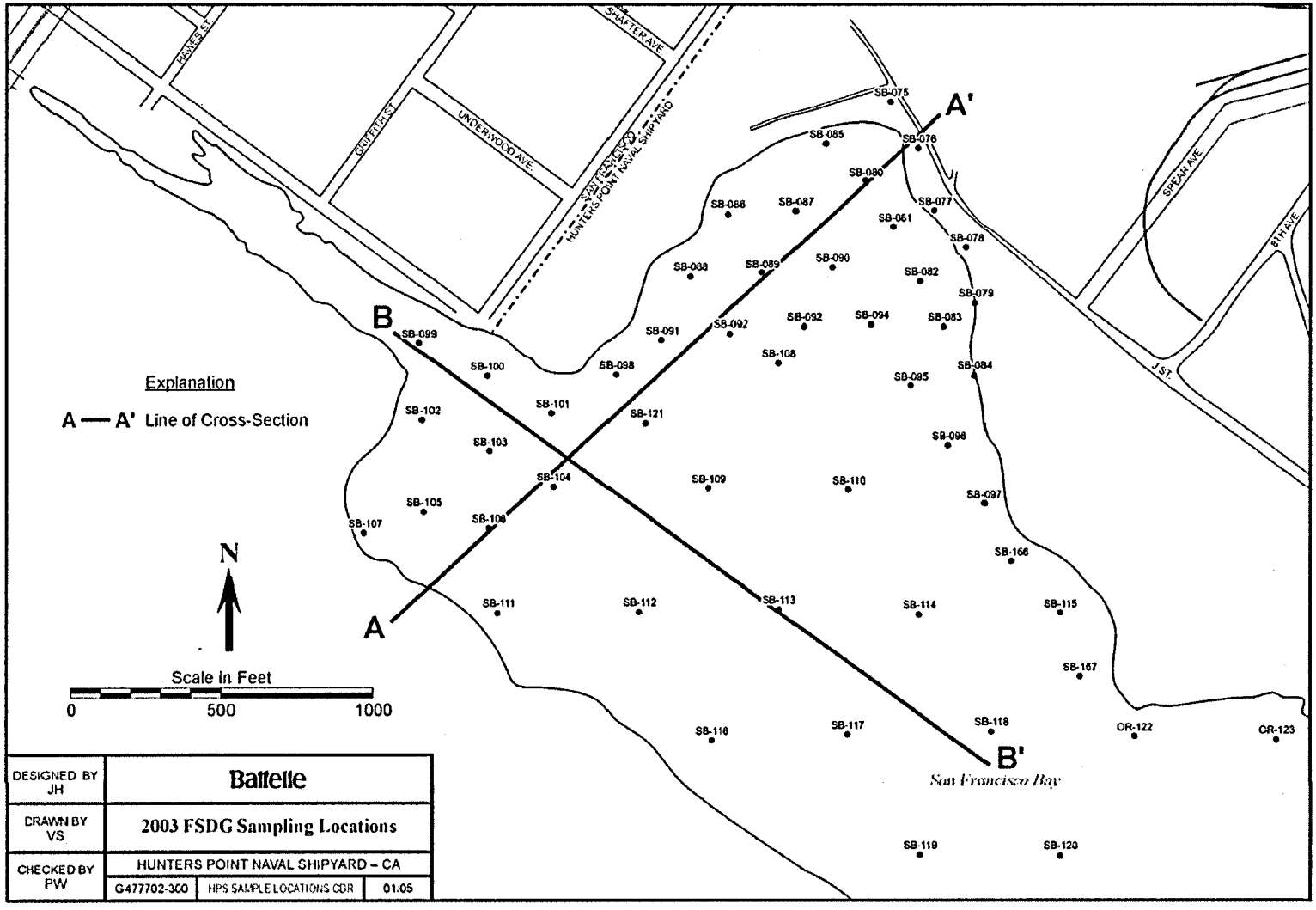


Figure 2-5c. South Basin Cross-Section Locations

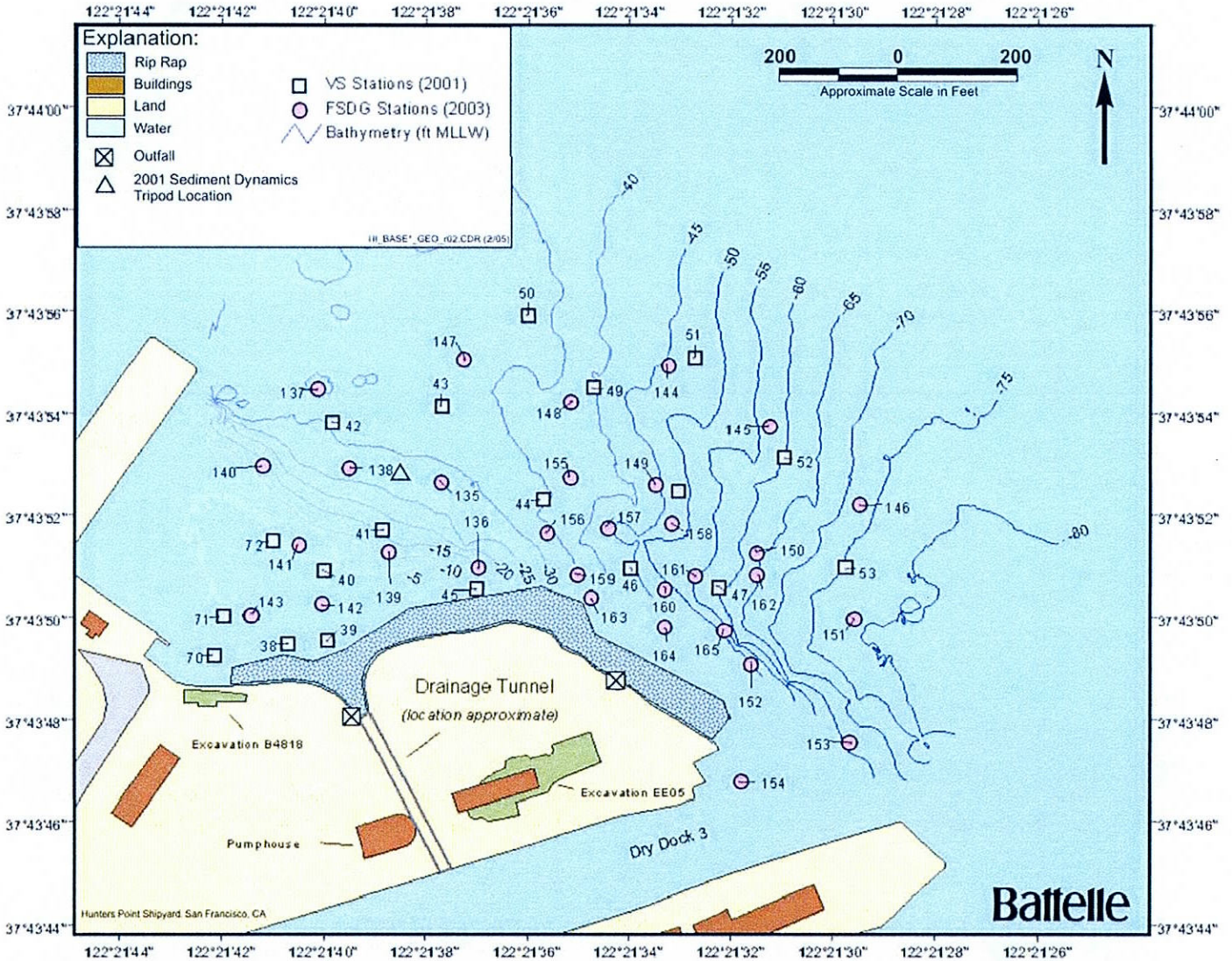


Figure 2-21. Point Avisadero Sample Locations, Parcel F Validation Study and FS Data Gaps Investigation

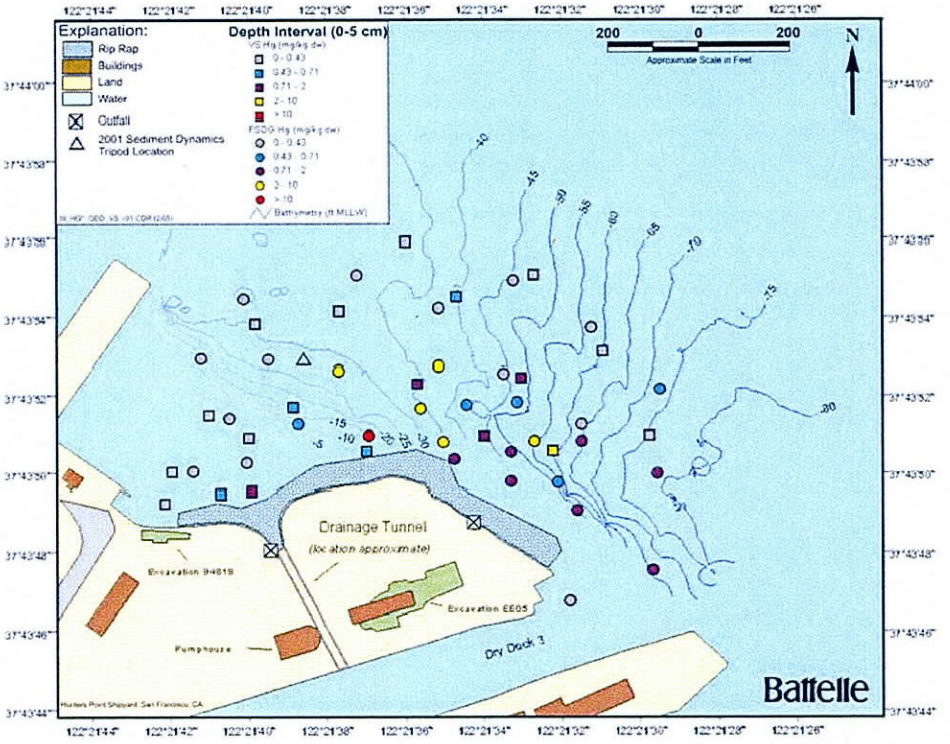


Figure 2-22a. Total Mercury in Surface Sediment (0-5 cm), Point Avisadero

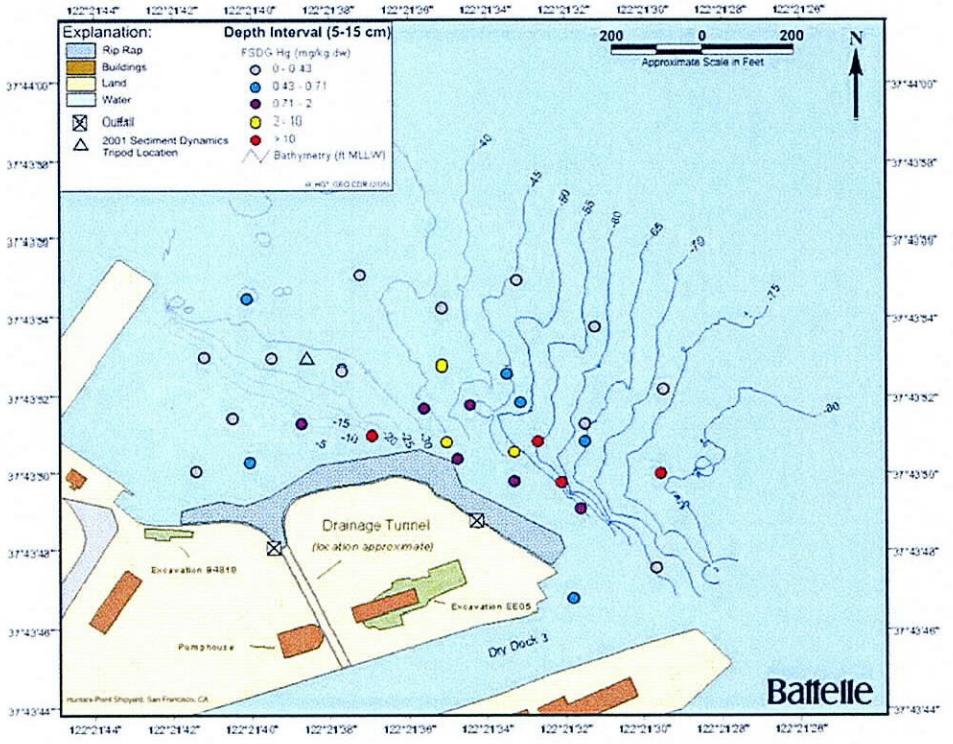


Figure 2-22b. Total Mercury in 5-15 cm Depth Interval, Point Avisadero

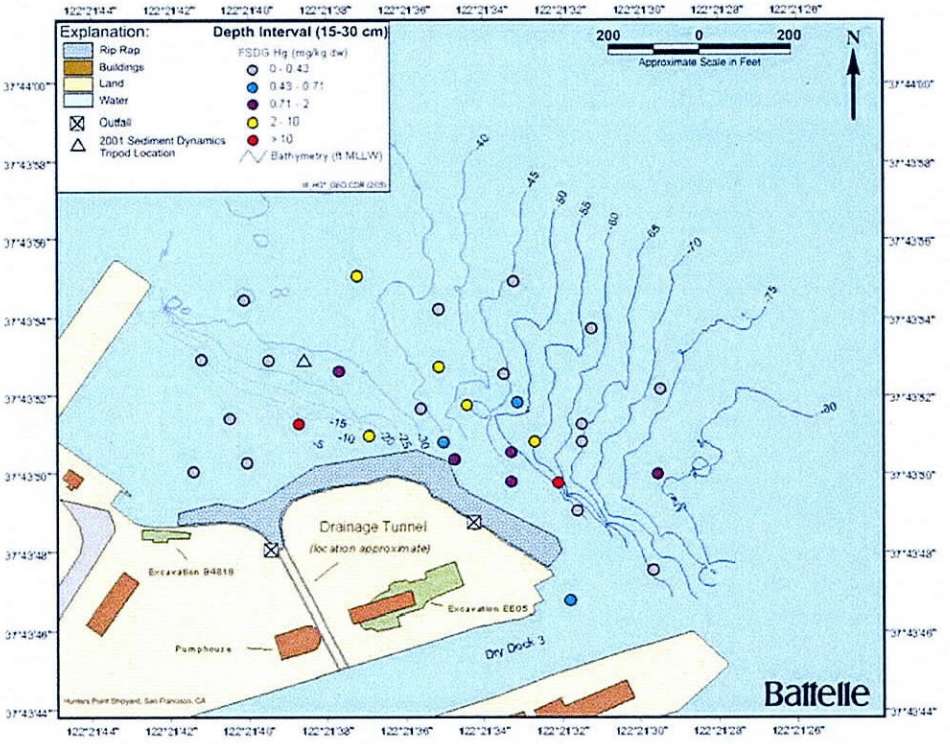


Figure 2-22c. Total Mercury in 15-30 cm Depth Interval, Point Avisadero

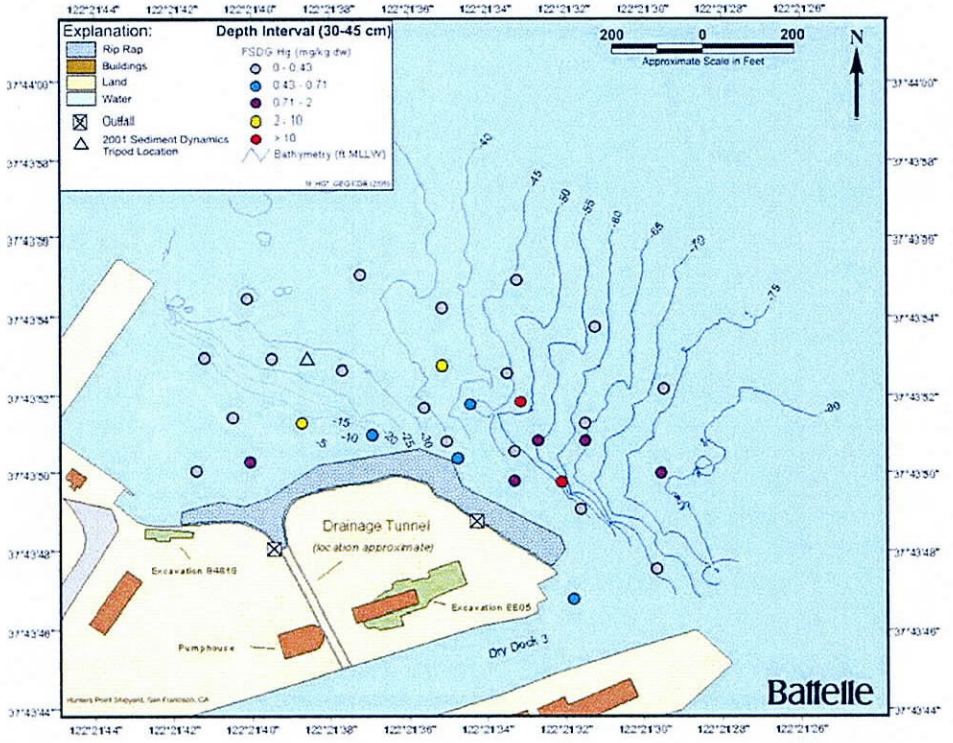


Figure 2-22d. Total Mercury in 30-45 cm Depth Interval, Point Avisadero

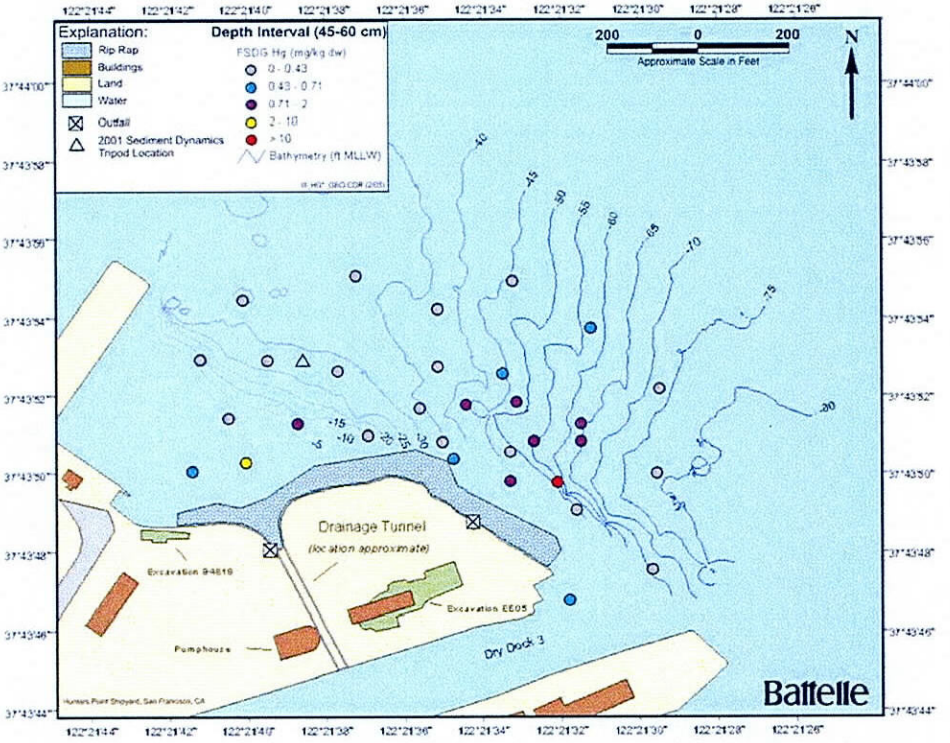


Figure 2-22e. Total Mercury in 45-60 cm Depth Interval, Point Avisadero

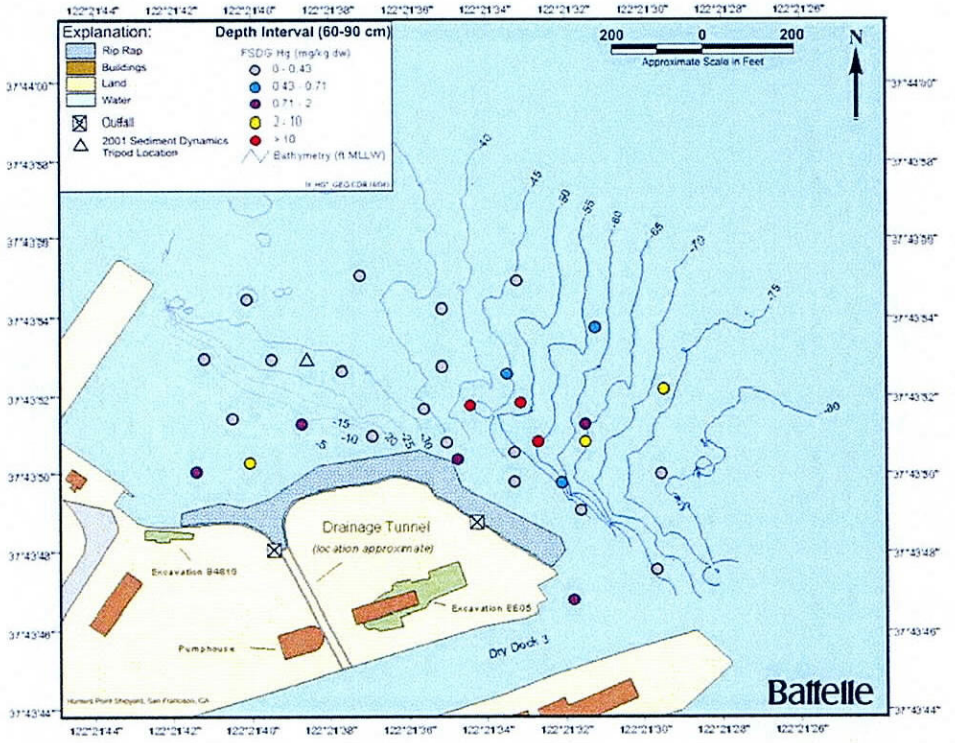


Figure 2-22f. Total Mercury in 60-90 cm Depth Interval, Point Avisadero

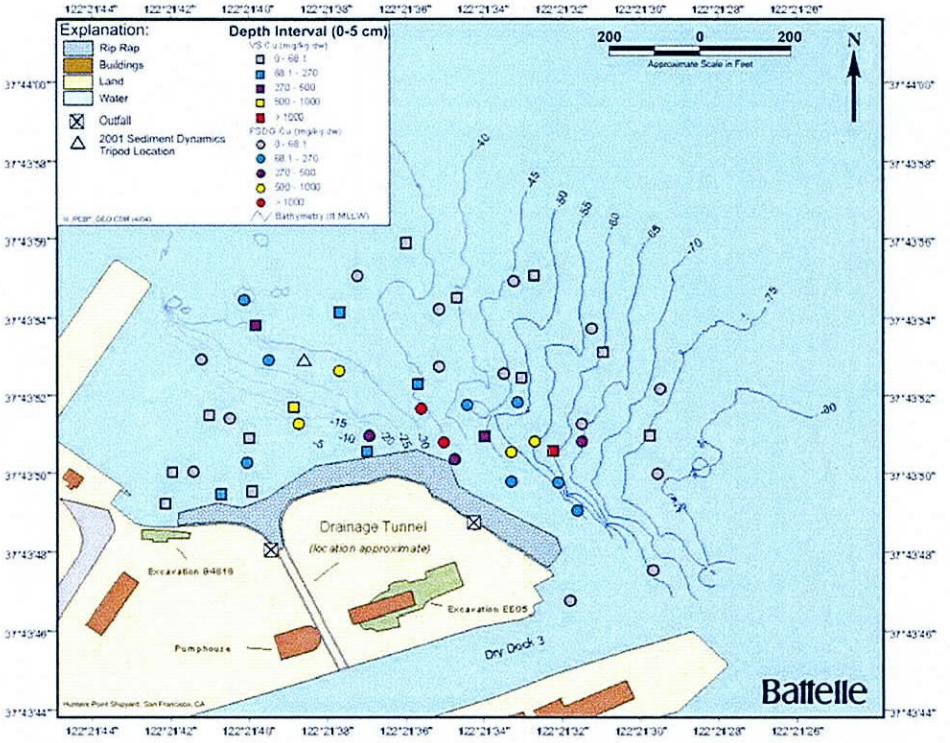


Figure 2-23a. Copper in Surface Sediment (0-5 cm), Point Avisadero

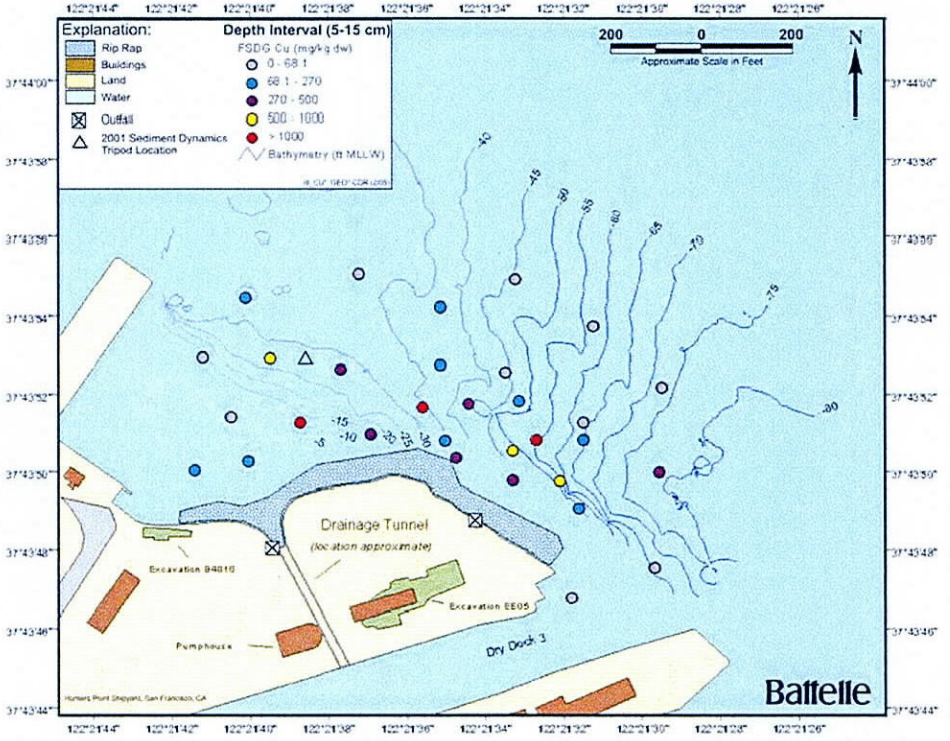


Figure 2-23b. Copper in 5-15 cm Depth Interval, Point Avisadero

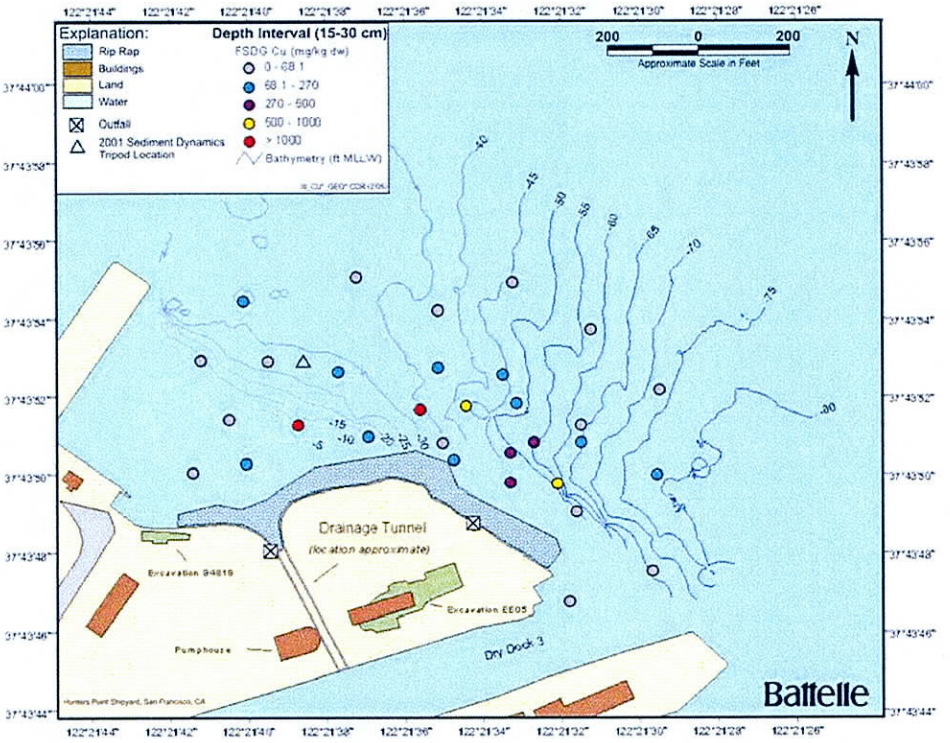


Figure 2-23c. Copper in 15-30 cm Depth Interval, Point Avisadero

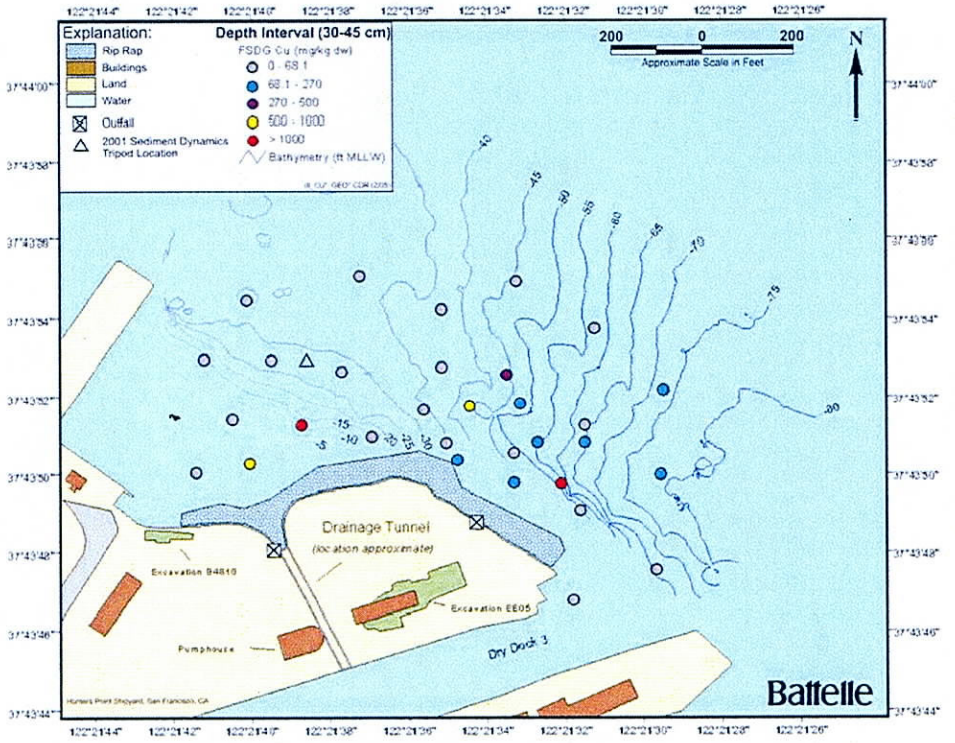


Figure 2-23d. Copper in 30-45 cm Depth Interval, Point Avisadero

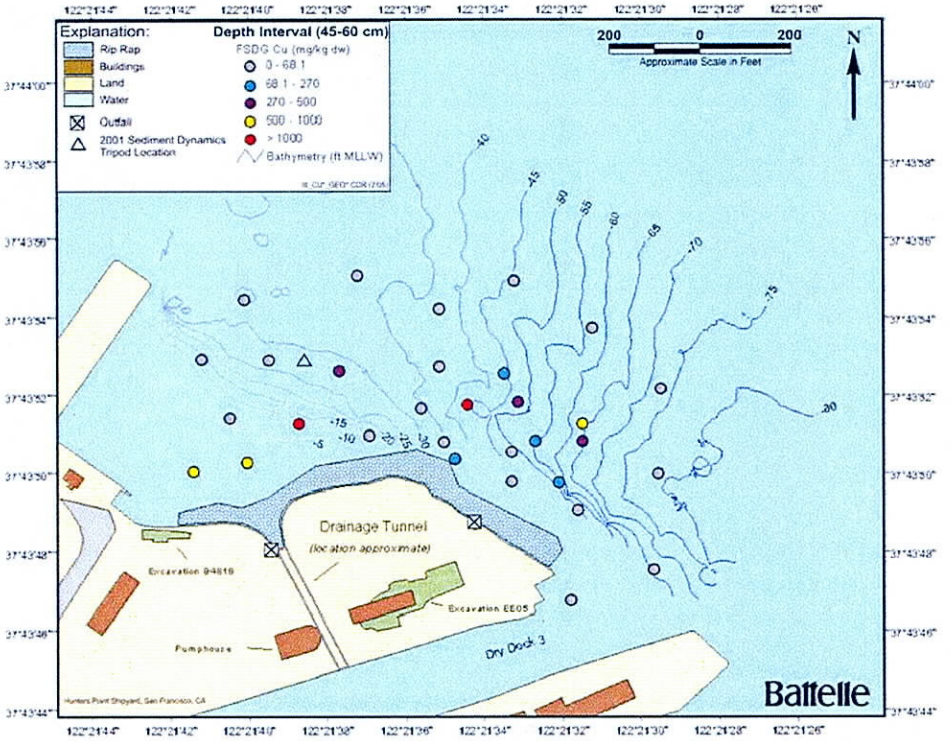


Figure 2-23e. Copper in 45-60 cm Depth Interval, Point Avisadero

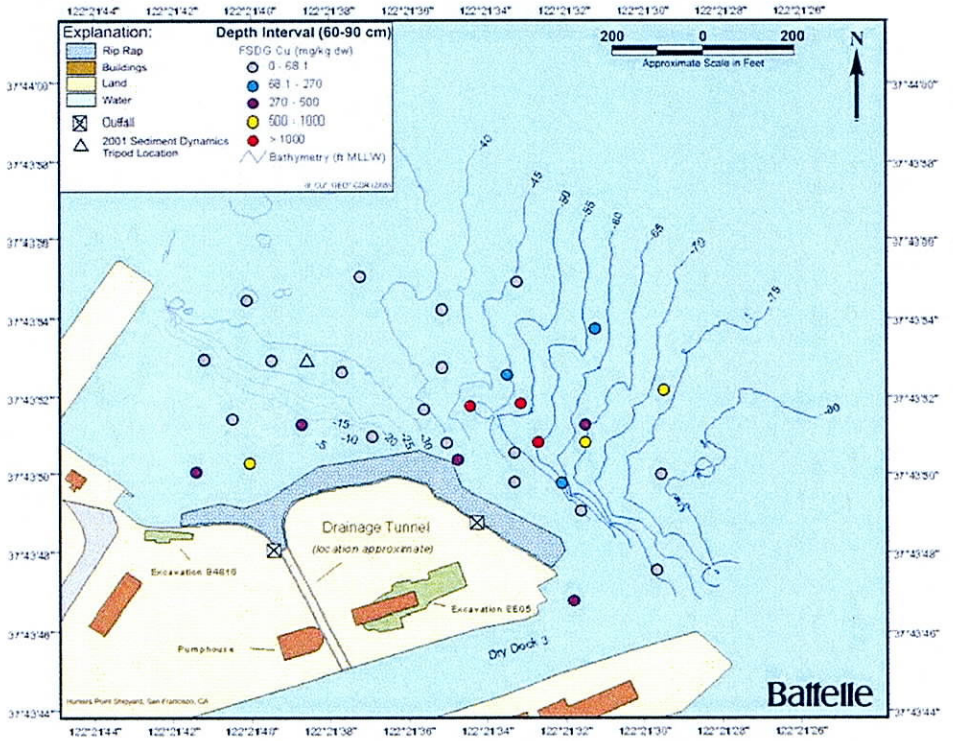


Figure 2-23f. Copper in 60-90 cm Depth Interval, Point Avisadero

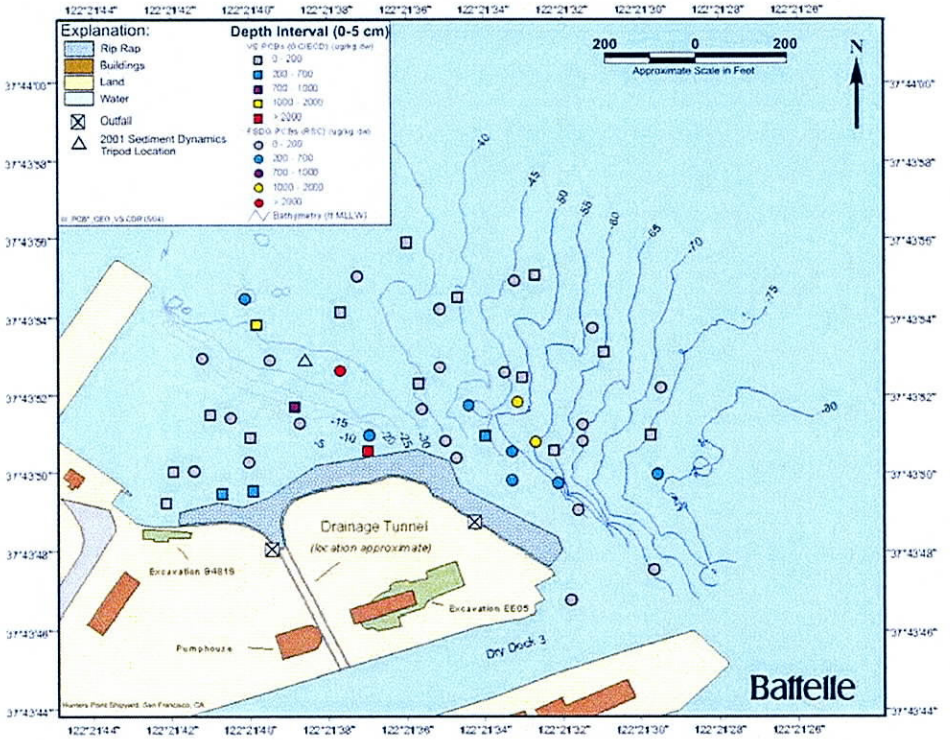


Figure 2-24a. Total PCBs (RSC Method) in Surface Sediment (0-5 cm), Point Avisadero

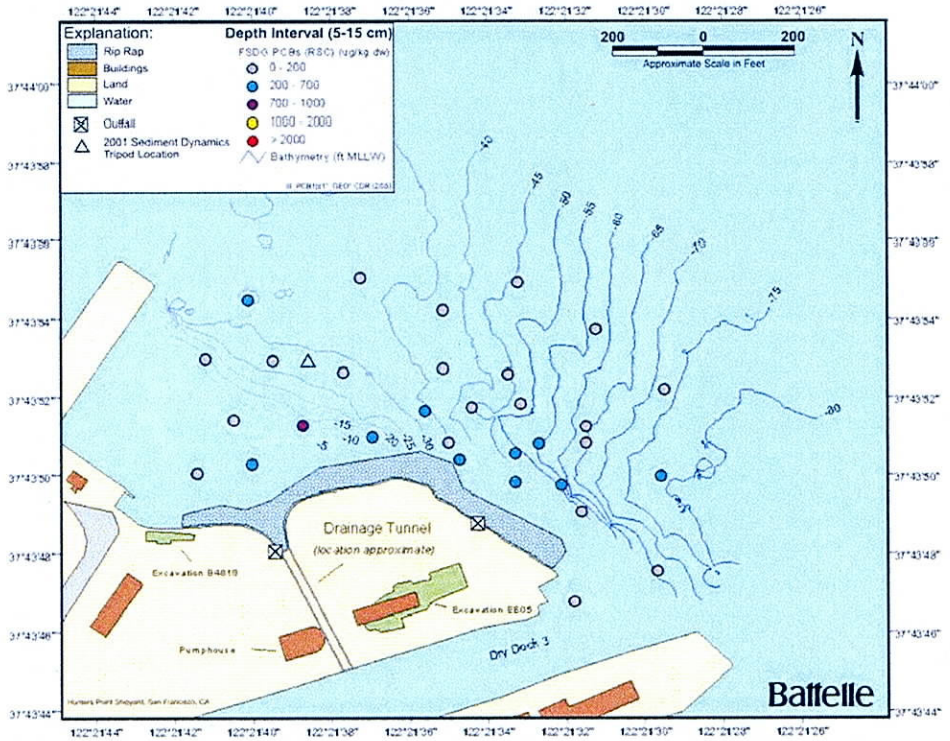


Figure 2-24b. Total PCBs (RSC Method) in 5-15 cm Depth Interval, Point Avisadero

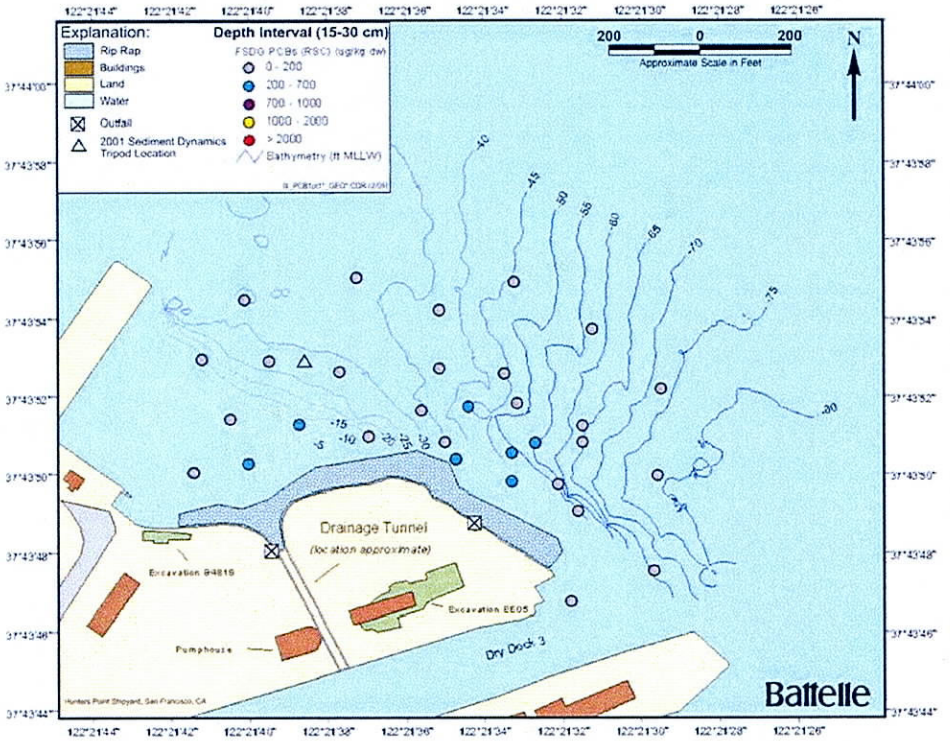


Figure 2-24c. Total PCBs (RSC Method) in 15-30 cm Depth Interval, Point Avisadero

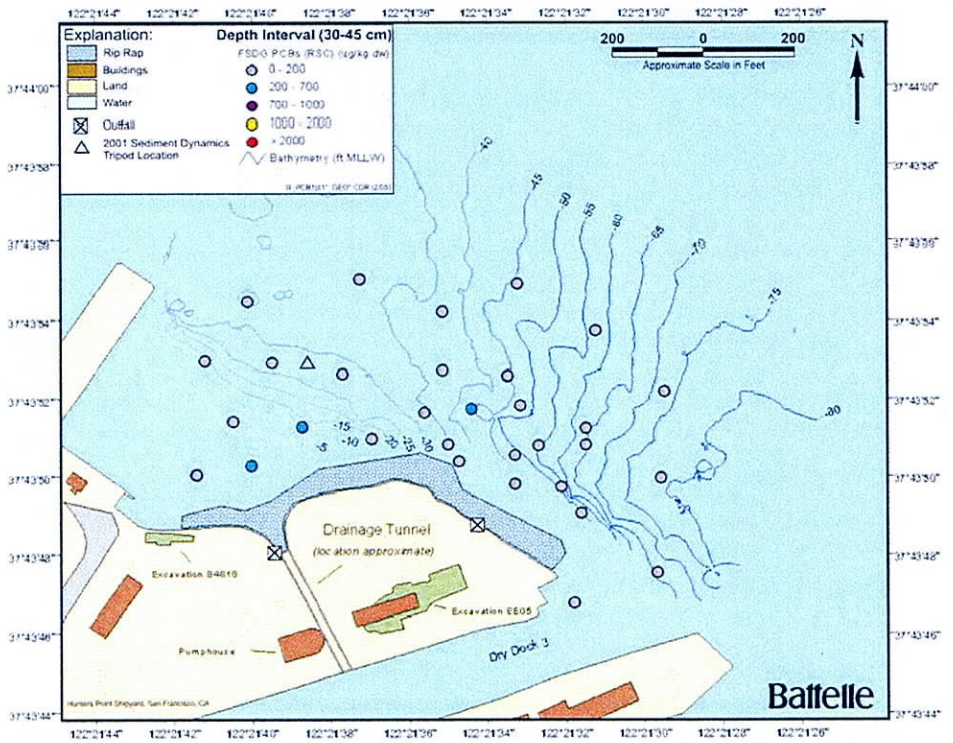


Figure 2-24d. Total PCBs (RSC Method) in 30-45 cm Depth Interval, Point Avisadero

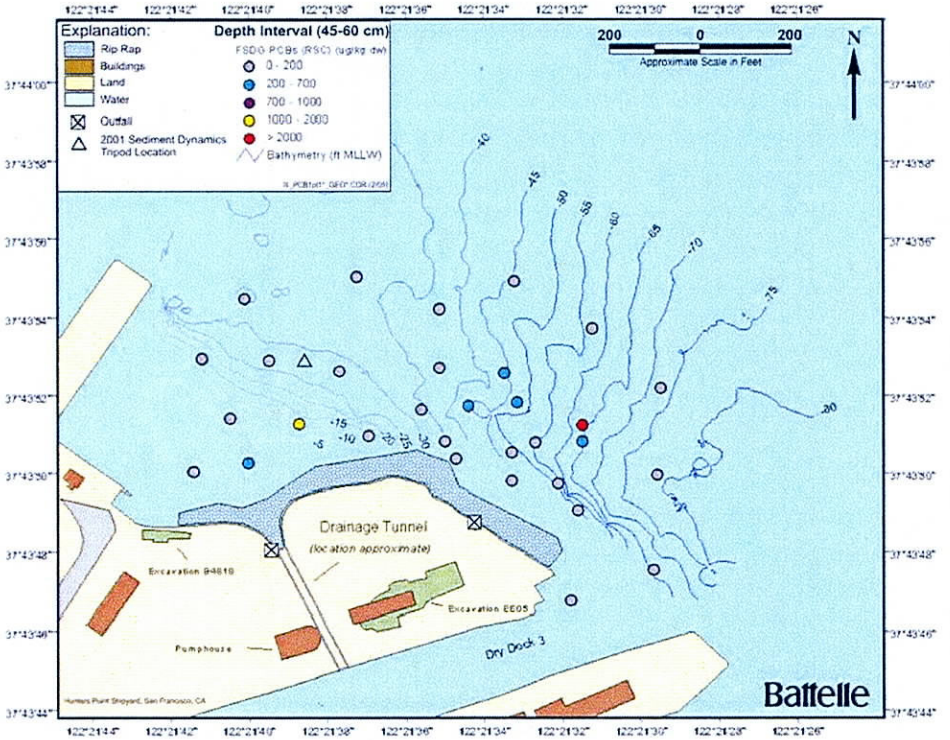


Figure 2-24e. Total PCBs (RSC Method) in 45-60 cm Depth Interval, Point Avisadero

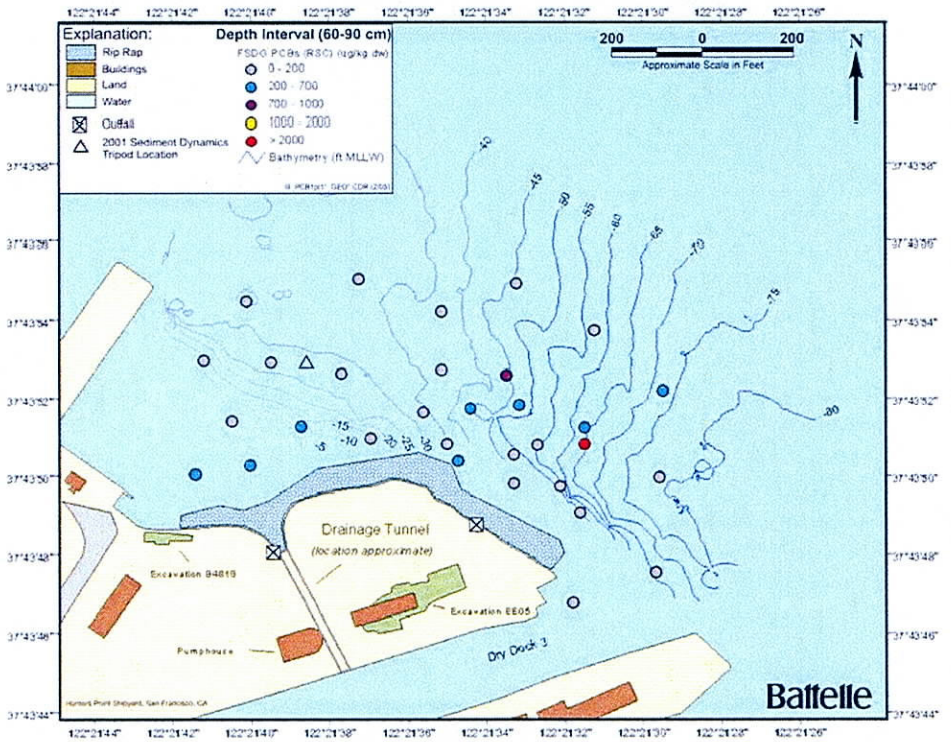


Figure 2-24f. Total PCBs (RSC Method) in 60-90 cm Depth Interval, Point Avisadero

ATTACHMENT 2
HHRA RISK CALCULATION MEMORANDUM
(PREPARED BY BATTELLE)

Battelle
The Business of Innovation

Date April 10, 2006

Battelle calculated a PCB Remediation Goal for human health associated with a consumption of shellfish pathway at Hunters Point Shipyard (HPS), San Francisco, CA.

Task 1. Calculation of Sediment Remediation Goals for Ingestion of Shellfish

Using the risk model developed for the HPS Validation Study (VS) for Parcel F, a PCB RG was calculated using assumptions appropriate for a shellfish ingestion scenario (Table 1).

Table 1. Calculation of Sediment Remediation Goals for Ingestion of Shellfish Scenario

IRshell (kg/day)	FI (unitless)	EF (days/yr)	ED (yrs)	BW (kg)	AT cancer (days)	Risk Level (unitless)	Oral CSF (mg/kg-day)-1	Acceptable Fish Tissue Concentration (mg/kg)	Sediment RG (mg/kg)
0.00213	0.1	365	30	70	25550	$1x10^{-5}$	5	1.54	1.4

For the purpose of this evaluation, the following equations were used:

Acceptable Fish Tissue Concentration = (BW x AT x RL) / (IR_s x FI x EF x ED x CSF)

Where:

BW = Body Weight
AT = Averaging Time
RL = Risk Level
IR_s = Shellfish Ingestion Rate
FI = Fraction Ingested from Source
EF = Exposure Frequency
ED = Exposure Duration
CSF = Cancer Slope Factor

Sediment Remediation Goal = %TOC x FT x MCF/ BAF x %lipid

%TOC = Percent Total Organic Carbon (1.3 unitless)
FT = Acceptable Fish Tissue Concentration (mg/kg)
BAF = Bioaccumulation Factor (1.96 unitless [Tracey, 1996])
% Lipid = Percent lipids in fish tissue (3 unitless)

A summary of the assumptions used to derive each of these exposure parameter values is provided below.

Shellfish Ingestion Rate

For the purpose of the HPS Validation Study (VS) (Battelle et al., 2004), a seafood consumption study conducted by the San Francisco Estuary Institute (SFEI, 2002) was used to estimate consumption rates for shellfish ingestion, resulting in a value of 48 g/day (90th percentile) for the reasonable maximum exposure (RME). As noted in the VS, this value was used to illustrate the potential risks associated with exposures at the site, but, in fact, provides a conservative estimate. Wong (1997) reported that shellfish typically comprises only 5 percent of total seafood consumption among San Francisco Bay anglers. Therefore, for the purpose of estimating remediation goals, 5 percent of the assumed seafood consumption rates reported by SFEI (2002) were used, resulting in shellfish ingestion rates of 0.00213 kg/day.

Fraction Ingested from the Source

For the purpose of evaluating risks in the VS, the fraction ingested from the source was assumed to be 1 for the RME and 0.5 for the central tendency exposure (CTE). Those values were based on the assumption that 100 percent of the shellfish consumed by the RME and 50 percent of the shellfish assumed by the CTE would have been collected from the site. However, because of the nature of the habitat along the shoreline, only limited mussel burrows actually exist at the site and the mussel population may not be large enough to support that level of consumption. Given the abundance of other, more attractive shellfish beds within the San Francisco area, the Fraction Ingested was adjusted down to a value of 0.1 or 10 percent.

Risk Level

To calculate a Remediation Goal it is necessary to define an appropriate risk level for site conditions. EPA guidance (EPA, 1991) stipulates that risk levels fall within the acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$. For the purpose of this evaluation, a risk level of $1x10^{-5}$ was used. This value falls in the middle of the acceptable risk range. In addition, a sediment concentration of 0.2 mg/kg has been proposed by the RWQCB as a reasonable value for the protection of human health based on the consumption of fish. That value reflects a human health risk level of 10^{-4}.

Exposure Duration

An exposure duration of 30 years was used based on recommendations by EPA (1989). This value represents the upper bound residential tenure at a single location.

Body Weight, Averaging Time and Exposure Frequency

These values represent standard, default exposure assumptions recommended by EPA (1989).

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ATTACHMENT 3
DEMONSTRATION PLAN FOR FIELD TESTING OF ACTIVATED CARBON MIXING AND IN SITU STABILIZATION OF PCBS IN SEDIMENT AT HUNTERS POINT SHIPYARD PARCEL F
(PREPARED BY STANFORD UNIVERSITY)

ATTACHMENT 3 – DEMONSTRATION PLAN FOR FIELD TESTING OF ACTIVATED CARBON MIXING AND IN SITU STABILIZATION OF PCBS IN SEDIMENT AT HUNTERS POINT SHIPYARD PARCEL F

THIS ATTACHMENT IS COMPLETE AS SUBMITTED

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Environmental Security Technology Certification Program
(ESTCP)

Demonstration Plan

for

Field Testing of Activated Carbon Mixing and In Situ Stabilization of PCBs in Sediment

at

Hunters Point Shipyard Parcel F
San Francisco Bay, California

December 5, 2005

(Final)

Prepared by

Stanford University

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A: Quality Assurance Project Plan (including Sampling and Analysis Plan)

B: Health and Safety Plan

C: Response To Regulatory Agency And Public Comments On Draft Demonstration Plan

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Acronyms

AC	activated carbon
AEI	Aquatic Environments, Inc.
BDO	Battelle Duxbury Operations
BRAC	Base Realignment and Closure Act
CEI	Compass Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DDT	dichlorodiphenyltrichloroethane
DoD	Department of Defense
EPA	United States Environmental Protection Agency
ERDC	Engineering Research and Development Center
ESTCP	Environmental Security Technology Certification Program
FS	Feasibility Study
HPS	Hunters Point Shipyard
NPL	National Priorities List
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
SERDP	Strategic Environmental Research and Development Program
SPMD	semipermeable membrane devices
TOC	total organic carbon
USACE	United States Army Corps of Engineers
UMBC	University of Maryland Baltimore County

1. Introduction

This demonstration plan is prepared for Dr. Richard G. Luthy of Stanford University, who is the principal investigator of a project that received demonstration/validation (DEM/VAL) funding under the U.S. Department of Defense (DoD) Environmental Security Technology Certification Program (ESTCP). This project will demonstrate and validate an innovative treatment for in situ stabilization of polychlorinated biphenyls (PCBs) in sediment under field conditions at Hunters Point Naval Shipyard. The treatment involves mixing activated carbon (AC) into the PCB contaminated sediment in order to stabilize PCBs and reduce their bioavailability to benthic organisms.

The demonstration plan will describe work to be completed for testing activated carbon mixing and in situ stabilization of PCBs in offshore sediments (Parcel F) at Hunters Point Shipyard (HPS) in San Francisco, CA. In addition to validating the effectiveness of the technology, the demonstration will determine its field costs, assess its regulatory acceptance, and provide an acceptable alternative to dredging and offsite disposal.

1.1 Background

Contaminated sediments pose challenging cleanup and management problems at many DoD sites. In the San Francisco Bay Area, for example, four major Naval Facilities undergoing base closure have contaminated sediments: Hunters Point Naval Shipyard, Alameda Naval Air Station, Moffett Field Naval Air Station, and Mare Island Naval Shipyard.[1] Currently the standard approach to addressing contaminated marine "mud flat" sediments is the expensive ex situ process of dredging and disposal. Finding cost-effective in situ technologies for contaminated sediment management will significantly reduce expenditures on environmental restoration.

The technology being demonstrated is an in situ treatment for sediment contaminated with hydrophobic organic contaminants such as PCBs and polycyclic aromatic hydrocarbons (PAHs). Generally, this technology involves the mixing of AC into the contaminated sediment, which strongly adsorbs the hydrophobic organic contaminants in the sediment. This strong sorption stabilizes and reduces the bioavailability of the contaminants in benthic organisms. This project will demonstrate that AC sorbent mixed with sediment is a cost-effective, in situ, non-removal, management strategy for reducing the bioavailability of PCBs in offshore sediments at HPS in San Francisco, CA.

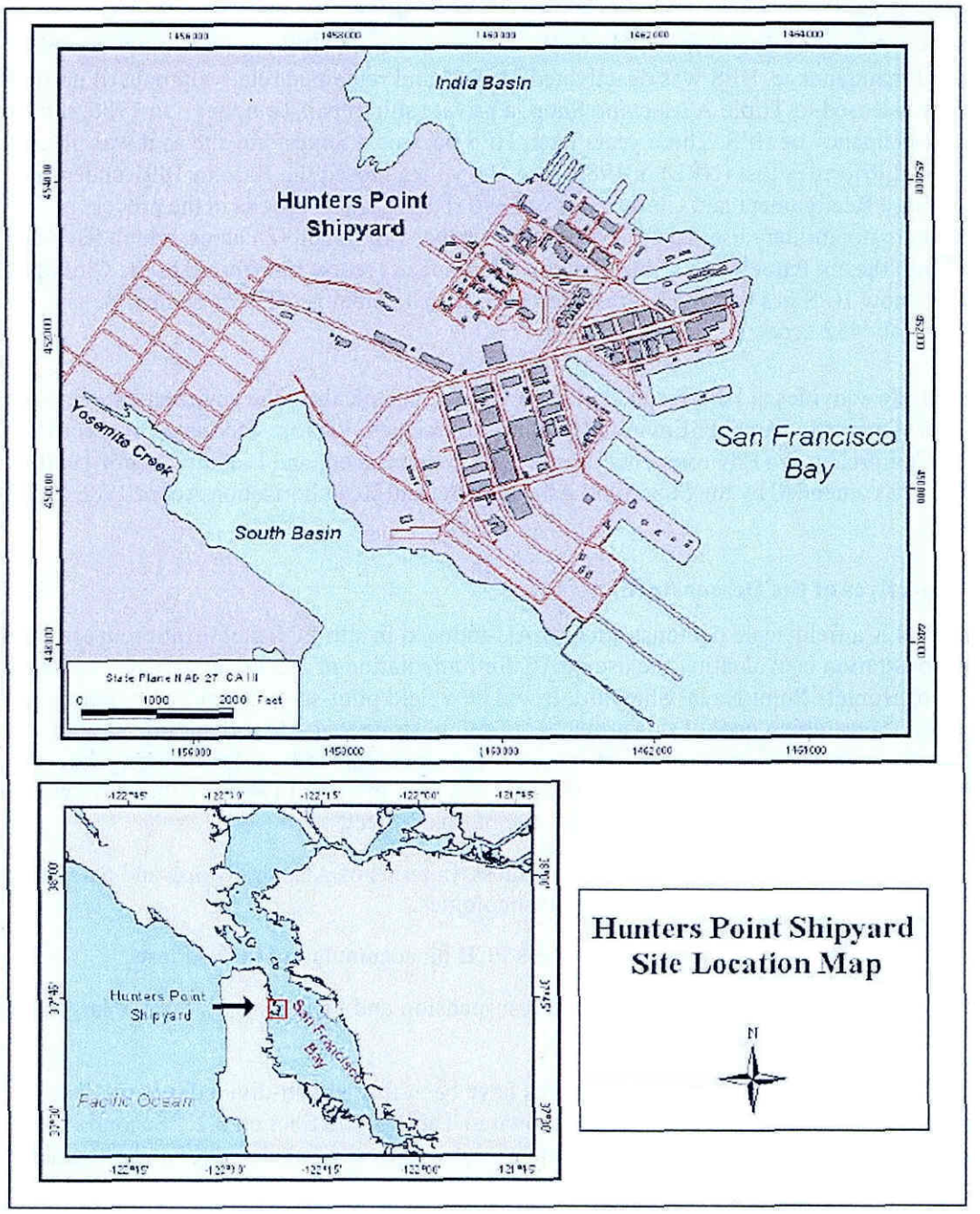

Figure 1-1. Hunters Point Shipyard Site Location Map

HPS is a former Navy installation located on a peninsula in the southeast corner of San Francisco, CA (Figure 1-1). From 1945 to 1974, the Navy used HPS predominantly for ship repair and maintenance. HPS was deactivated in 1974 and remained relatively unused until 1976, when it was leased to Triple A Machine Shop, a private ship repair company. In 1986, the Navy resumed occupancy of HPS. Three years later, HPS became a Superfund site as it was placed on the National Priorities List (NPL) in 1989. The Navy then closed the Base in 1991 under the Defense Base Realignment and Closure Act of 1990 (BRAC). The base is in the process of conversion to nonmilitary use. Historically, HPS consisted of about 928 acres, which have been divided into the six Parcels A-F. Since Parcel A has been recently transferred to the City of San Francisco, now HPS has only 853 acres. Parcel F, which contains offshore sediment, has approximately 432 acres.

Historical site activities at HPS resulted in the release of chemicals to the environment, including offshore sediments in Parcel F. Environmental restoration activities are conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

1.2 Objectives of the Demonstration

This project is a field-scale demonstration of AC-induced in situ PCB stabilization in sediment. The demonstration is evaluating the use of AC for remediation of PCB contaminated sediment at Parcel F of Hunters Point Naval Shipyard. It will be a field pilot-scale operation in a three-year period. The overarching goal of this project is to demonstrate that AC sorbent mixed with sediment is a cost-effective, in situ, non-removal, management strategy for reducing the bioavailability of PCBs in offshore sediments at HPS site. In order to achieve this goal, we have identified three primary objectives for the scope of this project:

- Demonstrate and compare the effectiveness, in terms of AC application and ease of use, of two available large-scale mixing technologies.
- Demonstrate that AC treatment reduces PCB bioaccumulation in field tests.
- Demonstrate no significant sediment resuspension and PCB release after the large-scale mixing technologies are used.

Please note that these three primary objectives have been further sub-divided into the five "primary performance objectives" that are shown in Table 3-1 in Section 3.1. "Secondary performance objectives," which support the primary performance objectives, can be found in Table 4-1 in Section 4.1 and are further discussed in Section 4.2. The performance objectives were sorted between primary and secondary by applying the following logic: If we were unable to meet the expected performance metric for a particular performance objective and that failure had a significant impact on several other performance objectives, then it was deemed as primary. If these two conditions were not met, then the performance objective was classified as secondary. For example, if neither of the large-scale mixing technologies were able to mix in AC

homogeneously down to one foot, this failure in "AC Application" would affect all of the other performance objectives and reduce our chances of achieving our overarching project goal. Thus, the objective of "AC application" was identified as a primary performance objective. As a converse example, if an homogenous AC treatment were found not to reduce PCB bioaccumulation, then it would matter less if it were found that the community structure of the plot was unaffected by the AC treatment. In this way, "Effects of AC treatment on indigenous benthic community" was identified as secondary to the primary "PCB bioaccumulaion in test or indigenous organisms" performance objective.

In addition to evaluating primary and secondary performance objectives, the demonstration project will generate supporting cost and performance data for implementation of the novel sediment remediation technology at DoD sites.

1.3 Regulatory Drivers

Environmental restoration activities at the site are being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

1.4 Stakeholder/End-User Issues

Many DoD sites across the country have PCB-contaminated sediment. Some examples of DoD sites in the San Francisco Bay Area that would benefit from a cost-effective, in situ, non-removal, management strategy for PCB-contaminated sediment are the following four major Naval Facilities undergoing base closure: Moffett, Alameda, Mare Island, and Hunters Point.

2. Technology Description

2.1 Technology Development and Application

Hydrophobic organic compounds such as PCBs, PAHs, and dichlorodiphenyltrichloroethane (DDT) associate with fine-grained, organic-rich, sediment material. This sediment serves as a contaminant reservoir in shallow estuarine and coastal regions from which fish and bottom-dwelling organisms could accumulate toxic compounds that may be passed up the food chain. However, work at Stanford University and elsewhere proposes that hydrophobic organic contaminants in sediment may be of more or less concern depending on how weakly or strongly they are sorbed to sediment organic matter.[2] In recent Strategic Environmental Research and Development Program (SERDP)-funded work with sediment from Hunters Point, San Francisco Bay, the Stanford team found that the PCBs and PAHs in the sediment tend to preferentially accumulate in coal-derived and char particles where the compounds may be strongly bound.[3,4] Building on these observations, the Stanford team proposes to demonstrate a new technology for contaminated sediment management where AC is mixed into sediment. In the proposed field demonstration, AC will be mixed into the sediment with two available large-scale equipment

technologies. This demonstration will also validate that PCBs are repartitioned into the AC by assessing the reduction in biological uptake of these compounds.

2.2 Previous Testing of the Technology

The SERDP-funded laboratory testing of this new, in situ remediation technology using contaminated Hunters Point sediment with PCB levels up to 10 mg/kg has been completed. This upper limit of 10ppm is the highest concentration of PCBs that we have observed in any of the sediment samples collected from Area X of Parcel F. Results from this three-year project are very encouraging and provide a strong basis for technology testing under field conditions. A time line of the development of this technology is shown in Table 2-1. Reductions in total PCB bioaccumulation of 69% by *Macoma* clams, 70% by *Leptocheirus* amphipods, and 82% by *Neanthes* worms were observed in laboratory tests on sediment treated for one month with AC as shown in Figure 2-1.[5] In tests with 6-months contact of AC and sediment, additional reductions in organism PCB uptake were observed (75%, amphipods; 87%, worms), indicating that the benefit to benthic organisms did not diminish and may actually improve with time. In comparison, biomimetic semipermeable membrane devices (SPMD) were used to assess the chemical and biological availability of PCBs and PAHs in sediment and water before and after treatment with activated carbon. AC-treatment for one month reduced SPMD uptake by up to 73% and 83% for PCBs and PAHs, respectively.[4] AC treatment for six months reduced SPMD uptake of PCBs by 77%.

Table 2-1: Technology Development History

Development Phase	Time Frame	Funding Agency	Publications
Discovery of the predominant role of coal and coke on strong sorption of PAHs in sediments	1998-1999	SERDP	6, 7
Discovery of low bioavailability of PAHs sorbed on coal and coke in sediments	1999-2000	SERDP, USACE ERDC	8, 9, 10
Discovery of the predominant role of coal-derived and char particles in the sorption of PCBs in Hunters Point and Milwaukee Harbor sediments	2001-2002	SERDP, Stanford Univ. Graduate Fellowship	3, 11, 12
Demonstration of very low absorption efficiency for a radio-labeled PCB and a PAH on activated carbon in particle-feeding tests with clams	2001-2004	Stanford Univ. Bio-X Research Program	3, 12, 21
Demonstration of reduced PCB aqueous availability from Hunters Point sediment treated with AC	2002-2004	SERDP	3, 4, 12

Table 2-1: Technology Development History (Continued)

Development Phase	Time Frame	Funding Agency	Publications
Demonstration of reduced PCB bioaccumulation in clams, polychaetes, and crustaceans from Hunters Point sediment treated with AC	2002-2004	SERDP	3, 5, 12
Demonstration of reduced PCB bioaccumulation and aq. PCB availability with increased AC dose	2003-2004	SERDP	3, 13
Preliminary field test of commercial equipment's ability to mix carbon into sediment	Fall 2004	NAVFAC	14

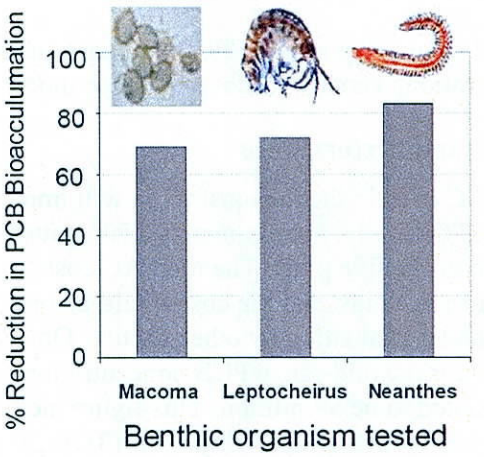

Figure 2-1. Percent reduction of PCB bioaccumulation (28 day exposure after one month AC treatment).

Results from physicochemical tests were similar to those from the biological studies. The total PCB aqueous equilibrium concentrations for sediment mixed with 3.4% by weight AC decreased by 87% and 92% for contact times of one and six months respectively. Adding AC to sediment also reduced aqueous equilibrium PAH concentrations 74% and 84% for one and six month contact periods, respectively.[4]

The effect of AC dose on clam PCB bioaccumulation and aqueous equilibrium PCB concentrations follows a similar trend as shown in Figure 2-2. A carbon dose of about 3 wt. percent produced the greatest reductions.

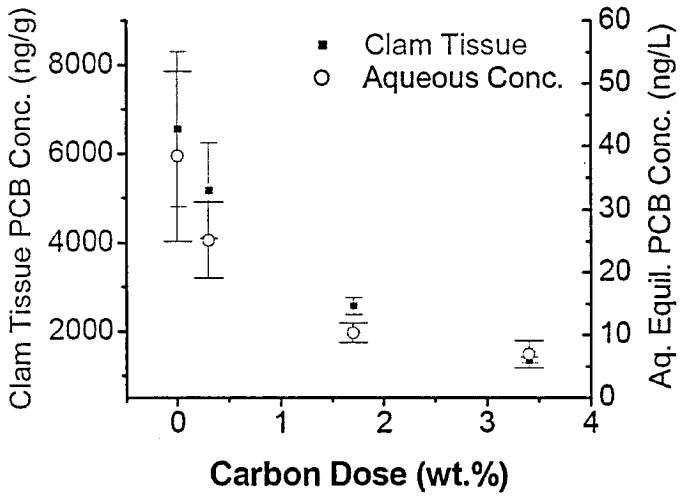

Figure 2-2. *Macoma* clam tissue PCB and aqueous equilibrium PCB concentrations versus AC dose after one month treatment.

2.3 Factors Affecting Cost and Performance

Cost Factors. The grade of AC used in the demonstration will impact the in situ remediation costs. For the scope of the ESTCP study, approximately 2500 pounds of AC will be used for the 3.4 wt.% amendments on two of the five plots. The total AC costs would be $5000 for virgin AC. If regenerated AC could be used instead, the cost would be only $700. The effectiveness of regenerated AC is currently under evaluation by other studies. On a larger scale, the cost of in situ treatment with virgin AC for the mid-range PCB concentration footprint at Hunters Point (200 -2000 ppb PCB) is estimated to be $9 million. This figure includes costs for materials, equipment, and labor to mix a 3.4 wt.% dose of virgin AC (TOG 50 x 200 grade, $2/lb.) to a depth of one foot for a surface treatment area of 1,000,000 ft^2. If the regenerated AC ($0.3/lb) is found to be as effective as virgin AC, then use of regenerated AC would reduce the large-scale costs from $9 to $2 million.

Other factors that may affect the cost are duration of the project, field condition (tidal calendar; weather impact; storm; loss of equipment, samples, and testing clams, etc.), sample collection and laboratory testing.

Performance Factors. The encouraging results that show reductions in PCB bioavailability have been obtained in laboratory tests where the sediment and AC were continuously and homogenously mixed. In the field demonstration, the sediment and AC will be well mixed once

with the large-scale equipment and then benthic activity may provide additional mixing. The differences in the homogeneity and amount of mixing between the lab and field studies may affect how quickly PCB bioavailability reductions are realized. However, if the AC is mixed in homogenously in the field, the relatively fast (less than one month) response observed in the laboratory suggests that even under conditions of less energetic mixing, positive results are likely at relevant time scales in the field.

In this project, we plan to further study the effect that AC has on organism development. Our laboratory studies[5] indicate that the survival rates and lipid content of *Leptocheirus plumulosus* amphipods and *Neanthes arenaceodentata* worms were not affected by addition of 3.4 wt.% AC dose to sediment. In addition, the growth rates of the *Leptocheirus plumulosus* were unaffected; however, a significant and yet unexplained decrease in growth rates of the *Neanthes areneceodentata* was observed in the study. In this demonstration project, we plan to further study the effect AC has on organism development. We will do so by examining the effects of AC on both PCB bioaccumulation in indigenous benthic biota, and on plot recolonization, macrofauna community structure and organism development. These tests are described further in Section 3.6.6.

2.4 Advantages and Limitations of the Technology

Technology Advantages: This treatment technology for contaminated sediments is innovative as it is an in situ process which would circumvent the need to do expensive dredging and disposal. Many DoD facilities across the country are challenged with management of sediments contaminated with persistent organic contaminants such as PCBs, PAHs, and DDT. This work addresses the DoD need for cost effective, in situ remediation technologies for persistent organic contaminants in sediments. The development of this technology for contaminated sediment management offers the potential to significantly reduce expenditures on environmental restoration, as well as gain acceptance by regulators and communities since it does not involve dredging and habitat destruction.

Technology limitations: Our laboratory results suggest that we may achieve a factor of 10 or more reduction in the bioavailability (or effective concentration) of PCBs in the field. We define low-range PCB concentrations in sediment as <1 ppm, mid-range as 1-10 ppm, and high-range as >10ppm. Therefore, if the final cleanup goal is to end up with sediments having an effective PCB concentration of <1 ppm, then sediment having a mid-range PCB concentration (1-10 ppm) would be an appropriate target for AC. We recognize that the final cleanup goal for the Hunters Point site is still in development, yet predict that the application of this in situ technology would most likely be limited to sediment having a low- to mid-range contaminant concentration of total PCBs. Dredging and disposal of hot spot areas with high-range contaminant concentrations would still be appropriate as reductions in effective PCB concentration through AC treatment would not be sufficient. The decision to use the AC in situ technology would be mediated by final cleanup goals for a particular site.

3. Demonstration Design

This project is designed to compare the effectiveness of two available large-scale mixing technologies, demonstrate that AC treatment reduces PCB bioaccumulation in field tests, and demonstrate that no significant sediment resuspension and PCB release occurs after the large-scale mixing technologies are used. Five test plots of 370 ft^2 area will be used in the field study. Various treatments will be applied to four of the five plots, leaving one plot to serve as a main control (several treatment-specific controls are also defined, as described in Section 4.3). The five plots will be analyzed using a combination of statistical tests, once before and twice after treatment. The primary performance criteria that will be used to demonstrate success of this innovative AC treatment technology are listed in Table 3-1.

3.1 Performance Objectives

Table 3-1. Performance Objectives

Type of Performance Objective	Primary Performance Criteria	Expected Performance (Metric)	Actual Performance Objective Met? (Future)
Qualitative	1. Ease of Use (Comparison of Mixing Technologies)	Mobilization to plot, Movement between plots, AC delivery, and Demobilization (These factors will be compared between mixing technologies in terms of ease of use.)	
Quantitative	1. PCB bioaccumulation in test organisms	Significantly lower PCB tissue concentrations for test organisms in AC-amended plots	
	2. PCB bioaccumulation in indigenous organisms	Significantly lower PCB tissue concentrations for indigenous organisms in AC-amended plots	
	3. AC application	Homogenous down to one-foot depth	
	4. PCB Resuspension	No significant differences between experimental and control plots.	

3.2 Selecting Test Site

The following criteria were used to select a suitable test site for successful implementation of the in situ remediation AC treatment technology:

- Sediment should have a mid-range total PCB concentration (1 to 10 ppm),
- Sediment should be cohesive in nature,
- Sediment should be located in an environment with low erosion rates,
- Sediment should be located in a tidal mudflat (so that it can be amended at low tide without the concern of immediate sediment suspension into the water column), and
- Site managers should be amenable to the technology's implementation.

As discussed in Section 2.4, the AC treatment is more appropriate for sediments having a low- to mid-range PCB concentration. Since we hope to obtain a significant analytical signal of PCBs in both our biological and physicochemical measurements even after reductions occur in the PCB availability upon AC treatment, we have set the criteria for site sediment to have mid-range PCB concentrations. Since we have lab evidence that AC remains in cohesive sediments in environments with low erosion rates,[15] we have set these criteria for the site sediment so that AC will stay in place after it is mixed into the sediment.

Using the above criteria, we selected the test site to be the HPS Parcel F tidal mudflat in South Basin for several reasons. First, PCBs have been identified as the major risk driver for HPS Parcel F and most of the sediment in Area X of Parcel F has a mid-range PCB concentration.[22] Second, the combined results of Sedflume experiments[15] on HPS Parcel F sediment and modeling studies[16] indicate that the South Basin area is a net depositional zone and is comprised of cohesive sediments. Third, preliminary field tests indicate that when AC is mixed into the sediment it stays in place due to the cohesive nature of the sediment and the slightly depositional nature of the site. Last, the Navy site managers at Hunters Point have indicated that they hope to use this technology in their final remedial decisions; if they do, technology transfer to other DoD sites should be straightforward. This technology has been discussed with the Hunters Point Base Closure Team and has received favorable comments.

The specific ESTCP demonstration area that has been selected at the HPS Parcel F tidal mudflat in South Basin is shown in Figure 3-1. Results of previous analyses of core samples taken from this area indicate that the sediment in this demonstration area has a concentration of approximately 2 ppm total PCBs, according to the analyses of sediment cores taken in the area. This location is accessible from the shore (Figure 3-2) and away from possible impacts of any potential ongoing PCB releases from the landfill on the north side of the cove.

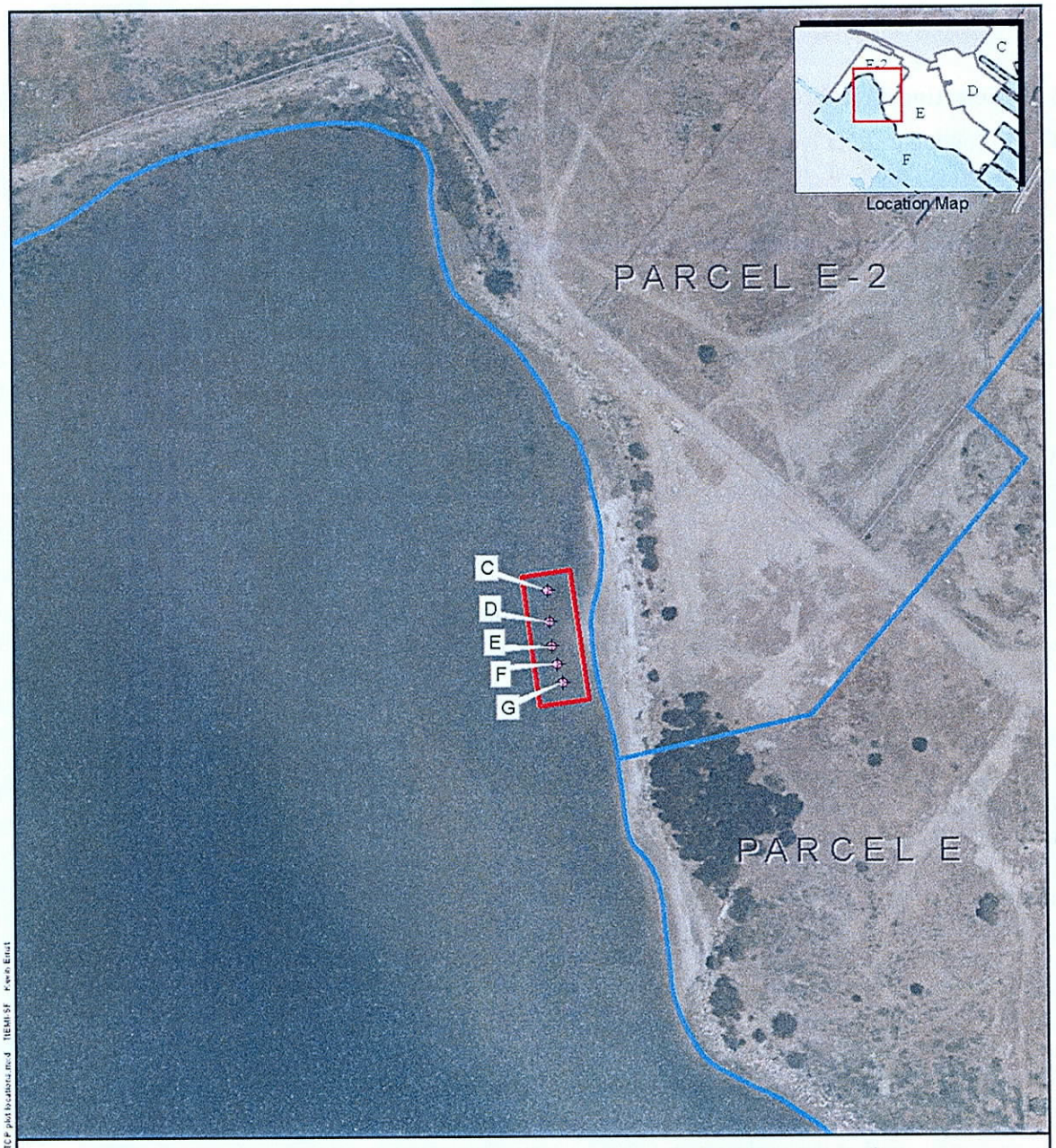

Figure 3-1. Demonstration Area

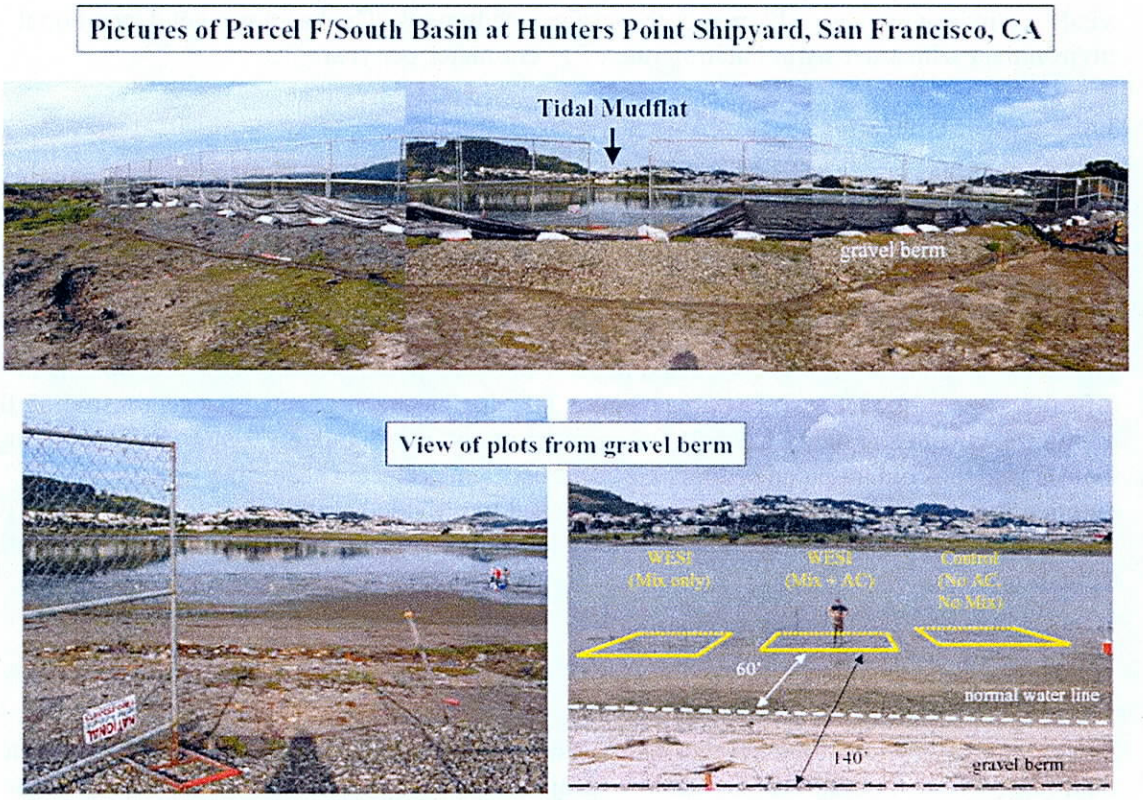

Figure 3-2. Demonstration and Plot Locations

3.3 Test Site History/Characteristics

HPS is a former Navy installation located on a peninsula in the southeast corner of San Francisco, CA (Figure 1-1), which comprises about 928 acres, with approximately 432 acres of offshore sediment. The Navy used the site for maintaining and repairing ships between 1945 to 1974. The facility was deactivated from 1974 to 1976. A private ship repair company, Triple A Machine Shop, leased the facility for its business in 1976 until the Navy resumed occupancy in 1986. It was closed in 1991 under the BRAC and is in the process of conversion to nonmilitary use. Historical site activities at HPS resulted in the release of chemicals to the environment, including offshore sediments. The cleanup of the chemicals is required for the site.

Pictures of the demonstration area are presented in Figures 3-1 and 3-2. The demonstration area is at the HPS tidal mudflat in South Basin. The top four inches of the sediment in the demonstration area is comprised of small gravel, shells, and clay particles. Underneath this top layer, a homogenous layer of clay, characteristic of bay mud, exists. The bulk density of the surface sediment (top 1 foot) is approximately 1.3 to 1.4 g/cm^3. The water depths are from 6 feet to less than 2 feet. Tidal currents are very weak. Because PCBs tend to adsorb to fine-grained sediment particles and organic matter, sediment resuspension and deposition are major contaminant transport pathways in South Basin. However, resuspension events due to storm

winds are infrequent and only impact the surficial sediments. The basin is a net depositional environment with a net sedimentation rate of 1 centimeter per year.[16]

3.4 Present Operations

The site was closed in 1991 under the Defense BRAC. Currently, there is no operation in the selected demonstration area. A feasibility study is underway for the offshore contaminated sediment.

3.5 Pre-Demonstration Testing and Analysis

The site characterization was conducted in 1991 to evaluate the presence of contaminants in offshore areas of the HPS.[17] The area (Figure 3-1) that has been selected for demonstrating the in-situ treatment technology has a PCB concentration of approximately 2 ppm. Before mixing the AC into the contaminated sediment, samples will be collected according to the schedule outlined in Table 3-3 in Section 3.6.7 and analyzed to provide baseline data for each of the five field test plots. This baseline data will be used to evaluate the performance of the demonstrating technology.

3.6 Testing and Evaluation Plan

3.6.1 Demonstration Set-Up and Start-Up

Two contractors with equipment that can be used to deploy and mix AC into sediments in the field scale will work on this demonstration project. The equipment will be used in four of the five plots as indicated in Figure 3-3. The AEI Aquamog will be located on the western side of Plots C and D; while the CEI injector will be located on the shore east of Plots F and G. The shapes of the plots were selected based on the mechanical movements of the mixing arms on each piece of equipment. As shown in Figure 3-3, the Aquamog has an arm that can mix a 6-foot swath and move in a radial fashion for Plots C and D; whereas the CEI injector arm can mix an 8-foot swath but can only move forward and backward on Plots F and G. The five plots have been located along a tide contour line in an attempt to ensure that the benthic communities that exist in these five plots are similar. Preliminary sediment cores taken from the five plots indicate that the sediment has a similar texture across all five plots.

The first contractor, Aquatic Environments, Inc. (AEI), has a barge-like machine (called an Aquamog, Figure 3-4) with a rotovator attachment that is typically used to disrupt weed growth in marshy areas. In the field demonstration, AEI will be responsible for the mobilization, storage, operation, and demobilization of the Aquamog to the Hunters Point Naval Shipyard field site in January 2006. The Aquamog will be deployed on the water during high tide and allowed to settle onto the sediment surface at low tide to do treatments on Plots C and D. AEI will supply an ARGO amphibious support vehicle and any auxiliary equipment to the demonstration site that will be necessary to complete the treatments. Before mobilization of the Aquamog, AEI is also responsible for the design, development, and testing of a delivery system for transferring AC from the deck of the Aquamog to the plot surface. Besides delivering AC to the sediment surface, the Aquamog has a rotovator attachment that will be used to mix transferred AC into sediments in Plot D to an approximate depth of one foot. The depth of the mixing can be

controlled by the speed and downward pressure of the rotovator. The rotovator attachment will also be used to mix (only) the sediments in Plot C to a depth of one foot. Employees of AEI will be responsible for the safe operation of all equipment. Operation of all equipment will occur under the supervision of a field project manager and/or AEI senior management.

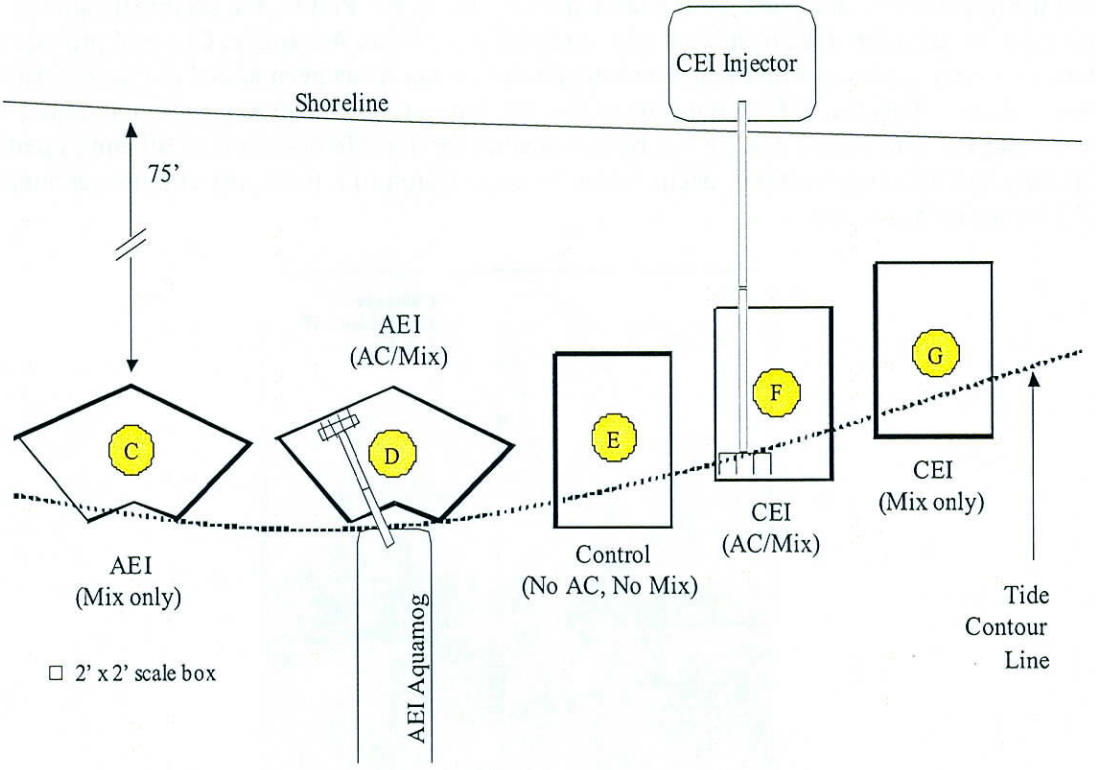

Figure 3-3. Schematic of ESTCP Plots and Mixing Equipment

Figure 3-4. AEI "Aquamog" with rotovator arm

The second contractor, Compass Environmental, Inc. (CEI) (formerly Williams Environmental Services, Inc.), owns an injection system used traditionally for sediment solidification with cement mortar (Figure 3-5). CEI will provide its patented rake injector and other equipment necessary to support the treatments of Plots F and G. This equipment will be located on the shore with the injector arm reaching out to Plots F and G. Via a slurry, AC will be injected and mixed into the upper one foot of tidal zone sediments for Plot F. For Plot G, the sediments will be mixed using the rake injector mixers with no application of an AC slurry. CEI will provide the data necessary to demonstrate that the requisite carbon mass has been added to Plot F. CEI will record data such as slurry flow rate, slurry density, pump time, and slurry volume pumped into each test plot. Employees of CEI will be responsible for the safe operation of all equipment. Operation of all equipment will occur under the supervision of a field project manager and/or CEI senior management.

Figure 3-5. CEI Slurry injection system

Both AEI and CEI will provide their own Health and Safety Plans that are related to their work. Other personnel present at the site and involved in this specific project will follow the Health and Safety Plan in Appendix B.

3.6.2 Period of Operation

The demonstration is a three-year project. The schedule of milestones is provided in Table 3-4 in Section 3.10. The field activities are expected to start in November 2005. A detailed schedule of anticipated dates for the occurrence of the plot treatments and sampling events has been included in Attachment 2 to the QAPP.

3.6.3 Amount/Treatment Rate of Material to be Treated

The PCB contaminated sediments in Plots D and F will be treated by applying a 3.4 wt.% dose of AC and mixing it into the sediment with the AEI Aquamog and CEI slurry injector system,

respectively. The AC dose will be applied to an approximate depth of one foot, corresponding to the biologically active zone. Each plot is about 370 cubic feet in volume and will require approximately 1250 pounds of AC. Therefore, a total of 2500 pounds of AC will be required for this field study.

The dose of 3.4 wt.% activated carbon for the field demonstration was chosen based on the laboratory data presented in Figure 2-2. Though we have not tested greater dose in the laboratory, the trends in Figure 2-2 indicate that the effect of the activated carbon dose on clam tissue PCBs and aqueous equilibrium PCBs begins to level off at 3 to 4 wt.% AC dose. Therefore, since we wish to maximize the effectiveness of the AC dose and minimize the costs of the AC, we believe that a 3.4 wt.% dose achieves this balance.

3.6.4 Residual Handling

There are no residual handling issues for applying AC into the site sediment. The sediment and tissue samples from the demonstration activities will be handled and disposed of by the selected analytical laboratories.

3.6.5 Operating Parameters for the Technology

The operating parameters for the AC treatment technology under field condition requires:

- a one-time treatment of AC into sediment with large-scale mixing equipment
- one skilled and experienced operator is needed to operate each large-scale mixing equipment, with another two people involved in support activities

The monitoring for the AC treatment technology will consist of the following sampling events:

- one pre-treatment sampling event at t = -1 month
- two post-treatment sampling events at t = 6 months and t = 18 months

Sampling and analyses will be conducted before and after AC application in a set schedule as presented in Table 3-3 in Section 3.6.7. The operating and sampling schedules will follow the Experimental Design outlined in Section 3.6.6 and further detailed in the Quality and Assurance Project Plan (QAPP) in Appendix A. Dr. Richard Luthy (Principal Investigator) of Stanford will provide the primary technical oversight to the project. Dr. Dennis Smithenry (Project Manager) will coordinate activities of the project between the project teams. AEI and CEI will be responsible for their respective sediment and AC mixing tasks. Stanford, United States Army Corp of Engineers - Engineering Research and Development Center (USACE-ERDC), and University of Maryland Baltimore County (UMBC) will be responsible for field sampling from the test plots. Ms. Yeo-Myoung Cho will serve as Project Quality Assurance Manager and coordinate field activities and lab analyses for Stanford.

3.6.6 Experimental Design

This project is designed to compare the effectiveness of two available large-scale mixing technologies, demonstrate that AC treatment reduces PCB bioaccumulation in field tests, and evaluate sediment resuspension and PCB release. To achieve these objectives, five test plots of 370 ft^2 area will be used in the field study and analyzed once before and twice after treatments are applied. As discussed in Section 3.6.1, various treatments will be applied to four of the five plots as shown in Figure 3-3, leaving one plot (Plot E) to serve as a main control. Plot C will be treated by mixing the sediment with the Aquamog rotovator, but without applying AC. Plot G will be treated by mixing with the CEI slurry injector system, but without applying AC. Plots D and F will be treated by applying a 3.4 wt.% AC and mixing it into the sediment with the Aquamog and CEI slurry injector system, respectively. The AC dose will be applied to an approximate depth of one foot, corresponding to the biologically active zone. A variety of samples will be taken once before and twice after treatments are applied, as outlined in the schedule in Table 3-3 in Section 3.6.7. The pre-treatment samples will be used to obtain baseline data.

In each of the five plots, five sampling locations have been selected using a stratified random sampling strategy. This sampling strategy ensures that the sampling locations are more evenly dispersed within each plot (that is, as opposed to spatially aggregated, which could occur if simple random sampling was used), and meet the criterion of random sampling so that statistical tests can be applied during data analysis. To obtain the five stratified random sampling locations for a given plot, each plot was divided into five equal sub-areas containing the same number of possible sampling locations. The outside 3-foot edge of the plots was not be included in the selection process to ensure that the sampling locations are located within the actual treatment area. In each sub-area, a random sampling location was selected. The resulting sampling locations are shown in Figure 3-6 for each plot. These same sampling locations for the five plots will be used in all three sampling time points so that pair-wise comparisons can be made over time when appropriate. The total number and types of samples obtained from each plot at each sampling time point is listed in Table 3-2 and illustrated in Figures 3-7 and 3-8.

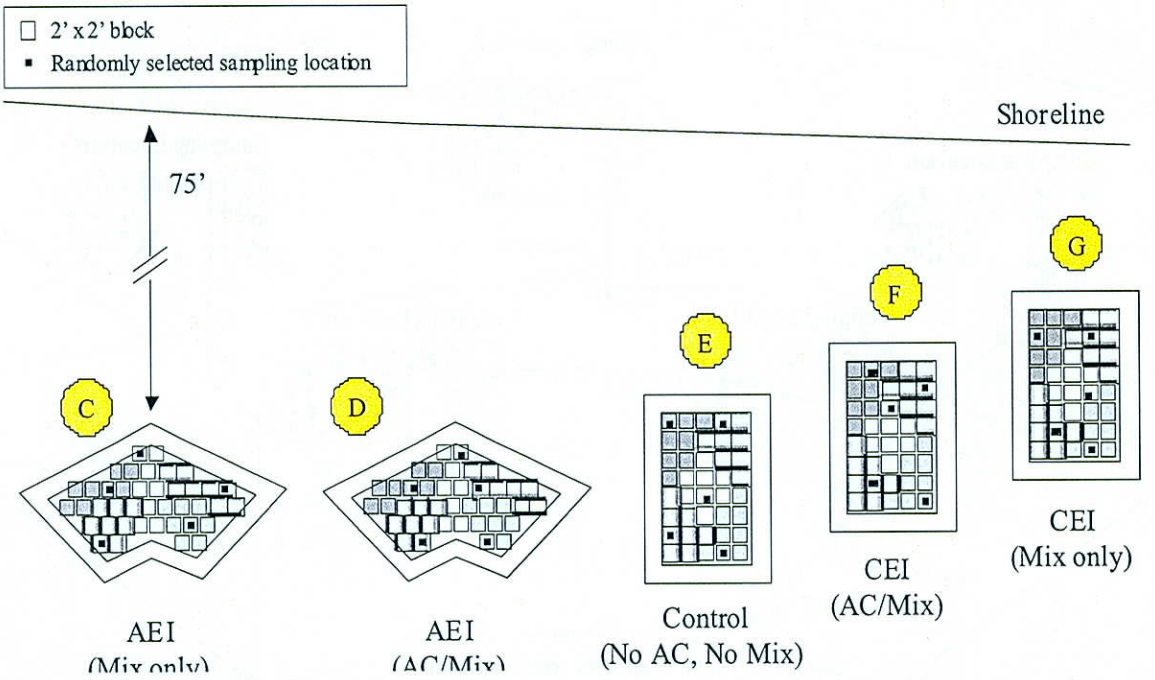

Figure 3-6. Schematic of the Five Sampling Locations (black dots) in Each Plot. These locations were selected through stratified random sampling in both plot shapes. Each sub-area has the same number of possible sampling locations. The outside edge of the plots were not included in the selection process to ensure that sampling locations are located within the actual treatment area.

Table 3-2: Number of Samples Obtained from Each Plot at Each Sampling Time Point

Field Sample Type	Sample Analyses	Sample Amount	Number
Clam Tissue	PCB concentration	composite of 6 clams	5 (each composite will be split between ERDC and BDO)
Amphipod	PCB concentration	mininum 200 mg composite	5 (each composite will be split between ERDC and BDO)
SPMD	PCB uptake	Each	5
Sieved Quadrat	Benthic Community	Each	5
Sediment Core	TOC	1 g	30
Sediment Core	Sediment PCB concentration	5 g	5
Sediment Core	Aqueous Equilibrium PCBs	30 g	5
Sediment Core	PCB desorption characteristics	100 g	2
Overlying Water	Dissolved PCBs	XAD column	2
Overlying Water	Particulate PCBs	Filter	2

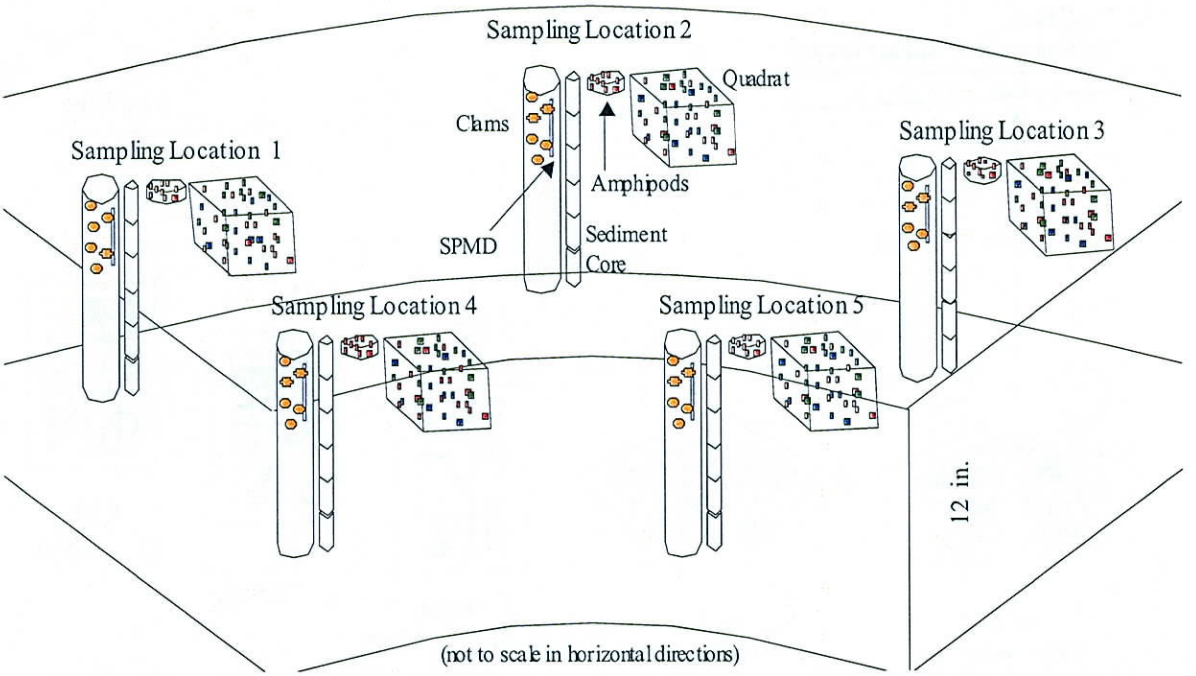

Figure 3-7. Schematic of Samples to be Taken From Each Plot at Each Sampling Time Point.

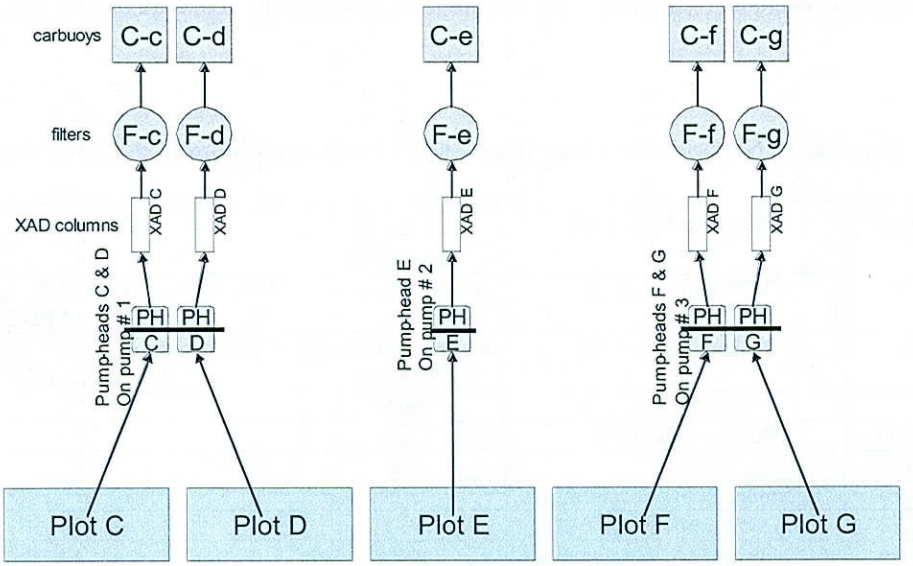

Figure 3-8. Schematic Of Overlying Water Samples From Each Plot. Duplicate samples will be collected from each plot in sequence at each sampling time point.

PCB bioaccumulation will be measured using *Macoma nasuta* clams that are particle-feeding organisms native to San Francisco Bay. As shown in Figure 3-7, six clams will be deployed into each of the five mesh-covered clam tubes (see Figure 3-9) that are sunk into the random sampling locations of each plot as shown in Figure 3-6. As outlined in Table 3-3, at three intervals during the study (1 month pre-treatment, 6 months post-treatment, and 18 months post-treatment), we will deploy clams and characterize their survival and 28-day PCB bioaccumulation. To measure PCB bioaccumulation, living clams shall be removed from tubes and transferred to a vented polyethylene jar. The clams will be transported to Stanford University and allowed to depurate in clean water for 48 hours at ambient temperatures. After depuration, each surviving clam will be shucked and each resulting clam tissue will be placed into a separate pre-cleaned 20 mL scintillation vial. The vials containing a single clam tissue will be immediately placed in a -10°C freezer. Once frozen, the samples will be shipped overnight (on dry ice in a cooler) to ERDC. At ERDC each set of six (or total number surviving) clams that came from a given clam tube will be homogenized and split. Half will be shipped to BDO for archiving*f* at -10°C; while the other half will be analyzed at ERDC. The ERDC split will then be subjected to PCB congener, moisture and lipid analyses.

PCB bioaccumulation will also be measured in indigenous benthic biota. At each of the three sampling time points, five separate surface (0-2 cm) sediment samples shall be collected as shown in Figure 3-7 at the sampling locations in each plot as shown in Figure 3-6, and placed into a separate wide-mouthed polyethylene jar with a vented lid. These jars shall be maintained at <18 °C in a cooler, and transferred to laboratory conditions within 2h of collection where they will be sieved for *Corophium* spp. amphipods. Each sieved sediment sample shall provide at least 200 mg wet weight of amphipods. In the laboratory, the amphipods shall be removed from the sediment using a 500μm sieve and rinsed with clean artificial seawater. Amphipods shall be depurated for 24 h using San Francisco Bay seawater receiving trickle flow aeration in a cold room facility at 15 °C. Following depuration, amphipods from each sampling location shall be removed and weighed by placing them into tarred and pre-cleaned 20 mL scintillation vials. Samples will be immediately frozen. Once frozen, samples will be shipped on dry ice to ERDC for homogenization and splitting. Half of the resulting homogenate sample will be analyzed by ERDC, while the other half will be shipped on dry ice to BDO for archiving at -10°C. Analysis of the PCB concentrations in these amphipod samples will assess the AC treatment effects upon PCB bioaccumulation in a resident benthic population.

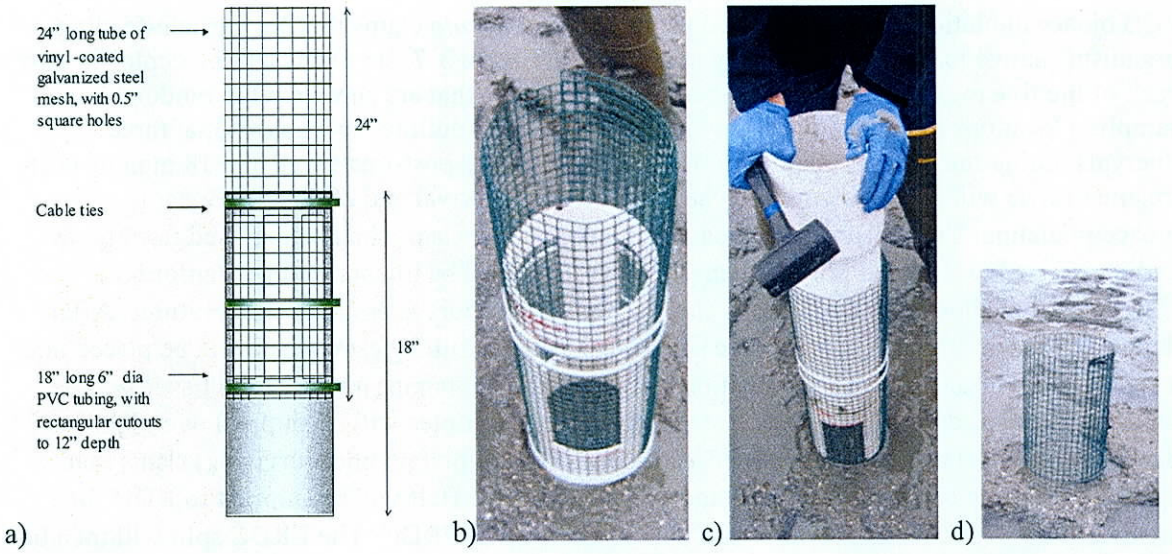

Figure 3-9. a) Schematic of Clam Tube, and b-d) Pounding Clam Tube in Sediment

The effects of activated carbon and mixing techniques on plot recolonization, macrofauna community structure and organism development will be evaluated by assessing benthic community samples obtained from quadrats. At each sampling time point, surface sediment (0-10cm) shall be collected from 0.25-m quadrats taken from the five sampling locations in each plot, as shown in Figure 3-7. Benthic organisms shall be sieved from the quadrats using a 500μm sieve, preserved in 10% formaldehyde solution in the field, and transferred to the laboratory in 500mL polyethylene jars. Once the benthic community samples have been collected, preserved, and stored at 4 °C, they will be shipped to ERDC and subjected to benthic community structure analyses. Once all of the benthic community samples (75) for the entire project have been analyzed, a suite of appropriate univariate and/or multivariate techniques will be used to address both spatial and temporal differences in community structure to isolate treatment effects upon benthic recolonization, community structure, and organism growth. The ERDC team has been in contact with Bruce Thompson, who is a local expert at the San Francisco Estuary Institute, concerning the assessment of the benthic community samples obtained in this project.

A combination of field and laboratory physicochemical tests will assess the homogeneity of the AC treatment and evaluate the effect of activated carbon addition on changes in chemical availability of PCBs in sediment. As indicated in Figure 3-7, a semi-permeable membrane device (SPMD) will be deployed inside each of the clam tubes in each plot before and after treatments to evaluate the in situ availability of PCBs to biota (see Figure 3-10).

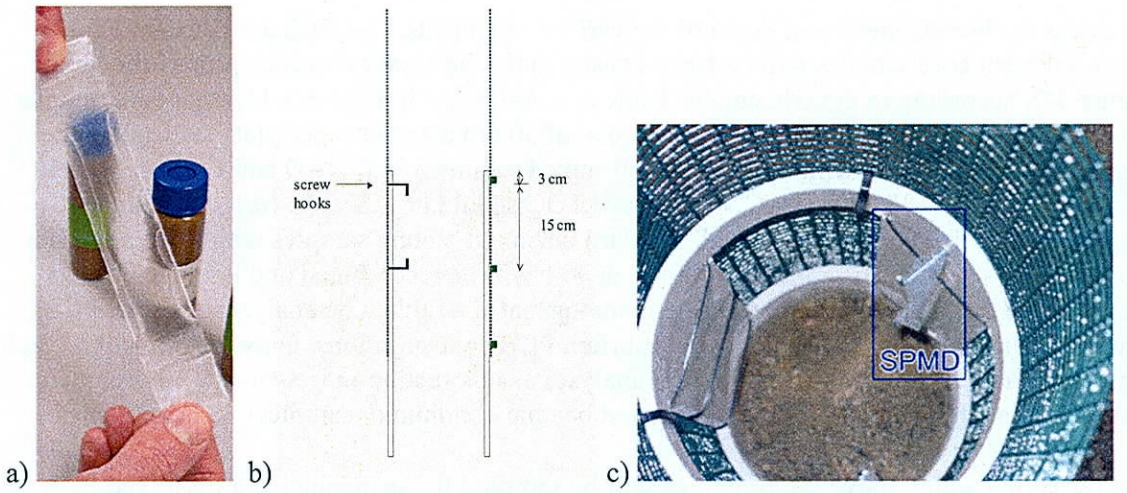

Figure 3-10. SPMDs (a) will be mounted onto screw hooks (b & c) inside of clam tubes.

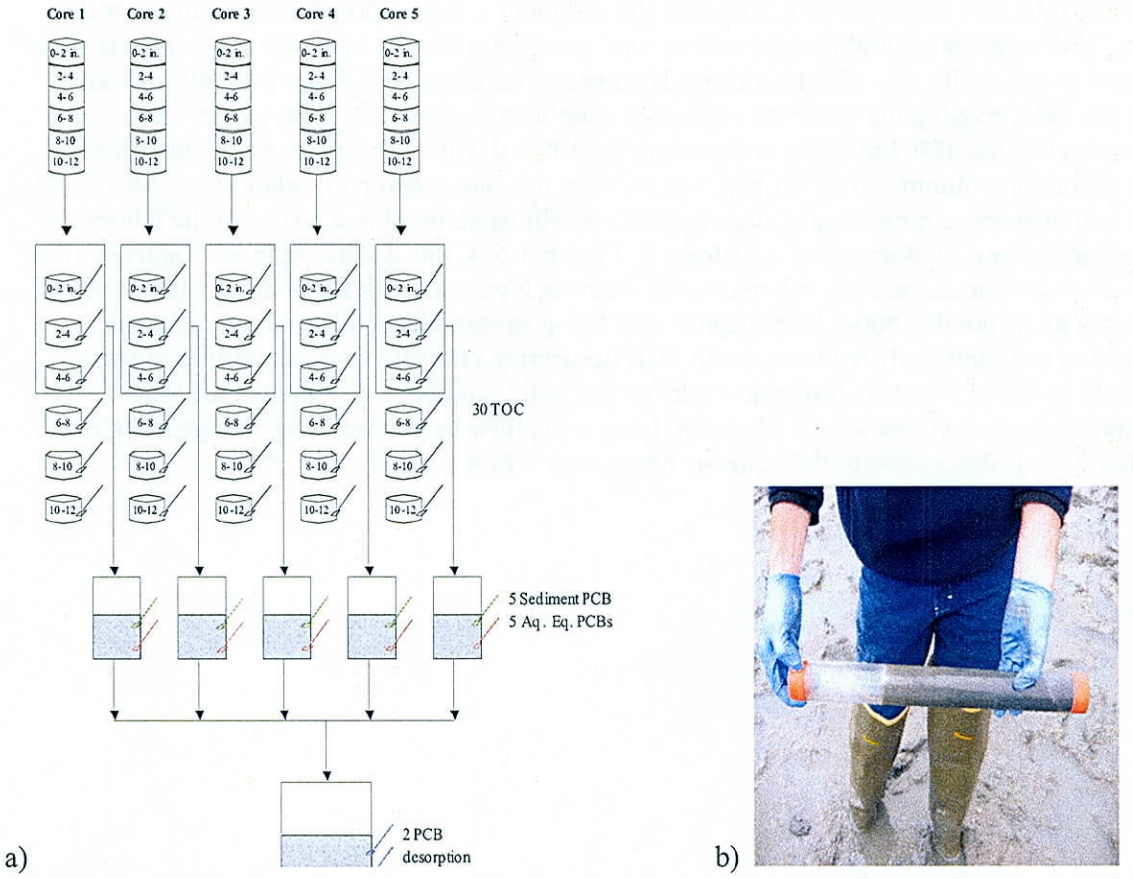

Figure 3-11. (a) Schematic Of Core Sampling In Each Plot And (b) Core Retrieved In Field.

To assess the homogeneity and depth of the various treatments, two-inch diameter (one foot long) sediment core samples will be taken at each sampling location in each plot as shown in Figure 3-7, according to the schedule in Table 3-3. As shown in Figure 3-11, each core sample will be divided into six core cross sections (total of 30 cross sections per plot) to evaluate the degree of carbon mixing with depth. For well-mixed sediment in Plots D and F that receive a homogenous 3.4 wt.% dose of AC, the average TOC should be 3.8 wt.% (original sediment average TOC = 1.0 wt.%) with a small standard deviation among samples within the plot. The top three cross sections (0-6 inches) from each core will be recombined and homogenized as shown in Figure 3-11. Subsamples of these homogenates will then be analyzed for total PCB sediment concentrations and aqueous equilibrium PCB concentrations. Only the top half of each sediment core will be used for future PCB analyses as this section represents the environment that the sampled biota (clams, amphipods, and benthic community samples) will experience.

The overlying water above the five plots will be sampled for suspended and dissolved PCB concentrations during high tide once before and thrice after treatments, as indicated in Table 3-3. During each sampling point, the water above the five plots will be sampled simultaneously so that weather-induced effects will not be an issue as shown in Figure 3-8. The inlet of our sampling tube will be placed at 0.5ft above the sediment surface and submerged under water during high tide. One sampling tube will be used per treatment plot to collect the duplicate water samples (sequentially one after the other). The method involves sampling up to 50L of water from the field, passing the water through a pre-combusted glass fiber filter paper with a nominal pore size of 0.7 microns and passing the filtered water through a pre-cleaned XAD-2 resin adsorbent column. The filter paper containing the suspended particulates and the XAD-2 resin columns containing trapped dissolved PCBs will be shipped in a cooler to the laboratory for extraction and PCB analysis. As shown in Figure 3-6, a 100-g subsample will be taken from each of the five homogenized sediment cores from each plot and will be combined into a 500-g homogenate. From this 500-g homogenate, two 100-g subsamples will be removed for the desorption tests and analyzed to evaluate PCB desorption characteristics according to the schedule in Table 3-3. The desorption tests on the sediment core subsamples will follow previously published methods.[11] These analyses will allow us to assess the change in PCB availability for desorption to the aqueous phase after treatment.

3.6.7 Sampling Plan

A detailed QAPP, which includes the Sampling and Analysis Plan (SAP) is provided in Appendix A. The schedule of plot sampling and analysis is summarized in Table 3-3. A detailed schedule of anticipated dates for the occurrence of the plot treatments and sampling events has been included at the end of Attachment 2 to the QAPP.

Table 3-3: Schedule of Plot Sampling and Analysis

Months Since Treatment (t)	Sampling Description
	Pre-Treatment Sampling
t = -2	• Collect duplicate water samples in the five plots to measure aqueous and suspended particulate PCB concentrations in the water column during high tide.
t = -1.5	• Deploy clams, five replicate enclosures in the five plots. • Deploy SPMDs, five replicates in the five plots. • Take five, two-inch diameter core samples in the five plots for analysis of TOC and sediment PCB concentrations, aqueous equilibrium PCB concentrations, and PCB desorption rates. • Sieve surface sediment quadrats to collect benthic community samples • Sieve surface sediment samples to collect amphipod samples.
t = -0.5	• Remove clams for PCB congener analysis. • Remove SPMDs for PCB congener analysis.
	Mixing and AC Treatments
t = 0	• Apply various treatments to four of the five plots.
	Post-Treatment Samplings
t = 0.05	• Collect duplicate water samples in the five plots to measure aqueous and suspended particulate PCB concentrations in the water column during high tide.
t = 5	• Collect duplicate water samples in the five plots to measure aqueous and suspended particulate PCB concentrations in the water column during high tide.
t = 5.5	• Deploy clams, five replicate enclosures in the five plots. • Deploy SPMDs, five replicates in the five plots. • Take five, two-inch diameter core samples in the five plots for analysis of TOC and sediment PCB concentrations, aqueous equilibrium PCB concentrations, and PCB desorption rates. • Sieve surface sediment quadrats to collect benthic community samples • Sieve surface sediment samples to collect amphipod samples.
t = 6.5	• Remove clams for PCB congener analysis. • Remove SPMDs for PCB congener analysis.
t = 17	• Collect duplicate water samples in the five plots to measure aqueous and suspended particulate PCB concentrations in the water column during high tide.
t = 17.5	• Deploy clams, five replicate enclosures in the five plots. • Deploy SPMDs, five replicates in the five plots. • Take five, two-inch diameter core samples in the five plots for analysis of TOC and sediment PCB concentrations, aqueous equilibrium PCB concentrations, and PCB desorption rates. • Sieve surface sediment quadrats to collect benthic community samples • Sieve surface sediment samples to collect amphipod samples.
t = 18.5	• Remove clams for PCB congener analysis. • Remove SPMDs for PCB congener analysis.

3.6.8 Demobilization

AEI and CEI will be responsible for demobilizing their respective mixing devices after treatments occur. Stanford, ERDC, and UMBC will be responsible for removing any sampling equipment that is used in the test plots. All equipment that has been used in the contaminated sediments will be subjected to a radiation screen prior to decontamination. Decontamination of mixing devices and sampling equipment will occur on site at decontamination pads that have been installed by the Navy.

3.6.9 Health and Safety Plan (HASP)

The health and safety plan is provided in Appendix B.

3.7 Selection of Analytical/Testing Methods

Full details of the primary analytical and testing methods that will be used by Stanford, ERDC, and UMBC in the ESTCP demonstration are presented in Appendix A. A brief summary of the analytical methods is given below.

Stanford will analyze the PCB Uptake in SPMDs, sediment PCB concentrations, aqueous equilibrium PCB concentrations, and TOC in sediment cores. SPMDs will be extracted using a previously published procedure.[4] Sediment samples will be extracted three times with sonication in a 50% acetone and 50% hexane mixture, following a procedure based on EPA Method 3550A. Aqueous equilibrium PCBs will be extracted using a previously published procedure.[4] The resulting extracts will be cleaned up by following EPA SW846 Method 3660A and EPA Method 3630C. PCB congener specific analysis of these extracts will be performed using a modified EPA Method 8082. TOC will be measured on a Carlo Erba NA1500 elemental analyzer at Stanford using a published method.[18]

ERDC will analyze PCB concentrations in clam and amphipod samples. Whole frozen clam or amphipod tissues will be received frozen with no prior homogenization. These tissue samples will be thawed and thoroughly homogenized. Aliquots will be removed for dry weight and lipid determination. The resulting homogenate from each sample will be split into two equal parts. One split will be analyzed by ERDC, while the other will be immediately frozen and later shipped on dry ice to Battelle Duxbury Operations (BDO) for archiving.

The extraction procedure will begin by weighing aliquots of each ERDC split into vials and adding surrogate. Hydromatrix will be added and stirred into each sample. Hexane will be added to each vial with sample. The vials will be shaken to ensure sample is free flowing and has not clumped together. Vials will be placed in ultrasonic bath and sonicated overnight. The extracted samples will be filtered through a funnel containing sodium sulfate and rinsed several times with hexane. The extracts will then be evaporated to approximately 1mL before subsequent cleanup. Extract cleanup will follow EPA Method 3630C. Extracts will be analyzed following EPA Method 8082. Benthic community structure analyses will be done in accordance with EPA Report 823/R-92-006.

UMBC will analyze aqueous and suspended particulate PCB concentrations in field water. Briefly, sample collection involves pumping field water through a pre-combusted glass fiber filter in a stainless steel filter holder to trap suspended particles followed by passing the filtered water through a XAD-2 resin trap in a glass column. The method is similar to the surface water sampling method used in the EPA Lake Michigan Mass Balance Study (http://www.epa.gov/glnpo/lmmb/methods/field96.pdf). The XAD-2 resin and the glass fiber filters will be extracted in a soxhlet extraction system with a 50% acetone and 50% hexane. The soxhlet extraction procedure will follow EPA SW846 method 3540C. The PCB sample will be cleaned up from organic interferences using a deactivated silica gel column following EPA SW846 method 3630C. Sulfur interferences will be removed by contacting with activated copper following EPA SW846 method 3660A. PCB congener specific analysis will be performed using a modified EPA SW846 Method 8082. UMBC will also measure PCB desorption characteristics of field sediments using previously published procedures.[11]

3.8 Selection of Analytical/Testing Laboratory

The Stanford, ERDC, and UMBC laboratories will be conducting the majority of the analyses for the ESTCP demonstration that are described in Appendix A. The names and addresses of these laboratories are listed below:

Stanford University
Department of Civil and Environmental Engineering
Terman Engineering Center, B6
380 Panama Mall,
Stanford, CA 94305

University of Maryland Baltimore County
Department of Civil and Environmental Engineering
Technology Research Center, Room 184
5200 Westland Blvd.
Baltimore, MD 21227

USACE Engineering Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Sample splits of clam tissues and amphipods collected at intervals during the ESTCP project will be archived and may be used at a future time as part of the HPS Feasibility Study (FS). Because the Navy considers the analytical results from these sample splits to be critical data for decision-making at the demonstration site, the splits must be analyzed by a Navy-certified laboratory. The laboratory chosen for this purpose is Battelle Duxbury Operations (BDO). ERDC will be sending sample splits of clam tissues and amphipods to BDO for archiving. The archived samples will be analyzed by BDO if in situ treatment using AC becomes part of an alternative for detailed analysis in the FS. This decision will be made by the Navy Remedial Project Manager (RPM) as part of the FS.

The name and address of this laboratory is:
Battelle Duxbury Operations
397 Washington Street
Duxbury, MA 02332

If it is determined by the Navy RPM that critical data concerning PCB bioavailability is to be generated for this project and the archives are to be analyzed, BDO will utilize the analytical and testing methods that are described in detail in Appendix A.

3.9 Management and Staffing

The demonstration project will be managed by Stanford University. The managerial hierarchy and the relationship between the Principal Investigator (PI), service representatives and the contractors are shown in a wiring diagram (Figure 3-12). The personnel and responsibilities are discussed below.

Non-Federal:

Stanford University (Richard G. Luthy, Dennis W. Smithenry, Yeo-Myoung Cho)
Dr. Richard G. Luthy is the Principal Investigator (PI) for the ESTCP DP. He is a professor at Stanford University whose lab studies support the in situ technology of applying AC to PCB-contaminated sediment. He will provide expertise and guidance to the Project Manager in the development and implementation of the QAPP. His team at Stanford (Dr. Luthy, Ms. Cho, and Dr. Smithenry) is responsible for assessment of proposed carbon application by AEI and CEI, deployment of semi-permeable membrane devices (SPMDs), analysis of sediment PCB concentrations, and analysis of aqueous equilibrium PCB concentrations.

Dr. Dennis W. Smithenry is the Project Manager. Dr. Smithenry, a postdoctoral researcher at Stanford University, is responsible for coordinating field efforts outlined in the QAPP between the various groups involved in the project. He is responsible for overall preparation and coordination of the study planning documents: the demonstration plan, QAPP, and supporting documents. He coordinates technical activities as a liaison between the ESTCP Environmental Restoration Manager, Navy RPM, Stanford PI, Project Health and Safety Officer, Project QA Manager, and NFESC DoD Contracting Officer's Representative. He is responsible for ensuring that communication of all decisions, which impact field or laboratory activities, are dispatched in real time. He is responsible for responding to QA reports and either implementing or requiring corrective action to address systematic problems.

Ms. Yeo-Myoung Cho will serve as Project QA Manager and Physicochemical Studies Leader. She will help the Project Manager develop the QAPP and must approve the final version. She is authorized to stop work if data quality or staff safety is threatened. She is responsible for reviewing the QAPP to ensure that all elements are addressed in adequate detail. She ensures that all SOPs cited in the QAPP are approved and available, and that appropriate training is documented for team members. She verifies that adequate forms and labels are designed for the sampling and analysis effort. She reviews chain of custody (COC) forms to verify that custody is maintained, and conducts field and laboratory inspections as appropriate to ensure that the QAPP

is implemented. In the role of Physicochemical Studies Leader, she will be responsible for assessment of proposed carbon application by AEI and CEI, deployment of semi-permeable membrane devices (SPMDs), analysis of sediment PCB concentrations, and analysis of aqueous equilibrium PCB concentrations.

University of Maryland Baltimore County (Upal Ghosh)
Dr. Upal Ghosh, an Assistant Professor at University of Maryland Baltimore County, will serve as Resuspension Studies Leader. He is responsible for carrying out field water quality tests that will assess if PCB resuspension occurs as a result of mixing the AC into the sediment. He will also conduct laboratory tests that assess the change in PCB availability for desorption to the aqueous phase after treatment. He will implement these tests in coordination with the Project Manager. Dr. Ghosh will be present to assist with and oversee the proper deployment of the two remediation technologies that will be tested at Hunters Point. Dr. Ghosh will assist with the evaluation of the technologies. Dr. Ghosh and his team at UMBC will also assist with technology scale-up and cost estimation for full-scale application. Dr. Ghosh will assist in preparing the ESTCP Cost and Performance Report, ESTCP Final Technical Report, and will be available to make presentations to the user community, regulatory community, and industry.

Aquatic Environments, Inc. (Lance Dohman)
Mr. Lance Dohman will represent Aquatic Environments, Inc. and will be responsible for the mobilization, storage, operation, and demobilization of the Aquamog, an ARGO amphibious support vehicle, and auxiliary equipment to the demonstration site. He will supervise and be responsible for the safe operation of equipment provided and used by AEI employees. He will provide technical assistance in using the Aquamog to treat Plots C and D in the demonstration area.

Compass Environmental, Inc. (Mark A. Fleri)
Mr. Mark Fleri will be responsible for the mobilization, storage, operation, and demobilization of its patented rake injector and other equipment necessary to support the injection of a dose of carbon in the upper one foot of tidal zone sediments at Hunters Point. He will supervise and be responsible for the safe operation of equipment provided and used by CEI's employees.

Tetra Tech EM, Inc. (Glynis Foulk)
Ms. Glynis Foulk of Tetra Tech is the Project Health and Safety Officer. She is responsible for reviewing the project Health and Safety Plan (HASP), ensuring that the field personnel have received appropriate health and safety training for work at the study site, and that the training is documented. She may also conduct inspections during field operations. She reports issues and concerns directly to the Project Manager and has the authority to stop work.

Federal:

U.S. Army Corps of Engineers Engineering Res. and Dev. Center (USACE-ERDC), (Todd S. Bridges)
Dr. Todd S. Bridges will represent ERDC and serve as Bioaccumulation Studies Leader. He is responsible for carrying out field clam bioaccumulation tests that will assess whether the bioavailability of PCBs is reduced by the mixing AC into sediments. He will coordinate and implement these tests in coordination with the Project Manager.

Southwest Division Naval Facilities Engineering Command, NAVFAC (Ryan Ahlersmeyer)
Mr. Ryan Ahlersmeyer will provide access, safety training, practical advice, and logistical support for the field implementation phases of this project at Hunters Point.

NFESC, Port Hueneme (Barbara Sugiyama)
Ms. Barbara Sugiyama will serve as DoD Contracting Officer's Representative to help prepare the full proposal and Phase II briefing. Ms. Sugiyama will take care of contract issues between Stanford and the ESTCP office.

3.10 Demonstration Schedule

The key tasks and the proposed timeline are shown in Table 3-4. Development of a draft Demonstration Plan will be done in cooperation with NAVFAC in April and May 2005, as we did in Fall 2004 for the Treatability Study Work Plan for Hunters Point Shipyard Parcel F.[14] The draft Demonstration Plan will be submitted in July 2005 to ESTCP for first review. At the end of August 2005, the Demonstration Plan will be revised based on ESTCP comments and resubmitted for ESTCP's second review. Once this review is complete and comments are addressed, the Demonstration Plan will go out in early September 2005 for review by area regulatory agencies such as Environmental Protection Agency (EPA) Region 9, California Department of Toxic Substances Control (DTSC), San Francisco Regional Water Quality Control Board (SFRWQCB), and National Oceanic and Atmospheric Administration (NOAA). The regulatory agencies' comments will be addressed and the Demonstration Plan will be sent to ESTCP for final review and approval by the middle of October 2005. Pre-GAC treatment sampling will take place in November and December 2005, with plot treatments occurring in January 2006.

In addition to the Demonstration Plan document, monthly financial and quarterly progress reports to ESTCP will be prepared. Once data analyses are completed in September 2007, drafts of the Final Report and Cost & Performance Report will be prepared for a November 2007 submission. Review and approval of these reports should be complete by December 2007.

ATTACHMENT 4
PCB FLUX MODEL DESCRIPTION
(PREPARED BY SEA ENGINEERING, INC.)

PCB Flux Model
Description

Prepared by:
Sea Engineering, Inc.
200 Washington Street, Suite 210
Santa Cruz, Ca 95060
Tel: (831) 421-0871
Fax: (831) 421-0875

Model Description

The following model is outlined in detail in Lick and others (2003). Basic to the present model of the flux of hydrophobic organic chemicals (HOCs) between bottom sediments and the overlying water is the adsorption and desorption of HOCs (especially those with high partition coefficients) between sedimentary particles/aggregates and the surrounding water are often slow, with equilibration times as long as weeks to years. This is especially true for HOCs with large partition coefficients, K_p (liters per kilogram [L/kg]), where K_p is defined as

$$K_p = \frac{C_s}{C_w} \tag{1}$$

where C_s (milligrams per kilogram) is the concentration of the chemical sorbed on the solids and C_w (milligrams per liter) is the concentration of the chemical dissolved in the water. Both experiments and theory have demonstrated this repeatedly (see Karickhoff and Morris, 1985; Jepsen and Lick, 1996) and have also demonstrated that, as K_p increases, the sorption rate decreases and the sorption time increases.

For particles/aggregates, a quantitative model of the sorption process was developed by Wu and Gschwend (1986) and later extended by Lick and Rapaka (1996). In this model, the transport of the chemical within the particle/aggregate is described by a time-dependent diffusion equation in spherical coordinates with no reaction terms, but with an effective diffusion coefficient given by

$$D_e = \frac{D_m}{1 + \left(\frac{1-\phi}{\phi}\right)\rho K_p} \tag{2}$$

where D_m (square centimeters per second [cm^2/s]) is the molecular diffusion coefficient of the chemical in the pore water of the particle, without consideration of any reactions but corrected for tortuosity; ϕ is the porosity of the particle; and ρ is the mass density of the solid particles (approximately 2.6 grams per cubic centimeter).

With the loss of some detail and accuracy, a simpler and computationally more efficient model was later developed (Lick and others 1997). In this latter model, it is assumed that the time rate of change of the average contaminant concentration in the sediment particle or aggregate due to the transfer of the contaminant from the water to the solid is given by

$$\frac{dC_s}{dt} = -k(C_s - K_p C_w) \tag{3}$$

where $k(s^{-1})$ is a mass transfer coefficient that can be approximated by

$$k = \frac{D_e}{0.0165 d^2} \tag{4}$$

where d is the diameter of the particle/aggregate in centimeters.

The fluxes due to molecular diffusion of several HOCs into and out of consolidated bottom sediments have been investigated both experimentally and theoretically by Deane

and others (1999). Good agreement with the experimental results was apparent in this study.

This model has been simplified and has also been extended to include bioturbation (Lick, 2002a, 2002b; Lick and others 2003). The physical effects of bioturbation are approximated as a diffusion of solids and water with an effective diffusion coefficient due to bioturbation of D_b. The diffusion coefficient for contaminants sorbed to solids, D_s, is then given by D_b, while the diffusion coefficient for the contaminant dissolved in pore waters, D_w, is the sum of D_m and D_b, where D_m is the molecular diffusion coefficient for the contaminant in water. In general, D_b depends on depth in the sediments with its maximum value at the surface and decreasing with depth with a characteristic length scale, x_b, on the order of 5 centimeters (cm) for fresh water organisms and on the order of 10 cm or more for organisms in seawater. As a first approximation, D_b can be expressed as $D_{bo}\ e^{-x/x_b}$, where D_{bo} is the value of D_b at the surface. This approximation produces bioturbation profiles consistent with the observations and previously developed models (U.S. Army Corps of Engineers 2001)

With these approximations and including molecular diffusion, bioturbation, time-dependent sorption as described by Equation (2), and one size sediment aggregate, the one-dimensional, time-dependent mass conservation equation for the contaminant dissolved in water (per unit volume of total sediment) is

$$\phi\frac{\partial C_w}{\partial t} - \phi\frac{\partial}{\partial x}\left(D_w\frac{\partial C_w}{\partial x}\right) = (1-\phi)\rho k(C_s - K_p C_w) \qquad (5)$$

while the conservation equation for the contaminant sorbed to the solids (again per unit volume of total sediment) is

$$(1-\phi)\rho\frac{\partial C_s}{\partial t} - (1-\phi)\rho\frac{\partial}{\partial x}\left(D_s\frac{\partial C_s}{\partial x}\right) = -(1-\phi)\rho k(C_s - K_p C_w) \qquad (6)$$

where ϕ is the porosity of the sediments. The flux of contaminant between the sediments and the overlying water due to diffusion of the dissolved contaminant is given by

$$q(t) = -\phi D_w\frac{\partial C_w}{\partial x}(0,t) \qquad (7)$$

It is assumed that there is no flux of contaminant from the solid particles directly into the overlying water. The surface flux is only due to release from the pore water.

Model Inputs

The two basic data types required for the setup and use of the flux model are the initial condition (that is,. concentration of polychlorinated biphenyls [PCB] in the sediment bed) and the sediment, chemical, and biological properties. For application of the model in South Basin, high resolution vertical PCB cores were obtained and analyzed for 45 congeners. To apply these data sets, surface PCB concentrations were contoured throughout South Basins, so regions of relatively similar concentrations could be defined and bounded. Using these contours, six different regions of PCB concentrations were defined in South Basin. These regions were concentrations above 700 micrograms per kilogram (μg/kg) (area 1), between 500 and 700 μg/kg (area 2), between 250 and 500

μg/kg (area 3), between 200 and 250 μg/kg (area 4), and below 200 μg/kg (area 6). Additionally, area 5 was selected separately to represent the regions of PCB concentrations above 250 μg/kg in the mouth of Yosemite Creek. The areas are shown in Figure 3 in the main text. Each of the four fine interval cores was assumed to be representative of the first four areas. The final two areas did not have detailed core data; therefore, Rapid Sediment Characterization (RSC) cores were used to specify the total PCB profiles in these areas. This distribution coupled with the total PCB profiles in the cores was used to define the initial model conditions. Figure 3 in the main text shows the final distribution of modeled areas.

The key properties required for flux modeling in South Basin once the initial conditions have been defined are as follows:

- Sediment/water partition coefficients representative of the specific PCBs on site
- Rates and depths of bioturbation
- Deposition rates
- Sediment porosity

The congener-specific PCB concentrations from the detailed cores were used to identify the congeners where the peak PCB concentrations occurred. Studies previously conducted by Zimmerman et al. (2004) determined site-specific sediment partition coefficients for the South Basin sediments. The average partition coefficient for the highest concentration congeners observed in the detailed cores was used for areas 1 through 4. The three congeners selected as representative of the PCB peak in these four areas were PCB-153, PCB-138, and PCB-149. The congener distribution based on confirmatory sampling during the Parcel F feasibility study data gap investigation was used to define the partition coefficients for areas 5 and 6. The area 5 partition coefficient was defined using PCB-177, PCB-138, and PCB-187 and the area 6 partition coefficient was defined using PCB-153, PCB 149, and PCB-180. Table A.1 shows the partition coefficients measured for each PCB. These partition coefficients were averaged for each area based on the PCBs present and assumed to be representative of the total PCB behavior in that area.

Table A.1 Partition coefficients used to describe each area in South Basin.

Area	PCB Congener	Partition Coefficient (L/kg)
1 - 4	153	250345
	138	257646
	149	190495
5	177	556107
	138	257646
	187	463230
6	153	250345
	149	180495
	180	692616

The bioturbation parameters were determined from the U.S. Army Corps of Engineers document on the proper selection of bioturbation rates and depths (2001). The depth of bioturbation is assumed to exponentially decrease with depth using a length scale of 10 cm. The bioturbation model is described in the previous section. The diffusion due to bioturbation was defined as $5x10^{-7}$ cm^2/s. This is the average value reported in the by Wheatcroft and Martin (1994) for cohesive sediment regions on the California coast.

From the radioisotope cores, South Basin was determined to have a net sediment deposition rate of ~ 1 centimeter per year (cm/yr) with a lower limit of 0.7 cm/yr. Since the data for South Basin does not extend beyond mean lowest low waterMLLW, a conservative site wide estimate was used. A deposition rate of 0.5 cm/yr was used in the modeling effort. The incoming sediments were assumed to be input from Central San Francisco Bay. Based on sediment trap data averaged over three deployment periods from Station SB-120 at the mouth of South Basin, the PCB concentration on the incoming sediments was assumed to be 121 μg/kg. The sediments porosity was assumed to be the average of all of the Sedflume cores taken throughout South Basin (sediment porosity = 0.57).

With the initial PCB concentrations and all of the sediment, chemical, and biological properties defined throughout South Basin, the model was run for 100 years. The data are presented at 0, 1.5, 3, 10, 30, 50, and 100 years in the main text.

Model Uncertainty

Model uncertainty results from the specification of the initial condition and the site-specific properties defined. Uncertainty is present in the PCB concentration specification of the initial conditions. South Basin is split into six distinct areas. It is assumed that the PCB profile in each of these areas varies relatively little. By calculating the average PCB concentration at each location within a given area, variations by as much as 200 percent in the average total PCB concentration can be seen. These variations are due to large differences in the magnitude of the deeper PCB peaks at each location. Since much of the focus is on the behavior of the surficial sediments and their evolution over time, this large average concentration discrepancy due to the deep peaks does not contribute significantly to the surficial concentrations. This can be seen in the vertical profile plots shown in Figures 4a through 4d in the main text. These large discrepancies are also confined to areas 5 and 6 where the PCB contribution is relatively low.

Partition coefficients were determined from directly measured values from the Zimmerman et al. (2004) work. These provide a site-specific data set for the sediments of interest and uncertainty in the model that only results from their final application. The model was used to only simulate total PCB flux for each location. Specific congeners were not modeled, since congener profile data were not available in all of the areas; therefore, not enough information exists beyond the four detailed cores to complete a site-wide congener specific model. The average partition coefficients used for each area are based on the three maximum PCB peaks observed in each core. The average partition coefficient models the total PCBs as a single concentration with a behavior approximating the bulk of the PCBs present. Uncertainty arises from lower partition

coefficient congeners being released more easily while higher partition coefficient congeners will tend to be more persistent in the sediments. An example calculation is shown for location SB-099, representing area 6, where the largest distribution in congener-specific partition coefficients was observed. The range was from 1.8×10^5 to 6.9×10^5 L/kg. The concentration profiles after 10 years are shown for both partition coefficients and the average value of 3.7×10^{-5} L/kg used in the final model. The model shows a less than 1 percent variation of par:

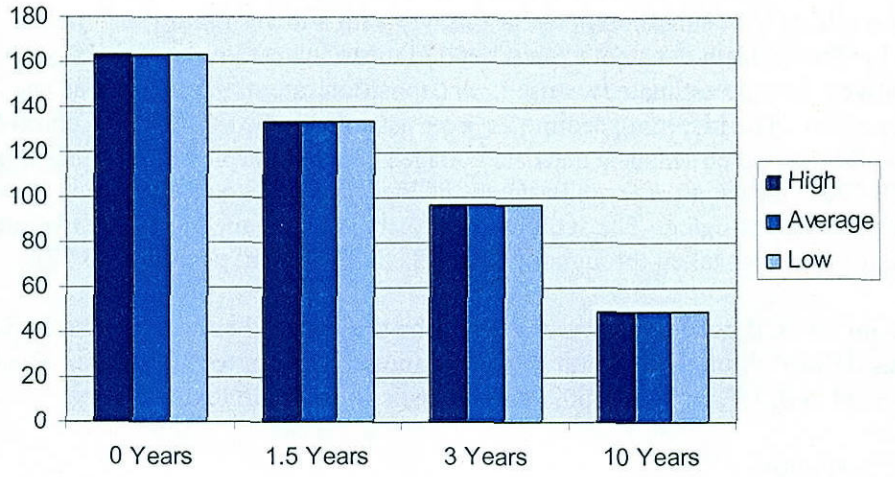

Figure A1. Surface PCB concentrations (μg/kg) for high, low, and average values of partition coefficients in area 6.

The depth of bioturbation is a difficult parameter to characterize. There is no one depth that can represent a "bioturbated zone" as bioturbation occurs continuously through a large portion of the sediment column. This is the reason for using a model that approximates a highly bioturbated zone at the surface, which then decreases with depth. The depth is chosen such that the most significant bioturbation occurs above that depth. Based on site-specific observations in South Basin, the oxidized sediments, hat are commonly used as an indicator of strong bioturbation were always less than 10 cm in depth. Therefore, 10 cm represents a depth that will capture the most effective bioturbators. Model tests indicated that the predicted PCB concentrations are not sensitive to this value with variations up to 30 percent. The rate of bioturbation is difficult measure in situ; therefore, a moderate value (5×10^{-7} cm^2/s) was chosen from the literature to approximate the bioturbators present at South Basin.

To investigate the uncertainty associated with bioturbation values of 2 times and ½ the moderate value was used in the model. Figure A2 shows that the increase in bioturbation of 2 times produces PCB surface concentrations approximately 45 percent higher than the moderate value, while ½ the moderate value shows a decrease in PCB surface concentration of approximately 35 percent. These values can be refined upon further investigation of bioturbation data during the feasibility study.

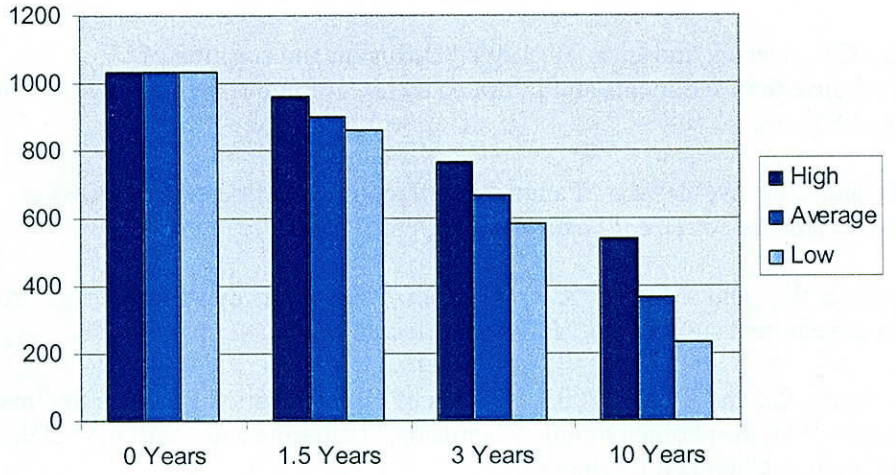

Figure A1. Surface PCB concentrations (μg/kg) for high, low, and average values of bioturbation in area 1.

Sediment porosity was applied as a site-wide average. The variation in average sediment porosity is less than 20 percent core to core. This small variation in porosity does not have a significant effect on the long-term fluxes of PCBs.

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