CONTAMINATED SEDIMENTS TASK FORCE MASTER DREDGING PERMIT APPLICATION

AL LARSON BOAT SHOP DREDGING AND UPLAND CONFINED DISPOSAL FACILITY

Prepared for

Halcrow, Inc.

1046 Seaside Avenue

Terminal Island, California 90731

Prepared by

Anchor QEA, L.P.

28202 Cabot Road, Suite 425

Laguna Niguel, California 92677

September 2009

(Update: October 2012)

Halcrow

A CH2M HILL COMPANY

TABLE OF CONTENTS

List of Tables

TABLE OF CONTENTS

List of Photographs

List of Figures

List of Appendices

LIST OF ACRONYMS AND ABBREVIATIONS

μg/kg	microgram per kilogram
ALBS	Al Larson Boat Shop
BMP	best management practice
CDF	confined aquatic disposal
CEQA	California Environmental Quality Act
EA	Environmental Assessment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ERM	effects range median
FMP	Fishery Management Plan
LAHD	Los Angeles Harbor Department
MLLW	mean lower low water
NEPA	National Environmental Protection Agency
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Los Angeles
RWQCB	Regional Water Quality Control Board
SUSMP	Standard Urban Stormwater Mitigation Plan
TBT	tributylin
TMDL	Total Maximum Daily Load
TTLC	total threshold limit concentration
USACE	U.S. Army Corps of Engineers
WDR	Waste Discharge Requirement
WQC	Water Quality Certification

1 PURPOSE AND NATURE OF THE ACTIVITY

1.1 Introduction

Al Larson Boat Shop (ALBS), the oldest shipyard in southern California, is located at the entrance of Fish Harbor in San Pedro Bay, Port of Los Angeles (Port; Figure 1). The ALBS facility serves both a commercial and recreational need for maintaining and repairing tugboats, government vessels, fireboats, ferries, barges, offshore oil equipment, research vessels, and yachts as well as many other types of marine equipment. The ALBS facility has four marine railways and one floating drydock on which to haul vessels from the water to facilitate underwater hull and other vessel repairs. The facility also has dock space to perform "dockside" repairs when dry berthing is not required.

The proposed project would be ALBS's first comprehensive rehabilitation since it moved to this location in 1923. Both the upland and shoreside portions of the ALBS facility are in need of upgrades and repairs to the existing dilapidated infrastructure. Photographs 1 through 4 show the existing conditions of the ALBS shoreside facility. In addition, approximately 19,000 cubic yards of sediment have accumulated at the facility's approach channel. The applicant, therefore, proposes to conduct maintenance dredging; replace aging infrastructure with newer, state-of-the-art equipment, including a new travel-lift boat hoist; and increase the vessel maintenance/repair area by creating up to 1 acre (approximately 0.9 acre of new land below the jurisdictional water line) by on-site construction of two small confined disposal [CDFs] cells).

Photograph 1. ALBS Wharf Face

Photograph 2.ALBS Marine Rails

Photograph 3. Existing Slipway, Looking Southeast

Photograph 4. Existing Slipway, Looking North

The applicant's proposed renovation will improve ALBS' ability to service its clients and maintain a regional need for marine vessel repair. In addition, the project would beneficially reuse impacted marine sediment to create new upland, enhance the sediment quality in the project area, and upgrade stormwater best management practices (BMPs) at the project site.

Maintaining safe navigation within the project area requires full use of the dock, boat lift, and channel areas; these areas are in need of maintenance dredging to remove sediment that accumulated since the last dredging episode. The sediments in Fish Harbor have been impacted by historical uses, resulting in contaminant concentrations above the relevant Total Maximum Daily Load (TMDL) listing criteria and sediment toxicity (Weston 2007). The beneficial reuse of this impacted sediment as new land for ALBS activities results in permanent confinement of impacted sediment from the marine environment.

1.2 Project Objectives

The overall objectives of the ALBS dredging and upland CDF project include:

1. Upgrading the facilities infrastructure by increasing the land available for use by adding two CDF cells, resulting in the fill of up to 1 acre (approximately 0.9 acre of Fish Harbor below the jurisdictional water line; 0.1 acre above)
2. Constructing a new boat lift to meet current standards
3. Restoring the navigable capacity of the facility by removing clean and contaminated sediments that accumulated above the design depth of -22 feet mean lower low water (MLLW; plus a 2-foot overdredge allowance)
4. Promoting regional sediment management objectives by beneficially reusing dredged material to create two CDF cells
5. Replacing outdated and/or dilapidated buildings and structures
6. Making upland improvements to the stormwater and dock-lighting systems as well as grading and paving for BMPs to improve drainage on site

2 DESCRIPTION OF THE ACTIVITY AND AFFECTED ENVIRONMENT

2.1 Overview

The proposed project consists of maintenance dredging and CDF construction with a total of up to 1 acre of fill, in-water improvements to marine structures (such as piers and bulkheads), addition of new boat lift and pier structure, and upland improvements. These activities will occur in three phases[1]. Specific project components include:

- Removing creosote-treated wharf from the marine environment. Creosote-treated materials will be disposed of in a suitable upland disposal facility for handling creosote-treated wood waste.
- Dredging approximately 19,000 cubic yards of sediment
- Installing sheetpile walls with sealed joints to create two small CDF cells (0.9 acre below the jurisdictional water line)
- Treating dredged material using the cement stabilization method and beneficially reuse the stabilized dredged material to create up to 1 acre of upland distributed within the two CDFs
- Replacing the existing boat lift piers with new system
- Demolishing buildings in the upland
- Installing a Standard Urban Stormwater Mitigation Plan (SUSMP) BMPs

2.2 Project Phasing

In order to maintain a working facility during construction, this project will need to be constructed in three phases. The project phasing is detailed in Table 1.

[1] There is a possibility that the work would occur over two phases. Currently, Phase 3 work includes demolishing existing upland facilities and constructing replacement buildings. This work may overlap with in-water work currently scheduled to occur in Phase 2.

Table 1
Construction Schedule

	Phase 1	Phase 2	Phase 3[1]
Timing of Construction	Fall 2012	Spring/Summer 2013	Spring/Summer 2014
Activities	• Demolition of buildings in Phase 1 footprint • Demolition of wharf deck. • Dredging of approximately 3,000 cubic yards • Installation of sheet pile wall for Phase 1 CDF • Construction of new boat lift piers • Installation of SUSMP improvements • Renovation of grading and paving	• Dredging of approximately 16,000 cubic yards • Construction of new sheetpile wall for Phase 2 CDF • Renovation of grading, paving, and lighting	• Demolition of buildings in Phase 3 footprint • Construction of replacement buildings • Renovation of grading, paving, and lighting

Notes:
Construction activities will be timed to coincide with allowable work windows.
Sheet pile joints will be grouted.
[1] Depending on final construction staging, Phases 2 and 3 may be overlapped. This potential modification would not affect any in-water work.

2.3 Permits Required

The proposed work at ALBS is within the jurisdiction of several agencies. The U.S. Army Corps of Engineers (USACE) is the lead agency for federal permits and approvals. Based on our pre-application meeting on August 25, 2009, a standard Individual Permit is required, and the USACE will prepare an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA). ALBS will also need to obtain a Clean Water Act Section 401 Water Quality Certification/Porter-Cologne Act Waste Discharge Requirements General Order (WQC/WDR) from the Los Angeles Regional Water Quality Control Board (RWQCB).

The Los Angeles Harbor Department (LAHD) is the lead agency for the California Environmental Quality Act (CEQA), is responsible for compliance with stormwater regulations set by the City of Los Angeles, and will determine if the project is consistent with the Master Coastal Development Permit pursuant to the California Coastal Act. ALBS is responsible for implementing and monitoring the improved BMPs installed under the SUSMP. A summary of the permits required for this project is contained in Table 2.

Table 2

Summary of Required Regulatory Permits

Required Permits/Approvals	Lead Agency
Department of the Army Individual Permit	USACE
WQC/WDR	RWQCB
Harbor Permit – Master Plan Consistency	LAHD
CEQA Environmental Impact Statement	LAHD

Notes:

Approximately 19,000 cubic yards of material is proposed to be dredged and placed in the on-site CDF cells.

2.4 Existing Physical and Biological Conditions

ALBS is a full service shipyard that incorporates four marine railways, a floating drydock, and dockside work areas, all separated by wood docks and piers. It consists of 7.70 acres (2.35 acres of land and 5.35 acres of water), which includes the marina. The marine railways range from 100 to 1,250 tons with the ability to haul-out barges up to 60 feet wide by 250 feet long. The floating drydock is 200 feet long by 44 feet wide with the ability to haul-out vessels up to 1,000 tons. Wood, welding, and machine shops; storage areas; and crew quarters (used when government contracts require office and living space for military personnel) support the shipyard. Portable and fixed cranes, portable forklifts, welders, and sand blasting equipment are utilized throughout the facility.

Sediment core samples were collected in 2005 from 21 stations in the vicinity of the ALBS facility. Figure 2 shows the locations of the sampling stations. Sediment grain size varied widely among samples (Weston 2007). Results from the analysis of the surface samples indicated that generally sediments located further offshore consisted of significantly higher percentages of fine-grain materials (silts and clays) than the coarser-grain sediments in nearshore locations. Grains sizes of subsurface (below 1 foot) sediment were predominantly coarse grained. The average coarse-grain composition for all surface sediment sampled was 59.3 percent, whereas the average coarse-grain composition for all subsurface sediment samples was 70.1 percent.

Sediment quality is impacted at Fish Harbor. According to *Chemical and Geotechnical Characterization of Sediments in the Vicinity of Al Larson Boat Shop* (Weston 2007; Appendix A), surface samples collected within the ALBS lease area (Parcel 4) contained concentrations of heavy metals and organics (Figure 2). Copper, lead, mercury, zinc, DDTs, polychlorinated biphenyls (PCBs), and tributylin (TBT) were found to be elevated in this area (elevated contaminants are defined as analytes with at least 10 percent of the samples exceeding the effects range median [ERM] or one sample exceeding the total threshold limit concentration [TTLC]). However, contaminants were found primarily in the top 4 to 6 feet of sediments in the ALBS lease area and in the broader dredge area.

The concentrations of many chemicals measured in subsurface sediment from stations resampled at greater depths (SV-8 and SV-10 equivalent to AL4-15 and AL4-13, respectively) were below ERM values. These chemicals included all metals examined, total polycyclic aromatic hydrocarbons (PAHs), and total DDTs. In addition, concentrations of phenols and phthalates were relatively low or below the detection limits at all stations. Organotin concentrations were low in samples from SV-8; however, in one subsurface sediment sample from SV-10 (4 to 6 feet), DBT and TBT concentrations exceeded levels that have been show to cause toxicity to aquatic organisms (greater than 100 micrograms per kilogram [µg/kg]). Similarly, the total PCB concentration in subsurface sediment (4 to 6 feet) from station SV-8 was also significantly elevated above the ERM value of 180 µg/kg. These findings suggest that most of the contamination within Parcel 4 of the ALBS lease area (i.e., metals, PCBs, PAHs, DDTs, and organotins) was limited to a depth of 5 feet.

2.5 Phase 1

The following sections focus on the USACE and Los Angeles RWQCB jurisdictional elements for in-water work. The upland components of the proposed project, while outside the scope for in-water analysis of impacts, are described here to provide a complete project description. Figure 3 shows the overall Phase 1 construction activities.

2.5.1 Demolition of Structures

In Phase 1, the obsolete, 170-foot-by-22-foot, creosote-treated, timber wharf within the footprint will be partially removed, but the existing riprap revetment under the wharf will remain (Figure 3). A boom will be placed around the perimeter of the work to contain floating debris that may be generated during the removal process. The creosoted debris, which is not suitable for disposal in a municipal landfill, will be transported to a disposal facility suitable for handling creosote wood waste.

2.5.2 Construction of CDF

Once the timber wharf has been removed, a steel sheetpile wall will be constructed in approximately the same outline as the wharf, with a 10-foot offset from the face of the wharf to form the perimeter of the CDF cell located within the footprint of Phase 1. Figure 4 shows the cross section of the sheetpile wall. Approximately 0.2 acre of new land will be created below the jurisdictional water line during Phase 1. The sheetpiles will be installed using a vibratory hammer to a minimum depth of -47 feet MLLW. The final elevation of the material inside the CDF will be approximately 5 feet higher than the existing wharf. The joints of the sheetpiles will be sealed to prevent exchange of water between the cement-stabilized sediments inside the CDF cells and the marine environment.

2.5.3 Dredging, Sediment Stabilization, and Material Placement

Working from a barge, a clamshell bucket and crane will dredge approximately 2,960 cubic yards within the Phase 1 footprint to a depth of -22 feet MLLW, plus a 2-foot overdredge allowance (Figure 5). The dredged material will be placed in a scow for treatment by cement stabilization prior to permanent placement in the CDF cell.

Cement stabilization, or immobilization technology, stabilizes and solidifies contaminated dredged material. This process involves stabilization and solidification of contaminated dredged material with cement-based additive mixes to convert contaminants in the material into the least soluble, mobile, or toxic form and enhances the physical properties of the material. Due to the small volume associated with this project and the need for fill to create upland areas at the project site, cement stabilization is the best treatment/disposal option. Cement stabilization is also very successful in immobilizing contaminants (such as PCBs) generally not mobile through air, soil, and water (Wiles and Barth 1992). Cement stabilization binds soluble constituents, reduces chloride mobility, significantly reduces compaction times, and reduces the need for imported fill material while increasing the capacity of the CDF by reducing the liquid content of the sediment.

The cement stabilization process uses select cement-based binders, such as Portland cement, to stabilize metals and other inorganics. Binder selection is based on the ability to precipitate metal ions, react with specific analytes, and bind/encapsulate specific contaminants. In a typical process, the binder is mechanically blended into the dredged material, and the cement reacts with process water and porewater in the dredged material (hydration) to produce a binding gel (e.g., Tobermorite gel). The binding gel coats the contaminated fine particles, cements the particles into larger clusters, and fills the micropores in the material's microstructure. The chemical reactions consume water through hydration, produce calcium hydroxide that reacts with siliceous particles to create additional binding gel, and generate heat that accelerates dewatering. Upon adequate curing, these reactions immobilize/encapsulate contaminants in the microstructure of the treated material and enhance the material's engineering properties (such as shear strength, compaction, and consolidation characteristics).

The cement stabilization treatment technology was developed and refined through several pilot studies conducted by the USACE in the mid 90's for the Ports of New York and New Jersey. In 2001, the Los Angeles Contaminated Sediments Task Force (CSTF) and USACE sponsored a regional pilot study to evaluate the effectiveness of the cement stabilization technology using contaminated dredge materials from Southern California. This pilot study proved successful and the technology was later adopted as one of the recommended treatment processes for use in managing contaminated sediment and included in the CSTF Contaminated Sediment Long Term Management Strategy 2005 decision framework. Since that time, the cement stabilization process has been utilized in actual contaminated sediment management projects such as the Port of San Diego 10th Avenue Pier dredging project where approximately 17,000 cubic yards of primarily storm drain runoff sediment contaminated with copper, zinc, lead, pesticides, and polychlorinated biphenyls (PCBs) was treated.

For this project, the dredged material will be placed in a scow, and the binder will be added to the sediment and mechanically mixed (Photographs 5 and 6). There will be no access for the cement truck at ALBS wharf; therefore, scows will be tugged to an accessible area approximately 0.23 mile from the dredge location (see Figure 1). Two scows will be used for this process. The material will be allowed to stabilize in the scow (approximately 1 to 2 days) and will be returned to ALBS and placed behind the sheetpile wall and into the CDF using the clamshell bucket. Approximately 0.2 acre of land will be created. Figure 5 shows a cross-section drawing of the Phase 1 CDF cell.

Photograph 5. Placement in Scow

Photograph 6. Cement Stabilization

2.5.4 Boat Lift Pier Construction and Completion of Phase 1

The new boat lift piers will be constructed in the Phase 1 footprint to allow the existing boat lift to continue operating during construction. Two concrete finger piers supported by thirty-two 24-inch octagonal concrete piles for each pier (64 total) will be installed to support the new 600-ton travel-lift hoist.

The final stage of Phase 1 consists of completing upland improvements within the footprint. Approximately 0.81 acre of pavement within the Phase 1 footprint will be removed and the area graded. Additional BMPs to mitigate for the potential impacts to stormwater will be installed. The pavement will be replaced with high strength pavement (including over the newly constructed CDF cell). Clean material will be imported to bring the upland area to the same elevation as the sheetpile wall (12 feet MLLW) and designed to drain toward the upland oil/water separator facility. The demolished buildings will be reconstructed as part of Phase 3, and the new lighting system will be installed.

2.6 Phase 2

Phase 2 construction activities are shown on Figure 6. Major tasks to be accomplished during this phase include demolition and CDF construction; dredging, sediment stabilization, and material placement, and upland improvements.

2.6.1 Demolition and CDF Construction

The finger piers for the existing boat hoist railway will be removed, but the rails associated with the existing travel-lift system will remain since this area will be contained within the CDF and covered with the treated dredged material. Asphalted areas currently being used for dry docking will also be removed, and all debris will be transported to proper off-site disposal facilities.

The second cell of the CDF will be constructed by installing sealed sheetpile, as shown on Figure 4 and described for Phase 1. As with the first cell, the joints of the sheetpile wall will be sealed to prevent exchange of water from the CDF cell to the marine environment. The CDF cell will be approximately 145 feet wide and will be up to 140 feet in length, or 0.7 acre below the jurisdictional water line.

2.6.2 Dredging, Sediment Stabilization, and Material Placement

The Phase 2 footprint is shown on Figure 6; approximately 11,800 cubic yards of material will be dredged to -22 feet MLLW (plus a 2-foot overdredge allowance) to provide navigation for the upgraded facilities. As in Phase 1, the dredged material will be stored on a scow and treated by the cement stabilization method. As the treatment process is completed, the material will be placed in the CDF cell. Figure 7 shows a cross-section drawing of the Phase 2 CDF cell.

2.6.3 Upland Improvements

The final stage of Phase 2 consists of completing all upland improvements. Pavement within the upland area of the Phase 2 footprint will be removed and the area graded. The pavement will be replaced with high strength pavement (including over the newly constructed CDF cell) and clean material will be imported to bring the upland area to the same elevation as the sheetpile wall (12 feet MLLW). The demolished buildings will then be reconstructed, and the new lighting system will be installed.

2.7 Phase 3

No in-water work is associated with Phase 3. During this final stage of construction, additional buildings will be demolished and reconstructed. Approximately 0.64 acre of asphalt will be removed. The area will be regraded and a new storm drain will be installed. Material will be imported to bring the final elevation up to that of the CDF (12 feet MLLW). There is a possibility that work in Phase 3 will be combined with Phase 2 depending on final construction phasing. This potential modification will not affect in-water work.

3 ESSENTIAL FISH HABITAT AND ENDANGERED SPECIES ACT

This section includes Essential Fish Habitat (EFH) and Endangered Species Act (ESA) information specific to dredging.

3.1 Essential Fish Habitat

Dredging-related impacts to EFH are for the most part temporary, minor increases in turbidity associated with construction. Dredging may temporarily remove benthic infauna from the dredged area, but overall fish and benthic biota at the site are sparse, and infaunal communities will rapidly recolonize following dredging. A silt curtain will be installed around dredging areas to prevent any off-site migration of suspended sediments, and water quality impacts due to dredging will be monitored, per the Los Angeles RWQCB dredging water quality monitoring plan developed for this project.

Because of the bottom-disturbing nature of the project, dredging will adversely affect EFH for species managed under the Pacific Groundfish and Coastal Pelagic Species Fishery Management Plans (FMPs). However, these impacts are temporary and minor and will be minimized to the maximum extent feasible by planned BMPs.

The ichthyofauna in the area of the proposed project has been extensively studied; more than 130 species of fish have been found in the Los Angeles Harbor (MEC 1988). Generally, the abundance of fish within the federal breakwater is higher than outside the breakwater, and the diversity and abundance of fish decline as one proceeds into the Inner Harbor, especially into the blind slips. Through the years, there has been an improvement in the harbor's water quality, and areas in the main channels and basins of the Inner Harbor, which historically were less valuable to fishes, have become more like areas of the deep Outer Harbor (MEC 1988). Three species—Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and white croaker (*Genyonemus lineatus*)—represent approximately 90 percent of the fish population in the Outer Harbor (MEC 1988).

The proposed project is located within an area designated as EFH for two FMPs: the Coastal Pelagics Species (covering 5 species) and Pacific Groundfish (covering 89 species) FMPs. Of the 94 species that are federally managed under these plans, 19 adult species are known to occur in the Los Angeles Harbor and could be affected by the proposed project (Table 3).

Table 3
Adult FMPs and Managed Species Potentially Affected by the Project, Port of Los Angeles

Common Name	*Species*	*Potential Essential Fish Habitat in Study Area*	*Abundance*
Pelagic Species (Coastal Pelagics)			
Northern anchovy	*Engraulis mordax*	Open water throughout.	Abundant throughout harbor in 2000, 2008.[1, 5]
Pacific sardine	*Sardinops sagax*	Open water throughout.	Abundant throughout harbor in 2000, 2008.[1, 5]
Pacific (chub) mackerel	*Scomber japonicus*	Open water, primarily in Outer Harbor; juveniles off of sandy beaches and around kelp beds.	Common throughout harbor in 2000, only one locale in 2008.[1, 5]
Jack mackerel	*Trachurus symmetricus*	Near breakwater and Inner to Middle Harbor. Young fish over shallow rocky banks. Young juveniles sometimes school under kelp. Older fish typically further offshore.	Common in Inner to Middle Harbor, uncommon in Outer Harbor in 2000, common in 2008.[1, 5]
Demersal (Bottom) Species (Pacific Groundfish)			
English sole	*Parophrys vetulus*	On bottom throughout. Benthic dwelling on sand or silt substrate.	Uncommon in 2000;[1] 24 collected in Outer Harbor in 2008.[5]
Pacific sanddab	*Citharichthys sordidus*	Primarily Outer Harbor. Benthic on sand or coarser substrate.	Rare in 2000;[1] common in Outer Harbor in 2008.[5]
Leopard shark	*Triakis semifasciata*	Primarily in Outer Harbor. Over sandy areas near eelgrass, kelp, or jetty areas.	Rare; 3collected in 2000,[1] none in 2008.[5]
Big skate	*Raja binoculata*	Primarily in Outer Harbor. Over variety of substrates generally at > 3-meter depth.	Uncommon; primarily in shallow water; none caught in 2008.[5]
Black rockfish	*Sebastes melanops*	Primarily Cabrillo shallow-water habitat. Along breakwater and deep piers and pilings. Associated with kelp, pilings, eelgrass, high-relief rock.	Rare; 4 collected in deep Inner and Middle Harbor waters in 2000,[1] none in 2008.[5]
California scorpionfish	*Scorpaena gutatta*	Rock dikes and breakwaters.	Common on rock dikes and breakwaters, also on soft bottom at night.[1–5]

Common Name	*Species*	*Potential Essential Fish Habitat in Study Area*	*Abundance*
Grass rockfish	*Sebastes rastrelliger*	Along breakwater and in eelgrass off of beach areas. Associated with kelp, eelgrass, jetty rocks.	Rare; 3 collected in 2000,[1] none in 2008,[5]
Vermilion rockfish	*Sebastes miniatus*	Primarily along breakwater. Typically near bottom and associated with kelp, along drop offs, and over hard bottom.	Common more recently: four collected in 2000,[1] 20 in 2008[5].
Cabezon	*Scoraenichthys marmoratus*	Primarily shallow waters, along breakwater and eelgrass areas. Benthic and use a variety of substrates including kelp beds, jetties, rocky bottoms, and occasionally eelgrass beds and sandy bottoms.	Rare; shallow water.[1] None collected in 2008[5].
Ling cod	*Ophiodon elongatus*	Primarily along breakwater and especially near Angels Gate. Typically on or near bottom over soft substrate near current-swept reefs.	Rare; shallow water.[1] None collected in 2008.[5]
Bocaccio	*Sebastes paucispinis*	Typically found in deeper water near hard substrate, kelp, and algae.	Uncommon; juveniles in kelp around breakwater.[2]
Kelp rockfish	*Sebastes atrovirens*	Found in association with kelp along the breakwaters.	Rare; in kelp along breakwater.[2]
Olive rockfish	*Sebastes serranoides*	Found in association with kelp along the breakwaters.	Common to uncommon; juveniles in kelp around breakwater.[2]
Calico rockfish	*Sebastes dalli*	Typically found in deeper water near hard substrate, kelp, and algae.	Rare; one collected in Long Beach Harbor,[4] shallow water.[1]
California skate	*Raja inornata*	Usually associated with hard substrate. Found along breakwater and deep piers and pilings. Associated with kelp, pilings, eelgrass, and high-relief rock.	Common; Primarily in Outer Harbor.[1, 5]

Notes:
Potential habitat use from McCain et al. 2005. Species occurrence in Los Angeles and/or Long Beach Harbors recorded from MEC Analytical Systems and SAIC studies.
Abundant: among 10 most abundant species collected.
Common: not one of the 10 most abundant, but at least 100 individuals collected.
Uncommon: between 10 and 100 individuals collected.

Common Name	*Species*	*Potential Essential Fish Habitat in Study Area*	*Abundance*
Rare: less than 10 individuals collected. Pelagic and benthic sampling employed in the 2000 surveys (MEC 2002) did not sample rocky breakwater and kelp habitat that could potentially be occupied by some of the species. Sources: [1] MEC Analytical Systems, Inc. (MEC) 2002. Ports of Long Beach and Los Angeles: Year 2000 Biological Baseline Study of San Pedro Bay. Report submitted to the Port of Long Beach in association with Science Applications International Corporation, Merkel & Associates, Inc., Keane Biological Consulting, and Everest International Consultants. [2] MEC 1999. Port of Los Angeles special study, August 1999. Prepared for Port of Los Angeles. [3] MEC 1988 Biological baseline and an ecological evaluation of existing habitats in Los Angeles Harbor and adjacent waters. Volumes I through III. Prepared for Port of Los Angeles. [4] SAIC and MEC 1997. Biological Baseline Study of Selected Areas of Long Beach Harbor. Final Report to the Port of Long Beach. May 1997 [5] SAIC 2010. 2008 Biological Surveys of Los Angeles and Long Beach Harbors. Prepared for Port of Los Angeles.			

Four of the five species in the Coastal Pelagics Species FMP are well represented in the vicinity of the project area. In particular, the northern anchovy is the most abundant species in the Los Angeles Harbor, representing over 80 percent of fish caught (MEC 1988 and 1999), and larvae of this species are also a common component of the ichthyoplankton (MEC 1988). It is generally held that this species spawns outside the Harbor. There is a commercial bait fishery for northern anchovy in the Outer Harbor. The Pacific sardine is at times one of the most common species in the harbor ranking second behind northern anchovy at some locations (MEC 1988). This species is not known to spawn in the harbor. Sardines are also a component of the commercial bait fish harvest in the harbor. Both of these species are important forage for piscivorous fish.

Two other Coastal Pelagic Species FMP species—Pacific mackerel (*Scomber japonicus*) and jack mackerel (*Trachurus symmetricus*)—are common, but not overly abundant, as adults in the harbor. The Pacific mackerel's main forage fish in the harbor is very likely northern anchovy.

Of the 15 species present from the Pacific Groundfish FMP, only four—olive rockfish (*Sebastes serranoides*), California scorpionfish (*Scorpaena gutatta*),vermillion rockfish (*Sebastes miniatus)* and California skate (*Raja inornata)* could be considered common in the harborThe olive rockfish has been found largely as juveniles associated with the kelp growing along the inner edge of the federal breakwater (MEC 1988). The scorpion fish is not a major component of the fish present in the harbor but may be underrepresented in the catch due to its nocturnal habits.

Likely project activities that would directly affect the identified FMP species include deepening of the channels, turbidity caused by dredging activity, suspension of contaminants from the sediments during dredging and dredged material disposal, and construction of submerged fill or landfill associated with dredged material disposal (Table 4). Project activities will not have any significant effect on FMP species that do not occur in the harbor or are rare or uncommon in the harbor (i.e., English sole [*Parophrys vetulus*], Pacific sanddab [*Citharichthys sordidus*], bocaccio [*Sebastes paucispinis*] and cabezon [*Scorpaenichthys marmoratus*]). The greatest effect of the proposed project is the loss of habitat resulting from the conversion of approximately 0.9 acre of marine environment to upland.

Table 4
Effects of the Proposed Project Activities on FMP Species

Project Activity	Impact Assessment
Channel Deepening	Deepening of channels to -22 feet MLLW. No long-term effect on FMP species.
Turbidity	Temporary adverse impact to FMP species resulting in avoidance of immediate area of dredging by adults and some loss of larval northern anchovy. Construction would be carried out in accordance with established WQC/WDR from the Los Angeles RWQCB.
Contaminant Suspension	Potential temporary adverse impact to FMP species in immediate area of contaminant dredging. Long-term benefit of removing contaminants from the harbor ecosystem.
Submerged Fill	Permanent displacement of FMP species. Long-term benefits resulting from isolation of contaminated sediments from marine environment, which benefits most FMP species.
Utility Improvements	Upgrades to the stormwater system. Install BMPs as part of the SUSMP benefits most FMP species.

3.2 Endangered Species Act

Sensitive bird species that are likely to occur at the project site are the California brown pelican (*Pelicanus occidentalis californicus*) and the double-crested cormorant (*Phalacrocorax auritus*). California brown pelicans do not nest within the Harbor, while double-crested cormorants have nested in transmission towers in the Port of Long Beach. The federally-listed California least tern (*Sterna antillarum browni*) is also likely to occur at the project site. The LAHD manages a California least tern nesting site at Pier 400 and the species is known to forage in the Harbor, specifically in shallow water areas. The double crested cormorants, California brown pelicans and California least terns are all commonly observed locally and have acclimated to port activities. Temporarily increased turbidity associated with dredging could potentially reduce the forage efficacy of these species; however, given the industrial location and setting of the project site, the relatively small amount of dredging, and the lack of overall habitat quality in the area, none of the species are expected to be affected by the proposed project.

To further ensure no effects to listed species, a silt curtain will be deployed around active dredging areas. With turbidity contained to this small portion of the available harbor, and given the distance from breeding colonies, no significant foraging opportunities for these species are anticipated to be lost; therefore, impacts to wildlife from maintenance dredging are expected to be temporary and negligible.

Noise-related impacts may be incurred during Phase 1 pre-stressed concrete piles installation as well as sheet-pile driving. Again, given the industrial location and setting of the project site, the relatively small amount of dredging, and the lack of overall habitat quality in the area, these species are not expected to be affected by noise from the proposed project.

4 CONSERVATION MEASURES AND MITIGATION

4.1 Conservation Measures

ALBS and its contractors will apply all construction BMPs, such as contractor education on the terms and conditions of the permits; trash and debris control; equipment staging and maintenance area control; and water quality monitoring.

The removal of the timber wharf will result in the elimination of creosote from the marine environment and a benefit to sediment and water quality.

Impacts to water quality associated with dredging activities are considered temporary and would be minimized through implementation of requirements associated with established WQC/WDR from the RWQCB.

The sheetpile joints will be sealed to create an impermeable structure, and dredged material will be cement stabilized. The cement stabilization and beneficial reuse of the impacted sediment results in a net benefit to sediment quality in the area through removal of contaminated marine sediment and the sealed joints protect water quality.

Dredging may result in temporary, minor water quality impacts due to resuspension of some sediment. Water quality BMPs and monitoring will be implemented at the site, including:

- Install and maintain a continuous, floating silt curtain that completely encompasses the dredging area
- Conduct water quality monitoring during all dredging activities to ensure that applicable turbidity standards (as determined by the Los Angeles RWQCB) are not exceeded
  - If water quality exceedence occurs, or if a plume of turbidity is visible outside of the silt curtain enclosure, the contractors shall adjust its operations to comply with water quality standards
  - Examples of possible adjustments to operations include reducing the speed of dredging, or temporarily halting work until the water quality exceedance has dissipated.

4.2 Mitigation

Of the activities identified above, the loss of general marine resources due to the construction of land as disposal sites (i.e., CDF cells) requires mitigation. The mitigation proposed for the fill and loss of open-water habitat associated with the project would include use of LAAHD mitigation credits. Inner Harbor credits are currently available in the Bolsa Chica mitigation bank. The LAHD may also be able to use Outer Harbor credits pending timing of establishment of the LAHD's new umbrella mitigation bank that is currently being set up under the 2008 Mitigation Rule.

In order to mitigate for the loss of approximately 0.9 acre of waters of the United States, the applicant will utilize 0.45 Inner Harbor or Outer Harbor Mitigation Bank credits obtained from the LAHD. Due to the nature of the sediment, the areas to be filled are areas of extremely low biological function; however, the agencies have specified the loss of waters be mitigated.

4.3 Statement of Avoidance and Minimization

The proposed design represents the optimal alternative for meeting the ALBS' objectives of restoring full use of its property, increasing navigability, improving sediment quality by isolating it from the aquatic environment, and improving stormwater BMPs. The project will result in temporary and minor impacts; however, the project lacks any impacts to sensitive aquatic sites and avoids impacts to endangered species. The project will avoid and minimize impacts to the maximum extent practicable by employing BMPs.

5 REFERENCES

MEC Analytical Systems (MEC). 1988. Biological Baseline and an Ecological Evaluation of Existing Habitats in Los Angeles Harbor and Adjacent Waters. Volumes I to III. Prepared for the Port of Los Angeles.

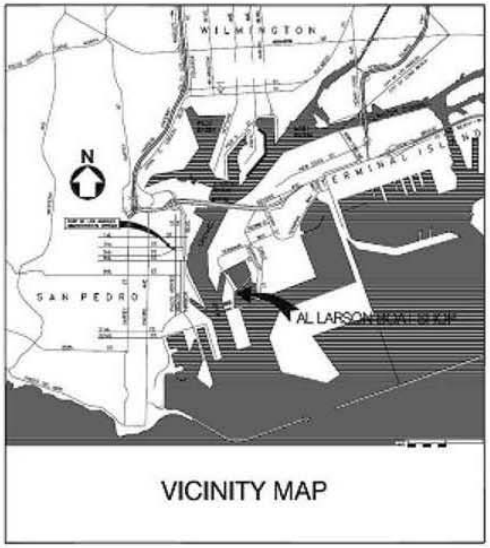
MEC. 1999. Biological Baseline and an Ecological Evaluation of Existing Habitats in Los Angeles Harbor and Adjacent Waters. Volumes I to III. Prepared for the Port of Los Angeles.

Weston Solutions, Inc. (Weston). 2007. Chemical and Geotechnical Characterization of Sediments in the Vicinity of Al Larson Boat Shop, Port of Los Angeles. Prepared for the Port of Los Angeles. April 2007.

Wiles and Barth. 1992. Solidification/Stabilization: Is It Always Appropriate? Stabilization and Solidification of Hazardous, Radioactive, and Mixed Wastes. 2nd Vol. ASTM STP 123. T.M Gilliam and C.C. Wiles, Eds. American Society for Testing and Material.

FIGURES

Sep 24, 2009 10:45am banaya C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 1



SOURCE: Drawing prepared from Halcrow 2009.

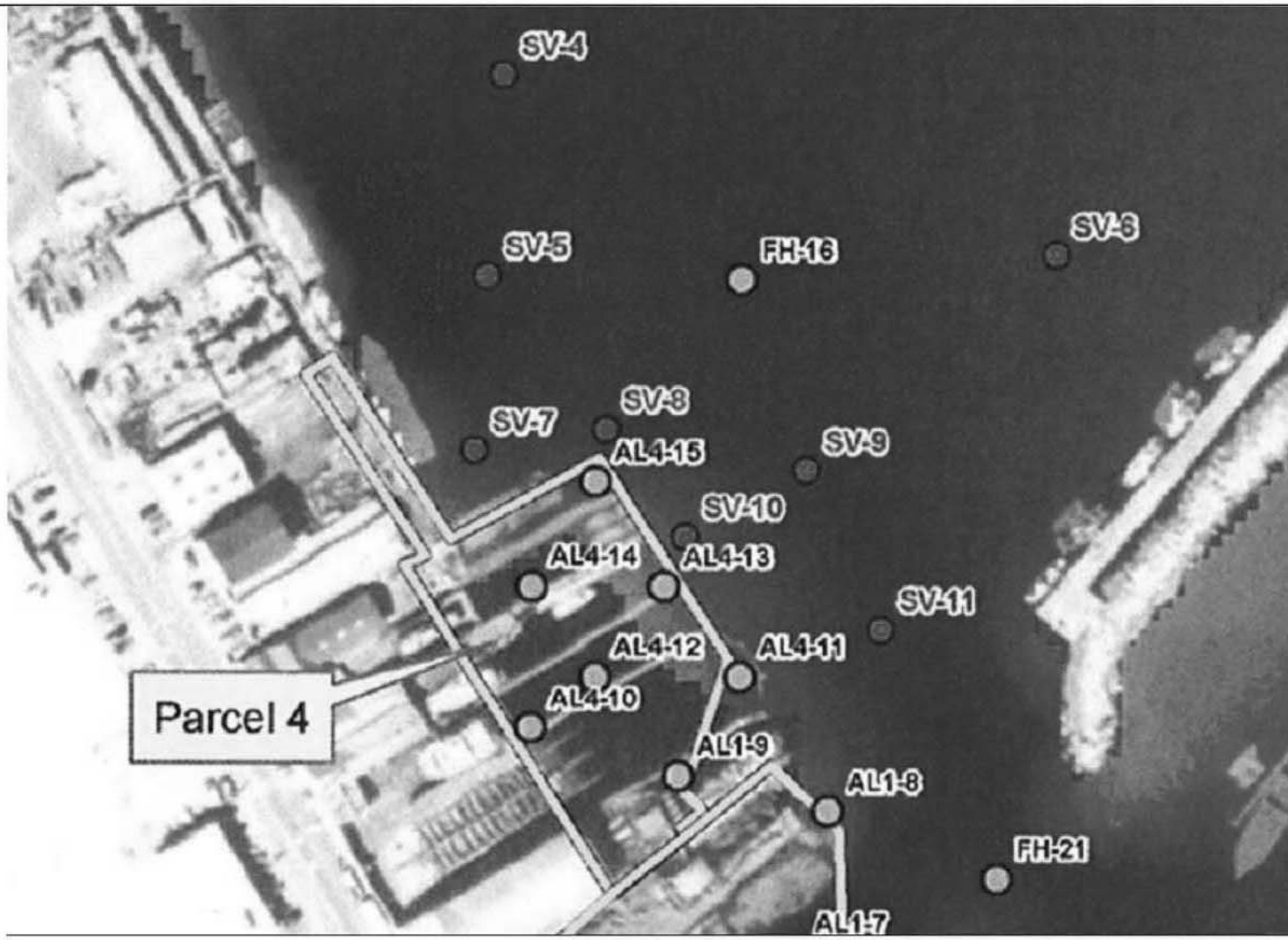
ANCHOR QEA

Halcrow

Figure 1

Project Vicinity and Location

Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

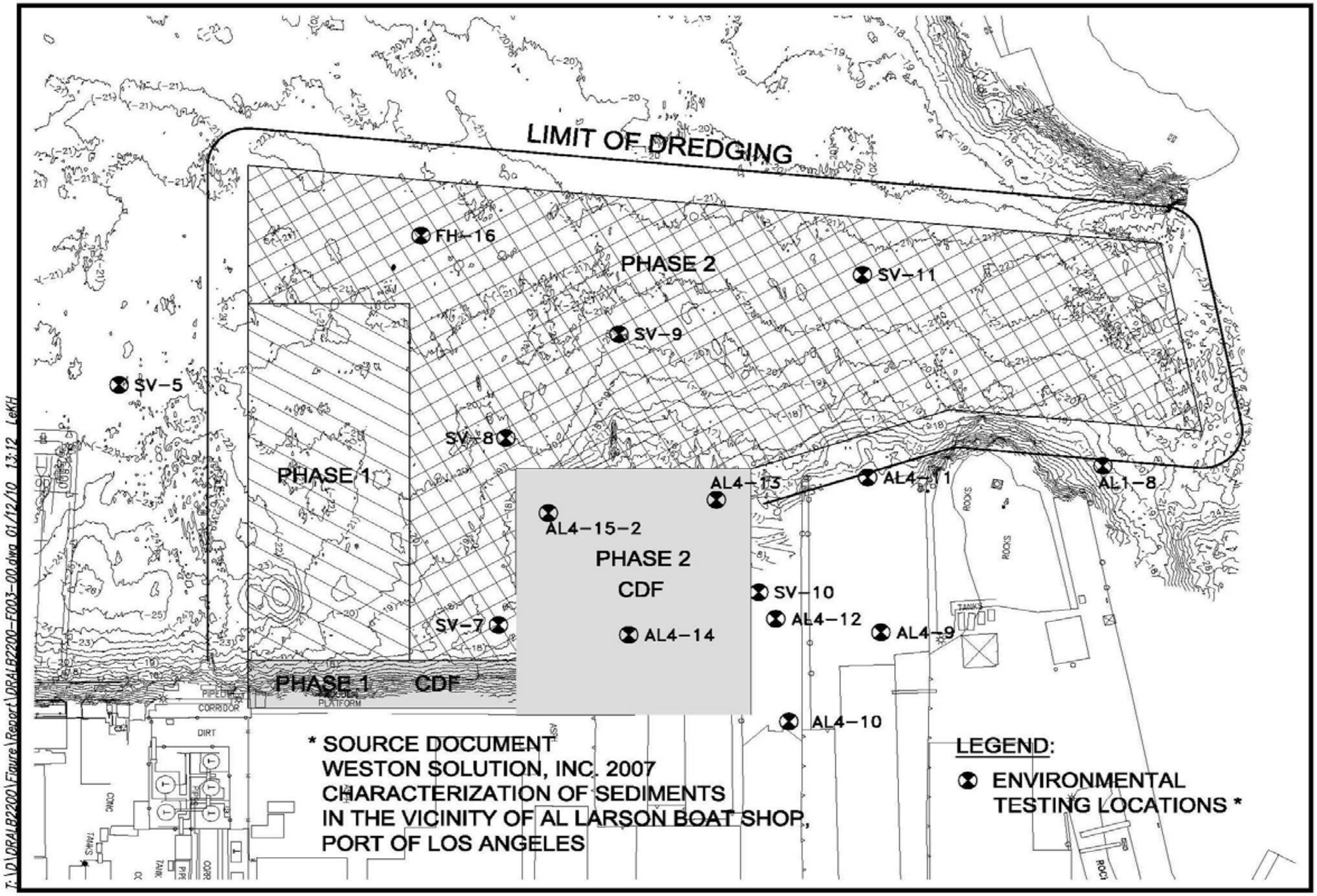


SOURCE: Weston Solutions, Inc. 2007. Chemical and Geotechnical Characterization of Sediments in the Vicinity of Al Larson Boat Shop, Port of Los Angeles.

Sep 24, 2009 10:45am banaya C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 2

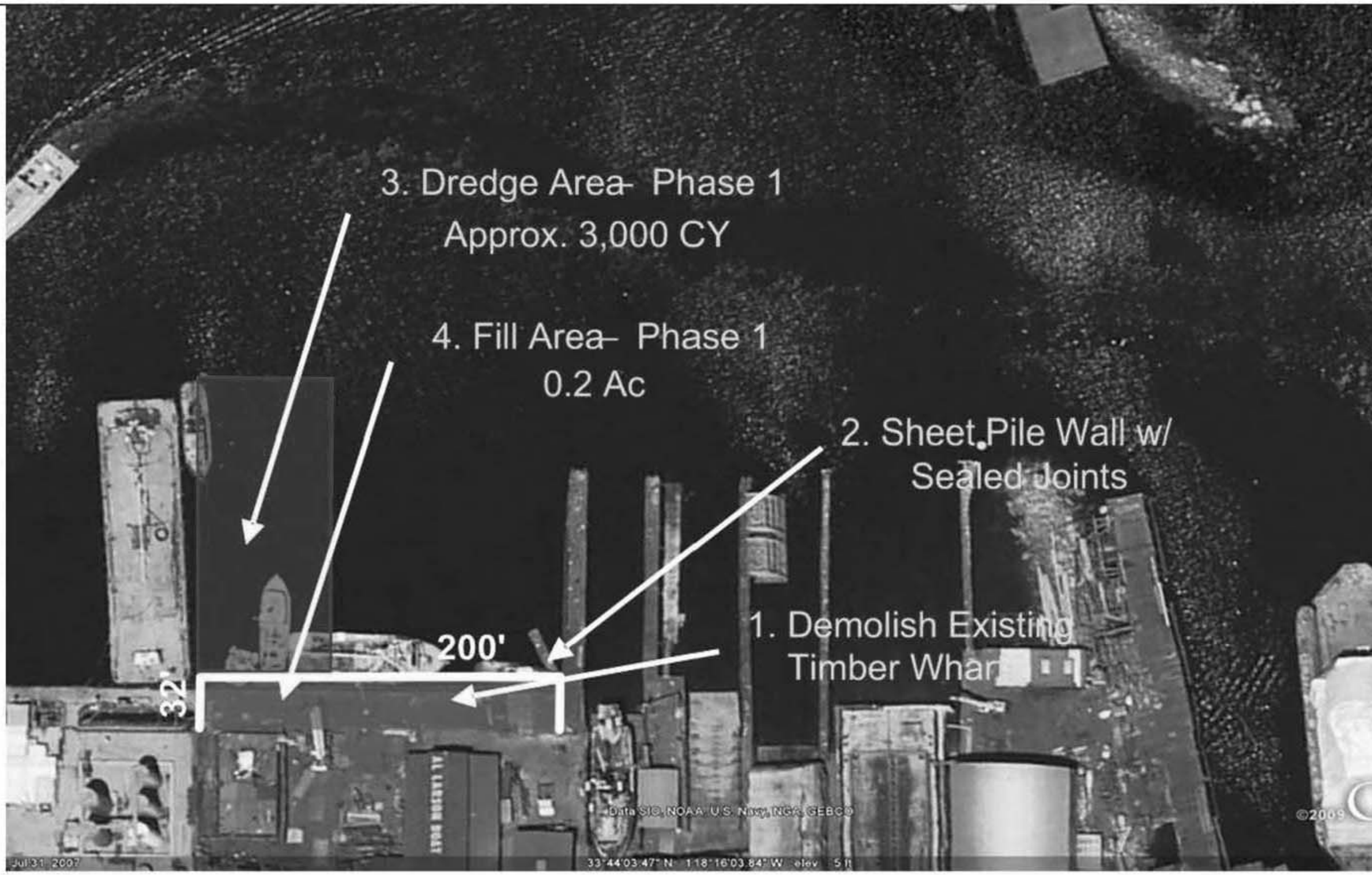
Figure 2
Environmental Testing Locations
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

ANCHOR QEA Halcrow



Halcrow

Figure 2a
Environmental Testing Locations
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility



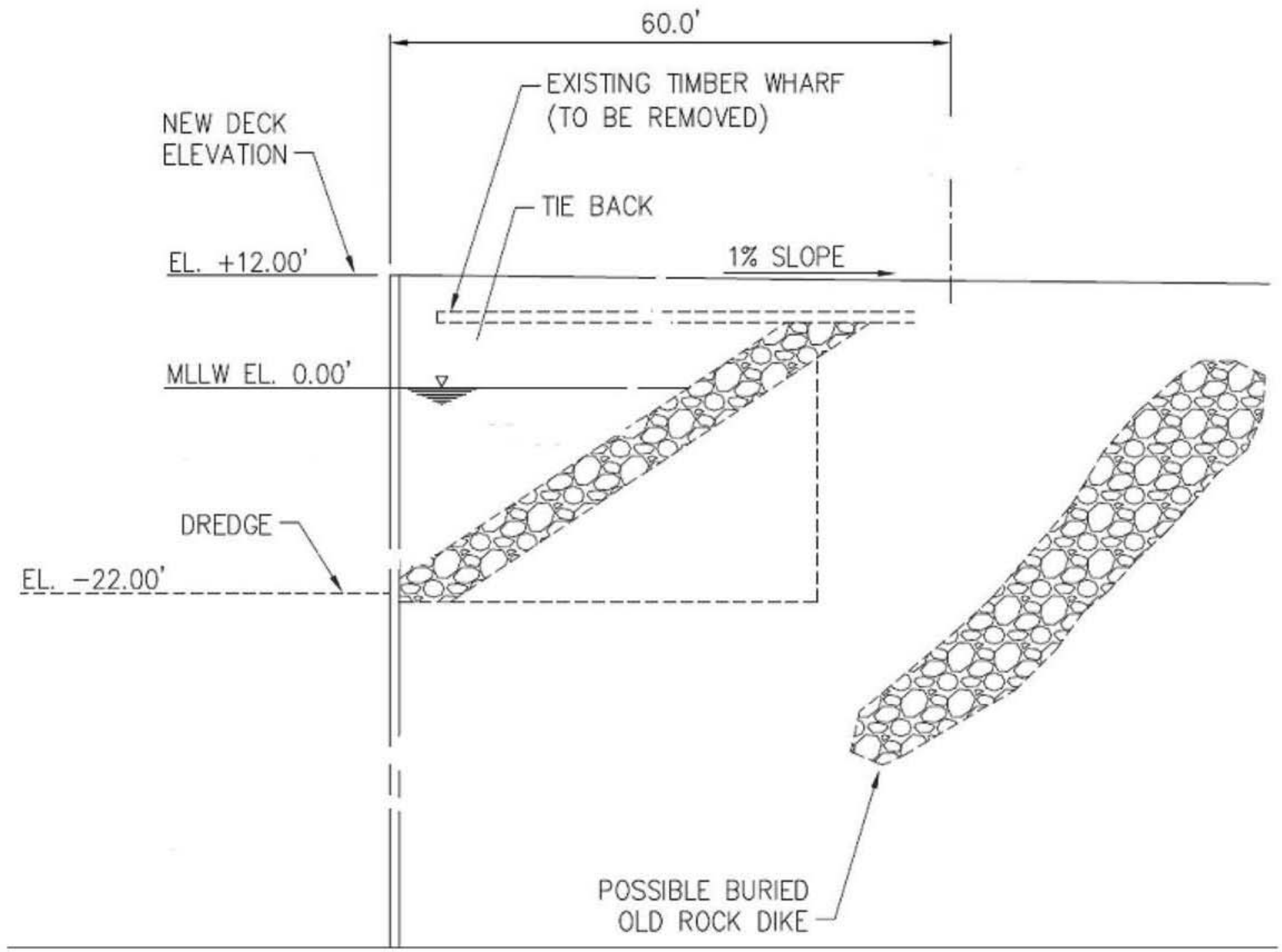
SOURCE: Drawing prepared from Halcrow 2009.

C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 3

Sep 24, 2009 10:45am banaya

Figure 3
Phase 1 Construction Activities
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

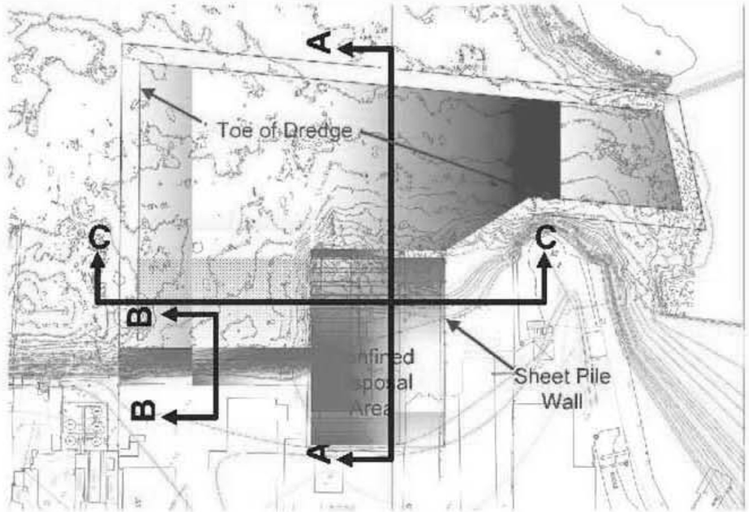
ANCHOR QEA Halcrow



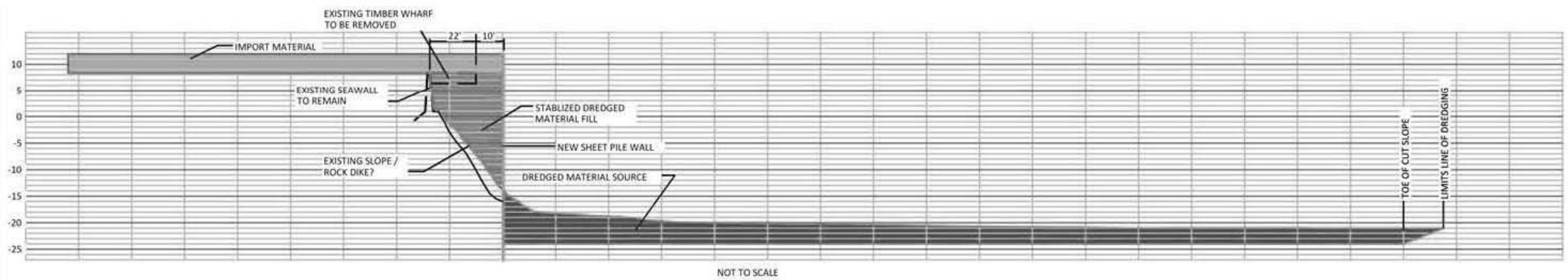
SOURCE: Drawing prepared from Halcrow 2009.

ANCHOR QEA Halcrow

Figure 4
Sheetpile Wall Cross Section
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility



SECTION B-B



SOURCE: Drawing prepared from Halcrow 2009.

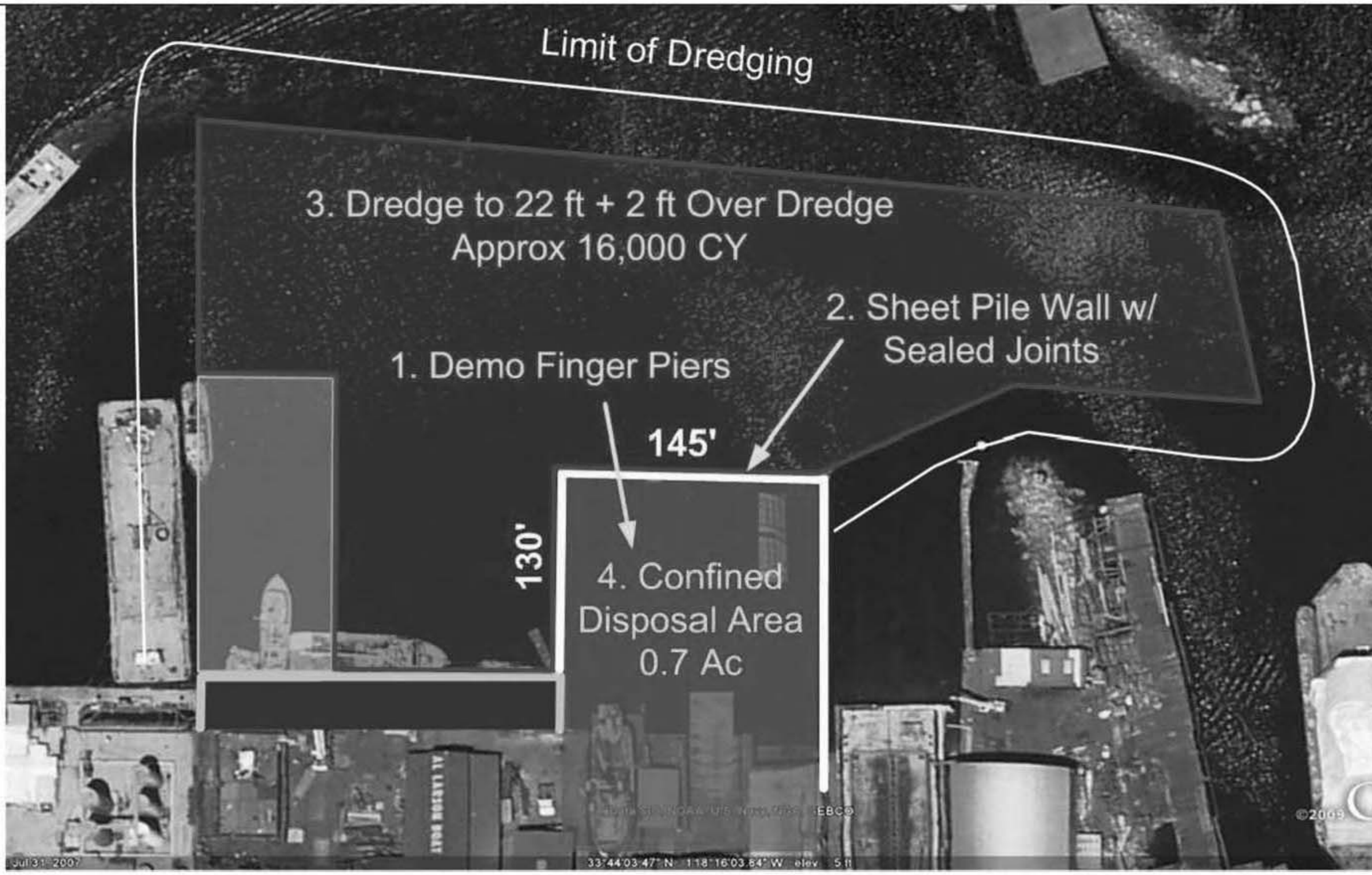
C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 5

Sep 24, 2009 10:45am banaya

Figure 5
Phase 1 Cross Section
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

ANCHOR QEA Halcrow

Sep 24, 2009 10:45am banaya C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 6



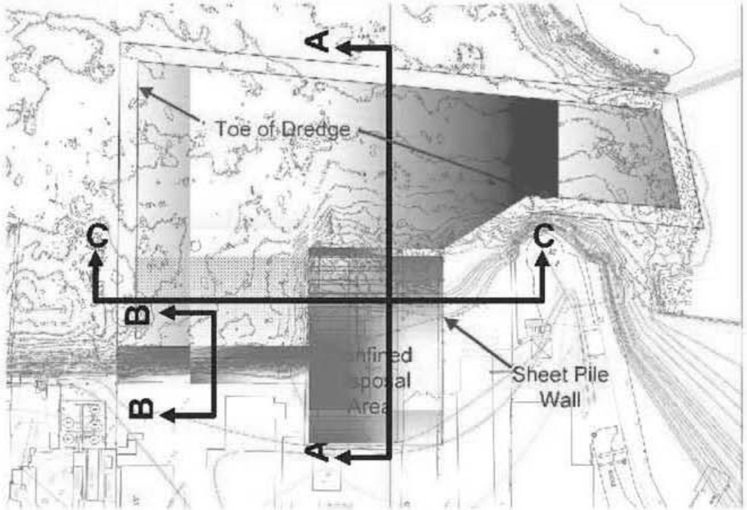
SOURCE: Drawing prepared from Halcrow 2009.

Figure 6

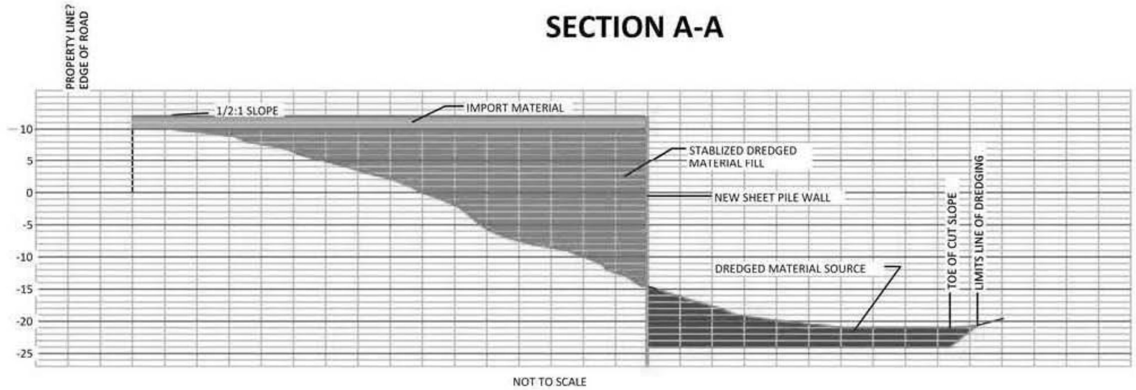
Phase 2 Construction Activities

Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

C:\DOCUME~1\banaya\LOCALS~1\Temp\AcPublish_3536\090623-01-RP-001.dwg Figure 7
Sep 24, 2009 10:45am banaya



SECTION A-A



SOURCE: Drawing prepared from Halcrow 2009.

Figure 7
Phase 2 Cross Section
Al Larson Boat Shop Dredging and Upland Confined Disposal Facility

APPENDIX A
CHEMICAL AND GEOTECHNICAL CHARACTERIZATION OF SEDIMENTS IN THE VICINITY OF AL LARSON BOAT SHOP, PORT OF LOS ANGELES

Final Report

Chemical and Geotechnical Characterization of Sediments in the Vicinity of Al Larson Boat Shop, Port of Los Angeles

Prepared for

Port of Los Angeles
Environmental Management
425 South Palos Verdes St.
San Pedro, CA 90731

WESTON SOLUTIONS

Final Report

Chemical and Geotechnical Characterization of Sediments in the Vicinity of Al Larson Boat Shop, Port of Los Angeles

Prepared for

Port of Los Angeles
Environmental Management
425 South Palos Verdes St.
San Pedro, CA 90731

Prepared by

Weston Solutions, Inc.
2433 Impala Drive
Carlsbad, California 92010

April 2007

APPENDICES

TABLES

FIGURES

ABBREVIATIONS and ACRONYMS

ALBS	Al Larson Boat Shop
AL1	Parcel 1
AL4	Parcel 4
COC	chain of custody
DBT	dibutyltin
DDT	dichlorodiphenyltrichloroethane
DGPS	differential global positioning system
ER-L	effects range–low
ER-M	effects range–median
FH	Fish Harbor
GC/MS SIM	gas chromatography – mass spectrometry with selected ion monitoring
GFAAS	graphite furnace atomic absorption spectrometry
HMW	high molecular weight
ICP-MS	inductively coupled plasma – mass spectrometry
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LMW	low molecular weight
MDL	method detection limit
MLLW	mean lower low water
MBT	monobutyltin
MRL	method reporting limit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PSA	preliminary site assessment
QA	quality assurance
QAP	quality assurance plan
QC	quality control
RPD	relative percent difference
SAP	sampling and analysis plan
SOP	standard operating procedure
SVOC	semivolatile organic compounds
TBT	tributyltin
TTBT	tetrabutyltin
TTLC	total threshold limit concentration
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbon
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
Weston	Weston Solutions, Inc.

UNITS of MEASURE

°C	degrees Celsius
ft	feet
mg/kg	milligram per kilogram
mL	milliliter
µg/kg	microgram per kilogram

1. INTRODUCTION

1.1 BACKGROUND AND HISTORY

The Port of Los Angeles consists of both water and land use areas covering 7,500 acres and is located in a heavily urbanized area, 20 miles south of downtown Los Angeles. Considered a landlord port, the Port of Los Angeles leases its property to tenants such as the owners of the Al Larson Boat Shop (ALBS), who operate their own facilities. The ALBS consists of 6 parcels of land and 3 parcels of water (i.e., 7.7 acres of land and 5.35 acres of water) and is located at 1046 Seaside Avenue, Berth 258, near the entrance to Fish Harbor (Figure 1). To the north, ALBS is bounded by the Mobil Oil Company (formerly leased by the General Petroleum marine fueling facility), and to the south, the Al Larson Marina. ALBS is bounded by the waters of Fish Harbor to the east, and until recently, Southwest Marine Inc. was located to the west and southwest.

ALBS began boat building and repair services in 1903 and is the oldest shipyard in Southern California. In the early 1900s, ALBS repaired and built small to medium sized boats. By the 1950s, ALBS was building yachts, fishing boats, and navy patrol crafts, and by the 1980s, ALBS began repairing larger ships such as Navy vessels. Today, ALBS is a full service shipyard which incorporates four marine railways, a floating dry dock, and dockside work areas, all separated by wood docks and piers. The marine railways at the shipyard range from 100 tons to 1,250 tons and are capable of hauling-out barges up to 60 ft wide and 250 ft long. The floating dry dock is 200 ft long and 44 ft wide with the ability to haul vessels up to 1,000 tons. ALBS currently services both commercial and recreational customers, maintaining and repairing tugboats, government vessels, fireboats, ferries, barges, offshore oil equipment, research vessels, and yachts, as well as other types of marine equipment.

Previous environmental assessments have been performed to primarily evaluate the ALBS facility and areas immediately adjacent to ALBS for environmental contamination. A Phase I Preliminary Site Assessment (PSA) was performed by Tetra Tech, Inc. in 1993. Results of the PSA indicated that in some areas of ALBS, soil and sediment were likely contaminated with waste materials including sandblast waste, oils, paints, and solvents (Tetra Tech, Inc. 1994). Later, a full site investigation was performed to further determine the types and levels of contaminants within soil and sediment samples from various locations within the ALBS facility (Mesa Environmental Services 1998). Significant levels of contamination were detected throughout the ALBS facility, but the type of contamination depended on the sampling location. At specific sites, there were high levels of diesel-weight refined hydrocarbons, polycyclic aromatic hydrocarbons, organotins, volatile organics, or metals in both soil and sediment samples. Similar to these findings, investigations on contaminants in other areas within the Port of Los Angeles have also demonstrated elevated levels of contaminants in soil or sediment. For example, mercury and butyltins were elevated in sediments from Parcel 4 within the former Southwest Marine leasehold area in the Port of Los Angeles (Anchor Environmental, L.L.C. 2005).

1.2 OBJECTIVE

The purpose of this study was to delineate the spatial distribution (vertical and horizontal) of chemical and geotechnical characteristics of sediments within and adjacent to ALBS, which has been operating in Fish Harbor, within the Port of Los Angeles for over 100 years. This study was undertaken to provide the Port with the information necessary for their management of potentially contaminated sediment in this leasehold.

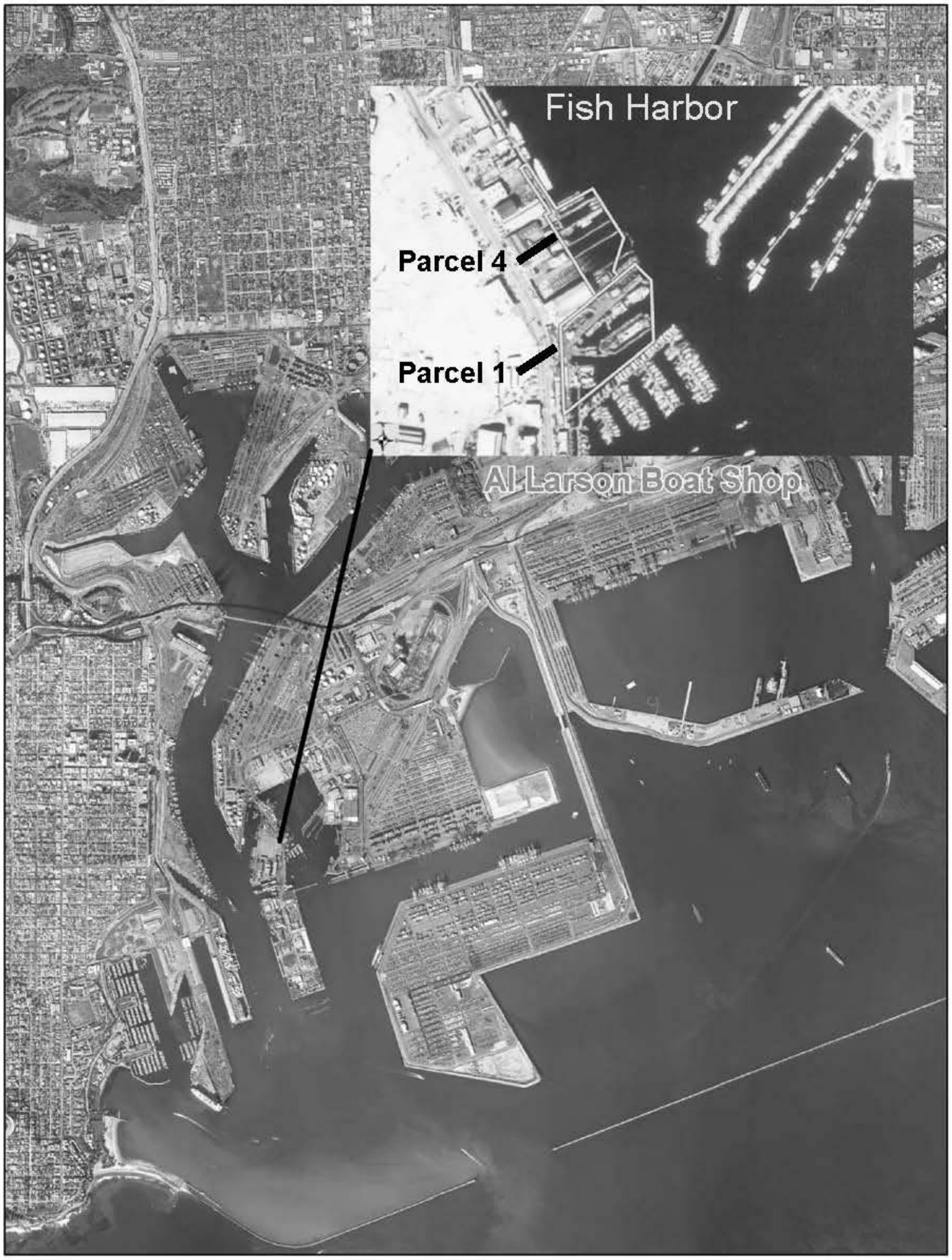


Figure 1. Location of Al Larson Boat Shop leasehold within the Port of Los Angeles

2. MATERIALS AND METHODS

2.1 JANUARY 2005 SAMPLING EVENT

2.1.1 Field Collection Overview

To delineate the spatial magnitude of contamination, sediment core samples were initially collected in January of 2005 from 21 stations in the vicinity of ALBS including eight stations within Parcel 1 (AL1), six stations within Parcel 4 (AL4), and seven stations outside of the leasehold area in Fish Harbor (FH), as described in the sampling plan prepared by Weston Solutions, Inc. (Weston). To determine the depth of contamination, sediment cores were collected to 5 ft unless refusal was encountered. Analyses were performed in two phases as shown in Table 1, to minimize the total number of samples analyzed. In phase 1, chemical and geotechnical analyses were performed on surface sediments (0-1 ft sections) from all stations (n = 21). Subsurface sediment samples (2-3 ft sections) were also collected and analyses performed (n = 13) in the deeper portions of the ALBS lease hold area and Fish Harbor. Phase 2 analyses were based on results of metals chemistry; if relatively high metal contaminants were detected 3 ft below the surface, additional analyses of deeper core sections (3-4 ft or 4-5 ft) were performed.

2.1.2 Stations and Depths

Sampling was conducted January 19-20, 2005. The weather was clear to partly cloudy and the sea was generally calm with mild chop in the afternoons. Sediment was collected at 21 out of 22 planned stations from three separate areas (ALBS Parcel 1, ALBS Parcel 4, and Fish Harbor Area). The presence of a large barged docked over Station AL-6 prevented sampling from being completed at this station. Between six and eight core locations were designated within each area (Figure 2). The core identification numbers, locations, and target core length are provided in the sampling and analysis plan (SAP; Weston 2005a).

2.1.3 Navigation

Pre-plotted station positions were located using a Furuno 1650D Differential Global Positioning System (DGPS). The system uses U.S. Coast Guard differential correction data, and is accurate to ±10-16 ft. All final station locations were recorded in the field using positions from the DGPS.

Table 1. Phased approach used in January of 2005 to analyze chemicals and geotechnical characteristics of sediment collected from the ALBS leasehold and outer areas of Fish Harbor.

Sampling Area	**Core ID**	**Target Core Length**	**Core Segment Samples Analyzed Using Phased Approach**					**Analyses Performed**
			0 - 1 ft	**1 - 2 ft**	**2 - 3 ft**	**3 - 4 ft**	**4 - 5 ft**	
ALBS Parcel 1	AL1-1	5 ft						Geotechnical and Chemical Sediment Analyses
	AL1-2	5 ft						
	AL1-3	5 ft						
	AL1-4	5 ft						
	AL1-5	5 ft						
	AL1-6	5 ft						
	AL1-7	5 ft						
	AL1-8	5 ft						
ALBS Parcel 4	AL4-9	5 ft						
	AL4-10	5 ft						
	AL4-11	5 ft						
	AL4-12	5 ft						
	AL4-13	5 ft						
	AL4-14	5 ft						
	AL4-15	5 ft						
Fish Harbor Area	FH-16	5 ft						
	FH-17	5 ft						
	FH-18	5 ft						
	FH-19	5 ft						
	FH-20	5 ft						
	FH-21	5 ft						
	FH-22	5 ft						

- Phase I Analysis
- Phase II Analysis, if Phase I yields low contamination at 2 to 3 ft
- Phase II Analysis, if Phase I yields high contamination at 2 to 3 ft
- Phase II Analysis, if Phase I yields *very* high contamination at 2 to 3 ft

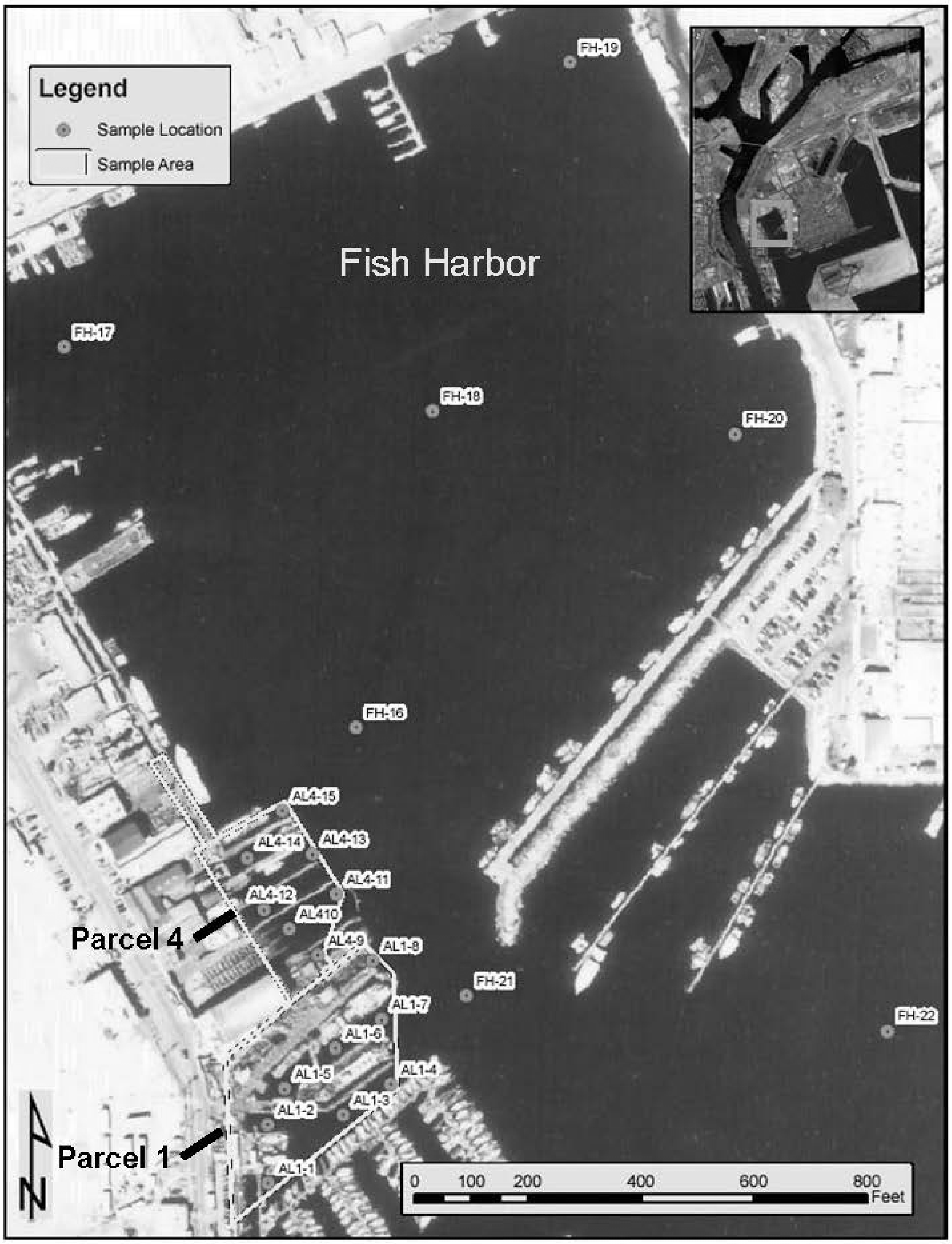


Figure 2. Project Area and Stations for the January 2005 sampling event in Fish Harbor, Port of Los Angeles, Los Angeles, CA

2.1.4 Core Collection and Handling

Cores were collected using a piston core (Figure 3, Figure 4). This manually operated collection device was deployed from the *RV JB*, a licensed sampling vessel. In cases where structural obstacles prevented vessel access to the station, samples were taken from piers or barges located adjacent to the sampling station. The piston core is capable of collecting cores up to 8 ft long in water depths up to 25 ft, and therefore, was sufficient to cover the target sampling depths (< 22 ft) necessary for this project.

At each of the sample locations, a new polyethylene core tube was attached to the end of the piston core. Appropriate lengths of aluminum extensions were added to the coring device in order to attain the target sampling depth. Unless refusal was encountered, the piston core tube was then advanced to at least 5 ft below the mudline. As the corer was removed from the sediment, a plunger within the piston core tube created a vacuum seal preventing loss of sediment and minimizing sediment disturbance upon retrieval. Core tubes were detached from the piston, sealed with end caps, and placed vertically in a rack. The cores were segmented, secured, and labeled. After allowing the core to settle for approximately 20 minutes, a measurement was taken of the core length and other relevant sediment characteristics were recorded (e.g., color). Water overlying the sediment within the core tube was drained by drilling a hole in the tube approximately 0.5-in above the water/sediment interface.

All sediment cores were collected to the appropriate depth unless refusal was encountered. Refusal is defined as less than 2 inches of penetration per minute. If refusal was encountered, the sample location was moved and a second core attempted. If refusal was encountered again, additional cores were not attempted unless operational problems were suspected.

Sediment cores were sectioned and homogenized in 1-ft depth horizons for analysis. Each section was homogenized in a stainless steel bowl with stainless steel utensils. Material was placed in glass jars with Teflon lined-lids; 500 mL of material was archived at Weston's laboratory in Carlsbad, 500 mL was analyzed for chemical constituents at Calscience Environmental Laboratories, and 500 mL was placed in a Ziploc™ bag for grain size and total organic carbon (TOC) analysis.

2.1.5 Need for Additional Sampling in September 2005

Initial analyses of sediment collected during January of 2005 indicated there were elevated concentrations of many contaminants in the vicinity of ALBS and outside of the leasehold area in Fish Harbor. Specifically, the concentrations of several analytes in sediment samples were greater than Effects Range-Median (ER-M) values (see section 4.2.1). In addition, copper, mercury, and total polychlorinated biphenyls (PCBs) were detected at concentrations greater than the total threshold limit concentration (TTLC) at several sample locations. Contamination was limited to the top 3 ft in all but one station in Parcel 1, while contamination was deeper than 3 ft in Parcel 4. The stations in the Fish Harbor area were far more variable; FH-17, FH-19 and FH-20, located in the corners of Fish Harbor had elevated contaminants at depths greater than 3 ft, while elevated contaminants were limited to the top 2 ft at FH-16, FH-18, FH-21, and FH-22. To examine the horizontal distribution of contaminants, data was interpolated using an inverse distance weighted method, and maps were generated to illustrate the concentration of specific contaminants such as mercury in surface sediments. The data interpolation had limited confidence because it was primarily based on sediment chemistry from stations within and immediately adjacent to the leasehold area. Nonetheless, mercury concentrations determined by this method were in excess of ER-M values throughout Fish Harbor and the ALBS leasehold area.

Preliminary sediment chemistry findings from the January 2005 sampling event indicated that additional site characterization was required to demonstrate the full extent of the spatial contamination patterns within Fish Harbor sediments (i.e., vertical and horizontal distribution). Specifically, higher resolution of the chemical data was needed for more accurate mapping of contaminant distributions. To obtain higher resolution, it was necessary to determine the maximum depth of sediment contamination by using deeper cores, and to establish the gradient of horizontal contamination from the ALBS leasehold area into outer portions of Fish Harbor (i.e., the outfall in the northeast corner of Fish Harbor), by measuring contaminants in sediment cores from more stations outside of the ALBS leasehold. Thus, it was determined that a second sampling event was necessary to more precisely determine the distribution of sediment contaminants within Fish Harbor.

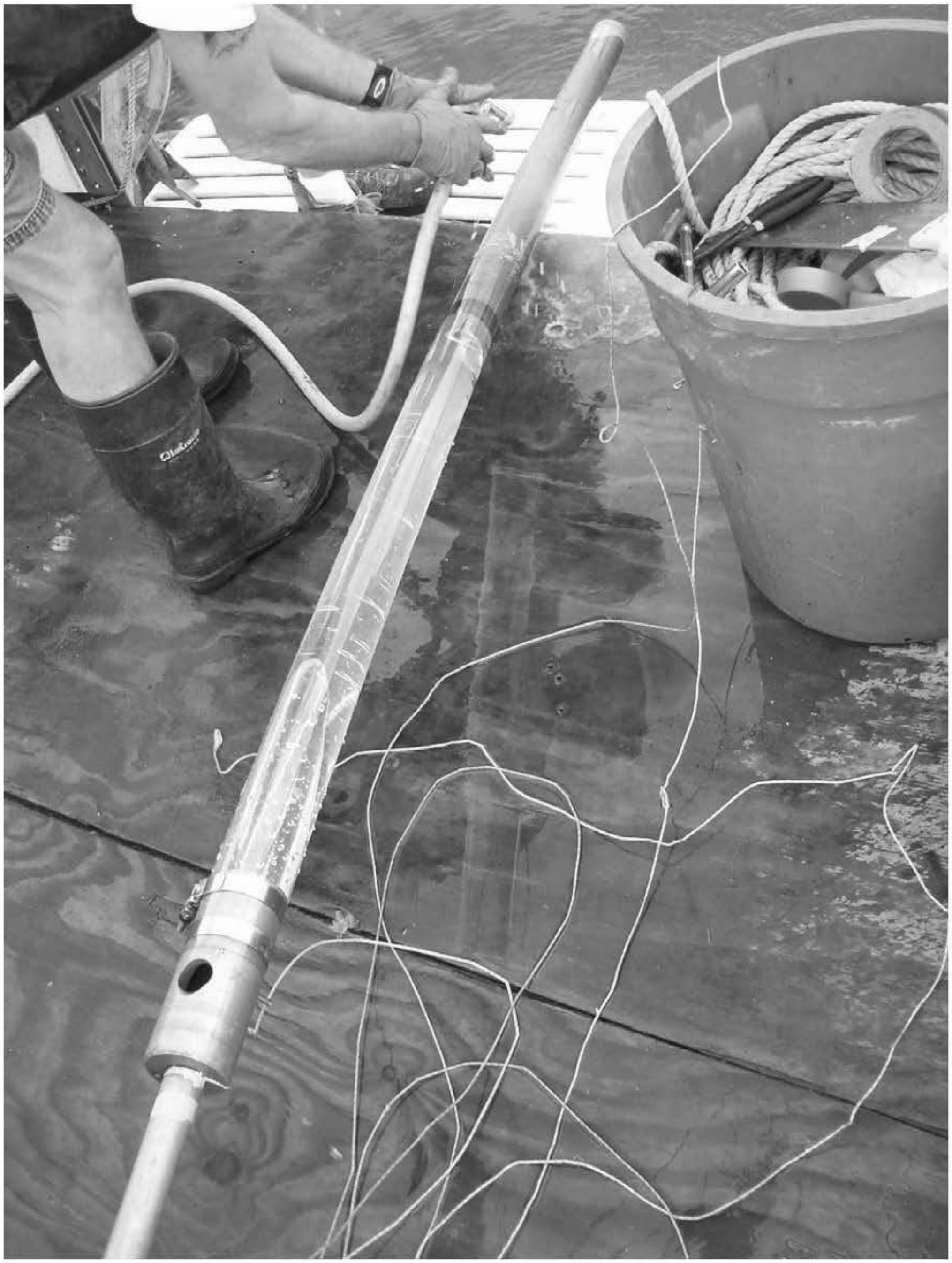


Figure 3. The piston core used in Fish Harbor, Los Angeles, California

Figure 4. Piston core samples in 1-ft sections taken from Fish Harbor, Los Angeles, California

2.2 September 2005 Sampling Event

The purpose of the September 2005 sampling event was to more precisely delineate the spatial (horizontal and vertical) distribution of chemical and geotechnical characteristics of sediments within and adjacent to the ALBS leasehold areas. Additional sediment core samples were collected on September 1- 2, 2005 from 10 stations within and outside of the ALBS leasehold area in Fish Harbor (Figure 5).

2.2.1 Field Collection Overview

Within Fish Harbor and adjacent to the ALBS leasehold area, 10 sediment cores were collected to 10 ft below the existing harbor bottom for all sample locations (Table 2). In order to minimize the total number of samples analyzed, analyses were phased. Chemical and geotechnical analysis were performed on the material collected in the surface (0-2 ft) and subsurface (4-6 ft). If preliminary chemistry data suggested that subsurface material contained elevated contaminant concentrations, then subsequent analyses of deeper sediments were performed. In addition, archived samples of each 2 ft section of material were frozen for possible future analyses.

Sampling was conducted September 1-2, 2005. The weather was clear and the sea was calm with mild chop in the afternoons. Sediment was collected from 10 out of 12 planned stations within the Fish Harbor, in the Port of Los Angeles[1]. The core identification numbers, locations, and target core length are provided in the SAP (Weston, 2005b).

[1] Per discussions with Kathryn Curtis during the sampling event, SV2 and SV3 were eliminated from sampling plan.

Table 2. Phased approach used in September of 2005 to analyze chemicals and geotechnical characteristics of sediment collected from the ALBS leasehold and outer areas of Fish Harbor.

Sampling Area	Core ID	Target Core Length	Core Segment Samples Analyzed Using Phased Approach For Chemical Analyses				Analyses Performed
Fish Harbor Area	SV-1	10 ft	0 - 2 ft	2 - 4 ft	4 - 6 ft	8 - 10 ft	Geotechnical and Chemical Sediment Analyses
	SV-4	10 ft					
	SV-5	10 ft					
	SV-6	10 ft					
	SV-7	10 ft					
	SV-8	10 ft					
	SV-9	10 ft					
	SV-10	10 ft					
	SV-11	10 ft					
	SV-12	10 ft					

Phase I Analysis

Phase II Analysis, if Phase I yields low contamination only at 4 - 6 ft

Phase II Analysis, if Phase I yields high contamination at 4 - 6 ft

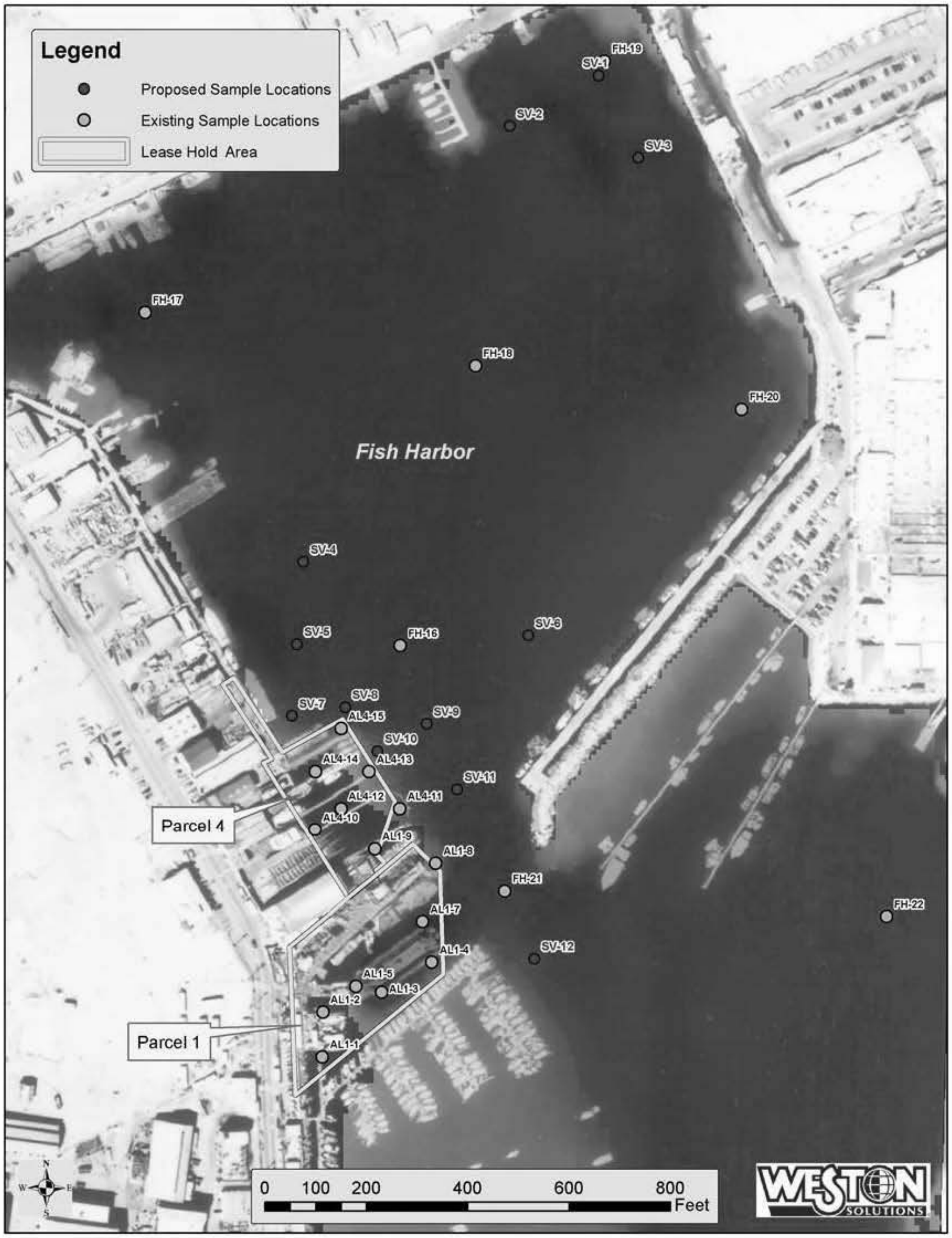


Figure 5. Project Area with Proposed Core Sampling Locations for the September 2005 Sampling Event in Fish Harbor, Port of Los Angeles, Los Angeles, CA

2.2.2 Stations and Depths

Sediment core samples were sampled from ten stations that were either within the Al Larson leasehold area (SV-8, SV-10) or in the Fish Harbor area (Figure 5). Stations SV-1, SV-8, and SV-10 were equivalent to the previously sampled stations called FH-19, AL4-15, and AL4-13, respectively, and were re-sampled to examine contaminant concentrations at greater depths. All other stations were chosen to further examine both the horizontal and vertical distribution of contaminants near the ALBS leasehold and surrounding areas in Fish Harbor.

2.2.3 Navigation

Pre-plotted station positions were located using the *RV Zephyr*'s Leica 300 SmallMX DGPS or a handheld Garmen eTrex GPS. The systems use U.S. Coast Guard differential correction data, and are accurate to less than ±10 ft. All final stations were recorded in the field using positions from the DGPS.

2.2.4 Core Collection and Handling

For areas accessible by boat, vibratory sediment cores were collected using an electric P-3 vibracore (Figure 6). This unit was deployed from the *RV Zephyr*. The vibracore was equipped with a 4-inch outer diameter aluminum barrel and stainless steel cutter head. The standard system was capable of collecting cores up to ~20 ft long. All sediment cores were collected to the appropriate depth unless refusal was encountered. Refusal is defined as less than 2 inches of penetration per minute. If refusal was encountered, the sample location was moved and a second core attempted. If refusal was encountered again, additional cores were not attempted unless operational problems were suspected. Each sediment core sample was brought to the vessel platform or dock, where the sediment sample was extruded from the core barrel onto polyethylene-lined collection trays, for subsequent logging and processing. Each sediment core sample was brought to the vessel platform, where the sediment sample was extruded from the core barrel onto polyethylene-lined collection trays. Each core was examined by a qualified scientist and photographed. The geologic description of each core was performed as described above.

Sediment cores were sectioned and homogenized in 2-ft depth horizons for analysis. Each section was homogenized in a stainless steel bowl with stainless steel utensils. Material was placed in glass jars with Teflon lined-lids; 500 mL of material was archived at Weston's laboratory in Carlsbad, 500 mL was analyzed for chemical constituents at Calscience Environmental Laboratories, and 500 mL was placed in a Ziploc™ bag for grain size and TOC analysis.

Figure 6. P-3 Vibracore Sampler

2.3 SAMPLE SHIPPING AND STORAGE

2.3.1 Sample Processing and Storage

Samples were labeled, placed on ice, and shielded from light until delivered to the laboratory for analysis. Any sediment sections not immediately analyzed were archived at -18°C at the Weston laboratory in Carlsbad in the event chemical characterization was required.

2.3.2 Documentation and Chain-of-Custody

Chain-of-custody (COC) procedures were initiated during sample collection. A COC record was provided with each sample or sample group. Each person who had custody of the samples signed the form and ensured that the samples were not left unattended unless properly secured. Completed COC forms were placed in a plastic envelope inside the ice chest containing the listed samples. The COC form was signed by the person transferring custody of the samples. The condition of the samples was recorded by the receiver. COC records were included in the final analytical report prepared by the laboratory, and were considered an integral part of that report. Samples were considered to be in custody if they were (1) in the custodian's possession or view, or (2) retained in a secured place (under lock) with restricted access. The principal documents used to identify samples and to document possession were COC records, field logbooks, and field tracking forms. COC procedures were used for all samples throughout the collection, transport, and analytical process and for all data and data documentation, whether in hard copy or electronic format. COC forms are reproduced in Appendix A.

2.3.3 Decontamination of Field and Laboratory Equipment

All piston core and vibracore sampling equipment was cleaned prior to sampling. Between stations, the core housing and deck of the vessel were rinsed with site water. New core tubes and caps were used at each sample location.

3. CHEMICAL AND GEOTECHNICAL ANALYSIS

Physical and chemical endpoints measured in this testing program were selected to provide data on potential chemicals of concern in Los Angeles Harbor. All analytical methods used to obtain contaminant concentrations follow U.S. Environmental Protection Agency (USEPA) or Standard Methods (SM). In addition, chemical and geotechnical measures selected for this evaluation are consistent with those recommended for assessing dredged material in Los Angeles. (USEPA and U.S. Army Corps of Engineers [USACE] 1991; USEPA Region IX and USACE-LA 1993). The specific sediment chemical analyses and target detection limits are listed in the SAPs (Weston, 2005a and b).

3.1 SEDIMENT CHEMISTRY

The analysis for priority pollutant metals (except mercury) was conducted using an inductively coupled plasma emissions spectrometer equipped with a mass detector (ICP-MS), in accordance with USEPA 6020. Mercury analysis was conducted using graphite furnace atomic absorption spectrophotometry (GFAAS), in accordance with USEPA 7471. The analysis for total and dissolved sulfides followed USEPA 376.2M. The analysis for dissolved ammonia followed USEPA 350.2M. Oil and grease were measured using USEPA 1664. Total recoverable petroleum hydrocarbons (TRPH) were measured by USEPA 415.1. Semivolatile organics (SVOC) (including polycyclic aromatic hydrocarbons [PAHs,] phthalates and phenols), organochlorine pesticides, and PCBs were analyzed using gas chromatography-mass spectrometry with selected ion monitoring (GC/MS SIM), using USEPA Method 8270 SIM, following serial extraction with methylene chloride and alumina and gel permeation column cleanup procedures. The PCBs were identified to the Aroclor level and individual congeners. The analytical method used to determine tributyltin (TBT) and its derivatives involves methylene chloride extraction, followed by Grignard derivatization and analyzed by GC/MS (Krone et al. 1989). Sediment chemical concentrations were compared to sediment quality guidelines.

3.2 GEOTECHNICAL ANALYSES

Physical analyses of the sediment included grain size, TOC, and total solids. Grain size analysis was conducted using the gravimetric procedure described in Plumb (1981) to determine the general size classes that make up the sediment (e.g., gravel, sand, silt, and clay). The frequency distribution of the size ranges of the sediment was reported in the final data report. The TOC, made up of volatile and nonvolatile organic compounds, was determined using modified USEPA 415.1. This procedure involves dissolving inorganic carbon (carbonates and bicarbonates) with phosphoric acid prior to TOC analysis. Total solids were also measured to convert concentrations of the chemical measures from a wet-weight to a dry-weight basis. Total solids were determined by SM 2540G.

3.3 QUALITY ASSURANCE/QUALITY CONTROL

The quality assurance/quality control (QA/QC) objectives for chemical analysis conducted by the participating analytical laboratories are detailed in their Laboratory QA Manual(s). These objectives for accuracy and precision involve all aspects of the testing process, including the following:

- Methods and standard operating procedures (SOPs)
- Calibration methods and frequency
- Data analysis, validation, and reporting
- Preventive maintenance
- Internal QC
- Procedures to ensure data accuracy and completeness

Results of all laboratory QC analyses were reported with the final data. Any QC samples that failed to meet the specified QC criteria in the methodology or quality assurance plan (QAP) were identified, and the corresponding data were appropriately qualified in the final report.

3.4 Data Review, Management, and Analysis

All data were reviewed and verified by participating team laboratories to determine whether all data quality objectives have been met, and that appropriate corrective actions have been taken, when necessary. All laboratories supplied analytical results in both hard copy and electronic formats. Laboratories had the responsibility of ensuring that both forms were accurate. Data analysis consisted of tabulation and comparison with regulatory guidelines. Patterns were examined in the chemistry data to describe the contaminant concentration and distribution within and adjacent to the ALBS leasehold area. Long et al. (1995) screening criteria were included in a sediment chemistry results summary table for comparison.

4. RESULTS

4.1 Sample Collection and Handling

4.1.1 Sample Collection: January 2005

Field coordinates, number of cores per station, depth of penetration relative to the mudline (i.e., the sediment surface), depth of recovery relative to the mudline, and core length retained for each station location are summarized in Table 3. Field core logs and core photos are provided in Appendix B.

Table 3. Field coordinates and sample depths for sediment core samples collected in January of 2005

Core ID	Attempt	Latitude (NAD83)	Longitude (NAD83)	Water Depth (ft MLLW)	Core Length (ft)	Penetration (ft)	Target Sampling Depth (ft MLLW)	Actual Depth Sampled (ft MLLW)	Core Length Retained for Processing & Analysis (ft)	Comments
AL1-1	1 of 1	33 43.959	118 16.093	7.0	3.0	3.5	12.0	10.5	3.1	Refusal due to riprap
AL1-2	1 of 2	33 43.979	118 16.095	7.2	0.8	1.5	12.0	8.7	0.0	Refusal due to riprap- sample discarded
AL1-2	2 of 2	33 43.975	118 16.091	10.1	1.0	1.5	15.1	11.6	1.0	Refusal due to riprap
AL1-3	1 of 1	33 43.980	118 16.070	25.1	3.8	4.0	30.1	29.1	3.8	Refusal @ 29.1’
AL1-4	1 of 1	33 43.991	118 16.053	22.3	3.75	4.0	27.3	26.3	3.75	Refusal @ 26.3’
AL1-5	1 of 1	33 43.982	118 16.080	26.7	2.8	3.4	31.7	30.1	2.8	Refusal @ 30.1’
AL1-6	Not Attempted due to barge docked over sample location									
AL1-7	1 of 2	33 44.004	118 16.050	29.0	1.5	3.0	34.0	32.0	1.5	Refusal @ 32.0’- sample lost upon retrieval; re-sampled
AL1-7	2 of 2	33 44.003	118 16.054	29.2	3.1	4.0	33.2	32.3	3.1	Refusal @ 32.3’-
AL1-8	1 of 2	33 44.022	118 16.049	14.3	0.0	0.0	19.3	14.3	0.0	Refusal @ surface
AL1-8	2 of 2	33 44.020	118 16.047	16.4	4.4	4.7	21.4	21.1	4.4	Refusal @ 21.4’
AL4-9	1 of 2	33 44.030	118 16.080	0.9	0.8	0.8	5.9	1.7	0.8	Refusal due to cement
AL4-9	2 of 2	33 44.030	118 16.080	0.9	0.9	0.9	5.9	1.8	0.9	Refusal due to cement
AL4-10	1 of 2	33 44.033	118 16.096	0.7	0.6	0.6	5.7	1.3	0.0	Sample discarded- refusal due to cement
AL4-10	2 of 2	33 44.033	118 16.096	0.7	1.8	2.0	5.7	2.7	1.8	Refusal @ 2.7’ due to cement
AL4-11	1 of 2	33 44.040	118 16.063	11.5	3.2	3.2	16.5	14.7	3.2	Refusal @ 14.7’ due to cement
AL4-11	2 of 2	33 44.040	118 16.063	11.5	3.7	3.8	16.5	15.3	3.7	Refusal @ 15.3’ due to cement
AL4-12-	1 of 2	33 44.040	118 16.085	6.9	2.8	3.7	11.9	10.6	2.8	Refusal @ 10.6’
AL4-12	2 of 2	33 44.040	118 16.085	6.9	6.1	6.1	11.9	13.0	6.1	
AL4-13	1 of 2	33 44.054	118 16.075	14.3	0.0	2.3	19.3	16.3	0.0	Refusal due to hard structure
AL4-13	2 of 2	33 44.052	118 16.075	14.7	3.2	3.9	19.7	18.6	3.9	Refusal @ 18.6’ due to cement

Core ID	Attempt	Latitude (NAD83)	Longitude (NAD83)	Water Depth (ft MLLW)	Core Length (ft)	Penetration (ft)	Target Sampling Depth (ft MLLW)	Actual Depth Sampled (ft MLLW)	Core Length Retained for Processing & Analysis (ft)	Comments
AL4-14	1 of 1	33 44.052	118 16.096	4.2	3.2	3.7	9.2	7.9	3.2	Refusal @ 7.9'- oil sheen at surface of water
AL4-15	1 of 2	33 44.066	118 16.086	13.8	3.1	3.5	18.8	17.3	3.1	Refusal@ 17.3' – core damaged, sample discarded
AL4-15	1 of 2	33 44.066	118 16.087	14.3	5.2	4.3	19.3	19.5	4.3	
FH-16	1 of 1	33 44.093	118 16.063	21.2	4.3	4.2	26.2	25.5	4.2	Refusal @ 25.5'
FH-17	1 of 1	33 44.201	118 16.163	21.4	5.0	5.3	26.4	26.7	5.0	
FH-18	1 of 1	33 44.184	118 16.034	24.3	3.8	4.2	29.3	28.5	3.8	Refusal @ 28.5' due to rock
FH-19	1 of 1	33 44.283	118 15.984	23.8	5.4	5.9	28.8	29.7	5.4	
FH-20	1 of 1	33 44.170	118 15.930	18.2	5.9	6.4	23.2	24.6	5.9	Fish scales in sample
FH-21	1 of 1	33 44.013	118 16.022	23.6	2.9	3.4	28.6	27.0	2.9	Refusal @ 27.0'
FH-22	1 of 1	33 44.005	118 15.873	24.5	4.0	4.3	29.5	28.8	4.0	Refusal @ 28.8'

4.1.2 Sample Collection: September 2005

Field coordinates, number of cores per station, depth of penetration relative to the mudline (i.e., the sediment surface), depth of recovery relative to the mudline, and core length retained for each station location are summarized in Table 4. Field core logs and core photos are provided in Appendix B.

Table 4. Field coordinates and sample depths for sediment core samples collected in September of 2005

Core ID	Attempt	Latitude (NAD83)	Longitude (NAD83)	Water Depth (ft MLLW)	Core Length (ft)	Penetration (ft)	Target Sampling Depth (ft MLLW)	Actual Depth Sampled (ft MLLW)	Core Length Retained for Processing & Analysis (ft)	Comments
SV-1	1 of 1	33 44.275	118 15.987	22.9	10.0	10.0	30.7	30.7	10.0	8-10 sample contains fish scales; No refusal
SV-4	1 of 1	33 44.115	118 14.093	25.0	9.0	9.0	31.5	30.5	9.0	Small shell layer at 3.5' and 7'; No refusal
SV-5	1 of 1	33 44.111	118 16.099	25.2	9.0	9.0	30.9	29.9	9.0	No refusal
SV-6	1 of 1	33 44.095	118 16.017	22.8	8.0	8.0	28.5	26.5	8.0	Refusal @ 8'
SV-7	1 of 1	33 44.064	118 16.103	19.8	9.0	9.0	27.7	26.7	9.0	Refusal @ 9'
SV-8	1 of 1	33 44.074	118 16.081	17.4	7.5	7.5	24.7	22.2	7.5	Refusal @ 7.5
SV-9	1 of 1	33 44.070	118 16.062	25.0	9.5	9.5	30.9	29.9	9.5	Refusal @ 9.5'; Oily sheen visible to 6'
SV-10	1 of 2	33 44.043	118 16.083	14.9	5.5	5.5	21.8	27.3	5.5	Refusal @ 5.5'
SV-10	2 of 2	33 44.043	118 16.083							Discarded
SV-11	1 of 1	33 44.052	118 16.040	24.7	8.5	8.5	31.3	29.3	8.0	Refusal @ 8.5'
SV-12	1 of 1	33 43.988	118 16.032	20.2	11.0	11.0	27.8	27.8	10.0	No refusal

4.2 ANALYTICAL RESULTS

Results of physical and chemical analyses for ALBS project sediments are discussed below. All results are expressed in dry weight unless otherwise indicated in Table 5 and Table 6. Target detection limits are provided in the SAP (Weston, 2005a and b). The actual detection limits and raw data for the analyses are provided in Appendix C. Analysis was not conducted on samples SV-4, SV-5, and SV-6[2].

Results of chemical analyses of sediment contaminants were compared to effects range-low (ER-L) and ER-M values developed by Long et al. (1995). The effects range values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., amphipod tests) and chemical analysis were available for individual samples. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. The ER-L and ER-M sediment quality values are included in Table 5 and Table 6.

For certain pesticide compounds (dieldrin and chlordane for example) the ER-L (0.02 µg/kg and 0.5 µg/kg, respectively) and ER-M levels (8 µg/kg and 6 µg/kg, respectively) are so low as to make it largely impractical to detect them in typical harbor sediments using standard EPA-approved analytical procedures. This is also true of dichlorodiphenyltrichloroethane (DDT) compounds. Accordingly, having non-detect results that are greater than the ER-L, ER-M, or method detection limits (MDLs) would not require re-analysis.

The measured chemical constituents are provided for surface sediments and subsurface sediments (Table 5 and Table 6). Analytes detected at concentrations greater than ER-L values were bolded, concentrations greater than ER-M were bolded and underlined, and concentrations greater than TTLCs were highlighted in yellow in the sediment chemistry tables.

---

[2] Per discussions with Kathryn Curtis, it was decided to hold off on analysis of these sample locations until it was determined that the analysis would be necessary to delineate contaminant patterns. These samples are currently stored at Weston's laboratory in Carlsbad.

Table 5. Chemical and geotechnical characteristics of surface and subsurface sediment from stations sampled in January 2005 within and outside the ALBS leasehold areas of Fish Harbor

Analyte	ER-L	ER-M	TTLC	AL1-1	AL1-1	AL1-2	AL1-3	AL1-3	AL1-4	AL1-4	AL1-4	AL1-5	AL1-5	AL1-7	AL1-7	AL1-7	AL1-8	AL1-8	AL1-8	AL4-9	AL4-10	AL4-10	AL4-11	AL4-11	AL4-11	AL4-12	AL4-12
Depth (ft.)	-	-	-	0-1	2-3	0-1	0-1	3-4	0-1	2-3	3-4	0-1	2-3	0-1	1-2	2-3	0-1	1-2	2-3	0-1	0-1	1-2	0-1	2-3	3-4	0-1	4-5
Physical Analyses																											
Gravel (%)	-	-	-	5.83	0.87	4.58	0.28	0.59	0.14	0.79	0.00	4.72	5.27	3.74	11.66	2.85	1.44	4.02	0.61	4.70	3.08	1.48	4.70	5.34	0.46	0.22	1.35
Sand (%)	-	-	-	73.53	96.20	66.80	13.63	95.01	12.14	26.65	94.91	32.98	65.19	85.53	85.94	95.66	91.29	82.75	86.85	88.58	91.59	95.95	10.84	75.83	91.44	40.46	68.15
Silt (%)	-	-	-	7.63	1.58	11.13	39.49	2.52	42.49	34.66	2.66	32.63	13.95	4.94	1.00	0.48	2.63	5.84	5.18	2.60	3.07	1.53	47.79	7.78	3.01	39.88	13.44
Clay (%)	-	-	-	13.01	1.35	17.50	46.61	1.88	45.23	37.90	2.42	29.68	15.59	5.78	1.40	1.02	4.63	7.40	7.36	4.13	2.26	1.04	36.67	11.04	5.09	19.45	17.07
Solids, Total (%)	-	-	-	64.8	82	80.2	45.1	82.7	48.2	47.5	79.3	50.2	69.4	56.7	86.6	85.1	70.6	73.8	73.4	76	79	78.6	37.6	72.3	77	50.4	56.9
General Chemistry			-																								
TOC (%)	-	-	-	1.89	0.32	1.75	2.36	0.15	2.13	2.41	0.10	1.80	1.38	0.42	0.63	0.48	0.75	1.02	1.02	1.34	1.41	0.92	3.56	1.57	1.04	3.18	3.23
Specific Gravity	-	-	-	1.72	1.81	1.58	1.31	1.63	1.25	1.3	1.59	1.42	1.7	1.66	1.91	1.75	1.64	1.65	1.73	1.42	2.21	2.08	1.15	1.62	1.77	1.33	1.49
Ammonia	-	-	-	<0.31	0.85	4.9	19	2.7	17	84	19	44	26	17	0.4	1.3	6.1	2.5	2.1	2.9	2.1	0.35	40	12	5.1	32	56
Sulfide, Dissolved	-	-	-	<0.15	-	<0.13	<0.22	-	<0.21	<0.21	-	<0.20	-	<0.18	-	<0.12	<0.14	-	<0.14	<0.13	<0.13	-	<0.26	<0.14	-	<0.20	-
Sulfide, Total	-	-	-	2.3	0.37	190	260	<0.12	290	330	<0.13	280	540	650	<0.12	<0.12	0.99	0.68	2.6	3.3	<0.13	<0.13	1400	0.97	<0.13	840	1300
Oil and Grease	-	-	-	120	29	21	190	<12	500	460	15	500	410	150	<12	<12	72	240	93	220	77	180	600	330	420	3200	4400
TRPH	-	-	-	100	31	21	170	<12	390	350	20	370	290	140	<12	<12	55	190	83	150	59	150	500	210	260	2200	2700
Metals (mg/kg)																											
Arsenic	8.2	70.0	500	8.98	3.29	5.33	21.3	0.59	22.1	18.5	0.86	23.8	22.2	24.4	0.69	0.74	12.7	6.27	4.01	37.2	43.1	82.4	26.3	13.9	3.57	80.2	35.7
Cadmium	1.2	9.6	100	0.46	<0.122	0.16	0.84	<0.120	0.66	1.46	<0.127	1.14	1.26	0.97	<0.115	<0.118	0.26	0.41	0.26	1.43	1.99	2.67	0.81	0.80	0.28	2.45	1.73
Chromium	81.0	370.0	500	54.4	7.81	69.1	94.5	9.71	105	82.4	11.7	78.8	174	124	7.14	7.19	62.6	104	29.0	86.3	60.3	112	89.5	60.6	12.6	167.0	70.5
Copper	34.0	270.0	2,500	424	6.35	118	1140	5.55	1110	637	6.16	2320	1390	1120	7.76	4.24	249	86.2	44.7	1490	4840	3050	1440	533	54.9	11300	1300
Lead	46.7	220.0	1,000	94.0	5.88	28.4	114	1.99	119	113	1.38	107	164	151	4.44	1.29	123	50.5	16.7	328	444	474	149	236	41.7	740	401
Mercury	0.2	0.7	20	1.73	<0.102	1.04	1.47	<0.101	2.07	1.83	<0.106	1.03	2.60	1.01	<0.0960	<0.0980	0.52	0.36	0.18	1.40	0.13	1.25	1.94	4.36	0.37	6.79	45.9
Nickel	20.9	51.6	2,000	13.6	4.96	6.31	43.1	6.33	47.2	37.6	7.74	30.1	21.5	39.3	4.70	5.25	12.1	8.95	8.58	12.7	32.3	30.2	36.9	19.1	8.44	45.9	29.0
Selenium	-	-	100	1.41	<0.610	0.63	3.20	<0.602	3.71	2.88	<0.633	3.42	1.50	3.07	<0.575	<0.588	1.06	0.87	0.77	0.85	1.79	5.61	2.57	1.25	<0.649	4.27	1.92
Silver	1.0	3.7	500	0.47	<0.122	0.40	0.96	0.31	0.93	0.86	0.23	0.97	0.82	0.86	0.14	0.16	0.41	0.74	0.28	0.40	0.92	0.91	0.79	0.45	0.27	1.68	0.87
Zinc	150	410	5000	224	25	93	763	25	573	525	34	1220	1010	609	22	14	332	140	82	1800	1880	3580	782	339	66	3480	734
Aroclor (µg/kg)																											
Aroclor-1016	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Aroclor-1221	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Aroclor-1232	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Aroclor-1242	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Aroclor-1248	-	-	-	92	<12	54	<22	<12	110	110	<13	340	230	180	<12	<12	61	<14	34	120	<13	1300	<26	270	<13	2900	320
Aroclor-1254	-	-	-	80	<12	68	<22	<12	78	74	<13	370	270	170	<12	<12	88	<14	45	100	<13	240	110	280	<13	1700	270
Aroclor-1260	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Aroclor-1262	-	-	-	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Total Aroclors	22.7	180	50000	172	0	122	0	0	188	184	0	710	500	350	0	0	149	0	79	220	0	1540	110	550	0	4600	590
Pesticides (µg/kg)																											
2,4'-DDD	-	-	1000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<7.2	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	8.40	<1.3	2.30	<2.6	3.50	<1.3	<2.0	<1.8
2,4'-DDE	-	-	1000	<1.5	<1.2	<1.3	<2.2	<1.2	4.30	3.80	<1.3	<2.0	13.0	6.20	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
2,4'-DDT	-	-	1000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<7.2	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
4,4'-DDD	2.00	20.00	1000	3.80	<1.2	1.50	<2.2	<1.2	2.70	5.10	<1.3	<2.0	8.20	<1.8	<1.2	<1.2	<1.4	7.80	<1.4	24.00	<1.3	19.0	<2.6	<1.4	<1.3	26.0	9.10
4,4'-DDE	2.20	27.00	1000	39.0	<1.2	13.0	<2.2	<1.2	41.0	41.0	<1.3	32.0	110	59.0	<1.2	<1.2	16.0	14.0	14.0	22.0	2.80	31.0	21.0	70.0	2.60	220	240
4,4'-DDT	1.00	7.00	1000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	4.60	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Total DDTs	1.58	46.10	-	42.8	0.00	14.5	0.00	0.00	48.0	54.5	0.00	32.0	131.2	65.2	0.00	0.00	16.0	21.8	14.0	54.4	2.80	52.3	21.0	73.5	2.60	246	249.1
Aldrin	-	-	1400	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Alpha-BHC	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Beta-BHC	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Chlordane	-	-	2500	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18
Delta-BHC	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Dieldrin	0.02	8.00	8000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endosulfan I	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endosulfan II	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endosulfan Sulfate	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endrin	-	-	200	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endrin Aldehyde	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Endrin Ketone	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Gamma-BHC	-	-	4000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	3.00	<1.8
Heptachlor	-	-	4700	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Heptachlor Epoxide	-	-	-	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Methoxychlor	-	-	100000	<1.5	<1.2	<1.3	<2.2	<1.2	<2.1	<2.1	<1.3	<2.0	<1.4	<1.8	<1.2	<1.2	<1.4	<1.4	<1.4	<6.6	<1.3	<1.3	<2.6	<1.4	<1.3	<2.0	<1.8
Toxaphene	-	-	5000	<31	<24	<25	<44	<24	<42	<42	<25	<40	<29	<35	<23	<24	<28	<27	<27	<130	<25	<25	<53	<28	<26	<40	<35
Total Chlordane	-	-	2500	<15	<12	<13	<22	<12	<21	<21	<13	<20	<14	<18	<12	<12	<14	<14	<14	<66	<13	<13	<26	<14	<13	<20	<18

Table 5 Con't.

Analyte	ER-L	ER-M	TTLC	AL1-1	AL1-1	AL1-2	AL1-3	AL1-3	AL1-4	AL1-4	AL1-4	AL1-5	AL1-5	AL1-7	AL1-7	AL1-7	AL1-8	AL1-8	AL1-8	AL4-9	AL4-10	AL4-10	AL4-11	AL4-11	AL4-11	AL4-12	AL4-12
Depth (ft.)	-	-	-	0-1	2-3	0-1	0-1	3-4	0-1	2-3	3-4	0-1	2-3	0-1	1-2	2-3	0-1	1-2	2-3	0-1	0-1	1-2	0-1	2-3	3-4	0-1	4-5
Organotins (μg/kg)																											
Dibutyltin	-	-	-	49.2	<1	109	255	<1	85.7	120	<1	40.3	282	55.5	<1	<1	10.8	10.5	<1	246	806	686	55.0	55.2	<1	4880	139
Monobutyltin	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrabutyltin	-	-	-	5.30	<1	48.7	13.7	<1	9.90	22	<1	9.90	30.6	11.0	<1	<1	4.60	<1	<1	52.4	58.9	127	6.50	19.9	<1	860	<1
Tributyltin	-	-	-	238	<1	2030	1400	<1	634	902	<1	581	3160	425	3.4	<1	282	15.2	5.70	2150	4550	440	616	651	9.20	46800	133
PAHs (μg/kg)																											
Acenaphthene	16.0	500	-	<31	<24	2900	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	38	450	<3500
Acenaphthylene	44.0	640	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Anthracene	85.3	1100	-	84.0	<24	3000	73.0	<120	57.0	<42	<25	160	<1400	62.0	<23	<24	220	<27	<27	730	<25	<1300	180	<140	<26	620	<3500
Benzo (a) Anthracene	261	1600	-	150	<24	4600	140	<120	95.0	120	<25	380	<1400	140	<23	<24	190	44.0	<27	2100	76.0	1400	400	440	66.0	2100	<3500
Benzo (a) Pyrene	430	1600	-	290	<24	2800	230	<120	200	190	<25	320	<1400	200	<23	<24	230	64.0	<27	1800	46.0	<1300	480	580	110	2100	<3500
Benzo (b) Fluoranthene	-	-	-	400	<24	3300	300	<120	270	250	<25	450	<1400	260	<23	<24	310	65.0	<27	2000	58.0	<1300	540	670	120	2300	<3500
Benzo (g,h,i) Perylene	-	-	-	75.0	<24	<1300	60.0	<120	64.0	67.0	<25	<80	<1400	43.0	<23	<24	61.0	<27	<27	790	<25	<1300	130	160	43	660	<3500
Benzo (k) Fluoranthene	-	-	-	440	<24	3200	350	<120	280	280	<25	470	1400	260	<23	<24	350	65.0	<27	2200	56.0	<1300	610	720	120	2200	<3500
Chrysene	380	2800	-	300	<24	3900	310	<120	230	180	<25	650	1600	350	<23	<24	400	51.0	<27	2500	100	1500	890	870	75	2500	<3500
Dibenz (a,h) Anthracene	63.0	260	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	59.0	<140	<26	<400	<3500
Fluoranthene	600	5100	-	350	<20	13000	140	<97	160	240	<20	470	2100	140	<18	<19	500	69.0	<22	4700	110	3200	320	1100	66	4100	6100
Fluorene	19.0	540	-	<31	<24	3100	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	38.0	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Indeno (1,2,3-c,d) Pyrene	-	-	-	88.0	<24	<1300	69.0	<120	68.0	<42	<25	<80	<1400	48.0	<23	<24	66.0	<27	<27	820	<25	<1300	140	170	40	680	<3500
Naphthalene	160	2100	-	31.0	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Phenanthrene	240	1500	-	140	<24	17000	100	<120	110	170	<25	120	<1400	61.0	<23	<24	170	<27	<27	3200	98.0	1800	170	320	42	1900	<3500
Pyrene	665	2600	-	480	<24	11000	370	<120	260	570	<25	720	3200	350	<23	<24	540	370	37.0	5000	320	3300	1400	1400	620	4900	7900
Total LMW PAHs	552	3160	-	255	0	26000	173	0	167	170	0	280	0	123	0	0	428	0	0	3930	98.0	1800	350	320	80	2970	0
Total HMW PAHs	1700	9600	-	1570	0	35300	1190	0	945	1300	0	2540	6900	1180	0	0	1860	598	37.0	16100	652	9400	3549	4390	937	15700	14000
Total PAH	4022	44792	-	2828	0	67800	2142	0	1794	2067	0	3740	8300	1914	0	0	3075	728	37.0	25840	864	11200	5319	6430	1340	24510	14000
Phenols (μg/kg)																											
2,4,5-Trichlorophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2,4,6-Trichlorophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2,4-Dichlorophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2,4-Dimethylphenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2,4-Dinitrophenol	-	-	-	<150	<120	<6300	<220	<610	<210	<210	<130	<400	<7200	<180	<120	<120	<140	<140	<140	<3300	<130	<6400	<260	<700	<130	<2000	<18000
2-Chlorophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2-Methylphenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
2-Nitrophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
3/4-Methylphenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
4,6-Dinitro-2-Methylphenol	-	-	-	<150	<120	<6300	<220	<610	<210	<210	<130	<400	<7200	<180	<120	<120	<140	<140	<140	<3300	<130	<6400	<260	<700	<130	<2000	<18000
4-Chloro-3-Methylphenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
4-Nitrophenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Pentachlorophenol	-	-	17000	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Phenol	-	-	-	<31	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500
Phthalates (μg/kg)																											
Bis(2-Ethylhexyl) Phthalate	-	-	-	190	41.0	<630	200	1600	36000	97.0	49.0	440	<720	120	110	89	110	120	44.0	<330	<13	1500	410	160	66.0	1100	<1800
Butyl Benzyl Phthalate	-	-	-	<15	14.0	<630	<22	<61	<21	<21	<13	<40	<720	<18	20.0	<12	<14	38.0	<14	<330	<13	<640	<26	<70	<13	<200	<1800
Di-n-Butyl Phthalate	-	-	-	24.0	<12	<630	32.0	<61	27	<21	18.0	<40	<720	<18	<12	<12	<14	28.0	<14	<330	<13	<640	<26	<70	<13	<200	<1800
Di-n-Octyl Phthalate	-	-	-	63.0	<12	<630	<22	<61	<21	<21	<13	<40	<720	<18	<12	<12	<14	<14	<14	<330	<13	<640	<26	<70	<13	<200	<1800
Diethyl Phthalate	-	-	-	<15	<12	<630	<22	<61	24	<21	<13	<40	<720	<18	<12	<12	<14	<14	<14	<330	<13	<640	<26	<70	<13	<200	<1800
Dimethyl Phthalate	-	-	-	46.0	<24	<1300	<44	<120	<42	<42	<25	<80	<1400	<35	<23	<24	<28	<27	<27	<660	<25	<1300	<53	<140	<26	<400	<3500

Table 5 Con't.

Analyte	ER-L	ER-M	TTLC	AL4-13	AL4-13	AL4-14	AL4-14	AL4-15	AL4-15	AL4-15	FH-16	FH-16	FH-16	FH-17	FH-17	FH-17	FH-18	FH-18	FH-18	FH-19	FH-19	FH-19	FH-20	FH-20	FH-20	FH-21	FH-21	FH-21	FH-22	FH-22
Depth (ft.)	-	-	-	0-1	2-3	0-1	2-3	0-1	2-3	3-4	0-1	1-2	2-3	0-1	2-3	4-5	0-1	1-2	2-3	0-1	2-3	4-5	0-1	2-3	4-5	0-1	1-2	2-3	0-1	2-3
Physical Analyses																														
Gravel (%)	-	-	-	13.27	0.51	0.91	14.37	10.42	1.85	5.16	0.01	0.01	0.04	0.31	0.84	0.48	0.53	0.94	0.84	2.13	0.50	0.98	0.43	1.40	0.91	0.48	0.20	0.08	0.03	0.00
Sand (%)	-	-	-	13.71	40.74	69.50	70.58	51.18	80.43	69.23	20.77	77.00	96.19	5.79	53.41	94.87	38.70	70.61	90.11	19.98	46.98	42.46	77.93	66.36	85.72	46.88	67.37	66.47	8.88	25.20
Silt (%)	-	-	-	35.69	32.20	15.35	7.81	17.13	7.33	12.29	38.88	13.43	2.40	33.00	27.74	2.12	26.00	13.71	5.44	37.10	23.39	22.42	8.91	13.90	7.51	33.62	17.49	19.50	40.49	37.54
Clay (%)	-	-	-	37.33	26.56	14.25	7.24	21.27	10.39	13.33	40.35	9.56	1.36	60.90	18.01	2.54	34.76	14.74	3.61	40.79	29.13	34.14	12.73	18.34	5.87	19.03	14.94	13.95	50.60	37.26
Solids, Total (%)	-	-	-	34.8	58.5	52.6	69.7	33.8	72.4	72.1	57.6	72.4	79.4	39.3	47.9	81.3	50.6	62.3	77.4	52.6	53.1	55.4	60	62	71.3	56.5	68	68.5	48.2	54.6
General Chemistry			-																											
TOC (%)	-	-	-	3.13	1.72	2.10	3.04	1.88	1.33	1.23	2.12	0.52	2.17	2.64	0.70	0.28	2.37	1.67	0.33	2.97	2.46	2.78	0.98	1.84	0.76	1.38	0.92	0.63	2.08	1.81
Specific Gravity	-	-	-	1.16	1.46	1.43	1.73	1.44	1.6	1.65	1.3	1.7	1.68	1.14	1.53	1.7	1.4	1.58	1.73	1.28	1.44	1.38	1.82	1.44	1.7	1.52	1.58	1.58	1.26	1.37
Ammonia	-	-	-	28	17	12	11	49	16	17	14	8.6	12	15	44	8.5	16	18	14	85	130	120	4	45	27	7	6	15	12	82
Sulfide, Dissolved	-	-	-	<0.29	<0.17	<0.19	-	<0.29	<0.14	-	<0.17	-	<0.13	<0.26	<0.21	-	<0.20	-	<0.14	<0.19	<0.19	-	<0.17	<0.16	-	<0.18	-	<0.15	<0.21	<0.18
Sulfide, Total	-	-	-	74	<0.17	260	100	850	130	890	38	1.3	2.5	77	73	<0.12	<0.20	<0.16	1.4	420	340	1.6	0.25	1.3	<0.14	140	37	24	0.62	0.73
Oil and Grease	-	-	-	110	200	490	1300	180	280	1600	2200	240	30	380	2300	37	460	1800	63	2700	1600	3200	260	2100	1300	250	460	120	190	610
TRPH	-	-	-	100	170	400	890	160	200	990	1800	160	31	290	2100	35	360	1300	62	1500	2000	2400	180	3000	800	180	310	94	140	510
Metals (mg/kg)																														
Arsenic	8.2	70.0	500	18.8	61.4	25.1	29.3	12.9	30.0	39.9	10.4	4.23	2.37	25.1	18.0	2.84	19.1	8.28	4.25	24.6	18.1	18.8	10.0	9.52	3.98	14.1	5.50	7.63	20.9	18.5
Cadmium	1.2	9.6	100	0.61	2.70	0.58	1.39	0.65	1.24	1.64	0.94	0.34	<0.127	1.52	3.04	<0.123	0.69	1.33	0.14	1.62	1.61	11.2	0.54	1.23	0.41	0.66	0.76	1.18	1.19	3.33
Chromium	81.0	370.0	500	71.3	102	83.6	149	61.1	122	188	46.4	20.6	12.5	135	84.6	9.59	104	36.7	14.2	91.4	75.3	97.8	55.0	46.4	15.7	76.2	30.5	40.9	113	81.3
Copper	34.0	270.0	2,500	1150	2860	2280	1390	604	1020	897	202	25.3	6.28	725	348	7.18	521	172	14.0	1970	954	729	322	275	51.5	259	52	63.6	252	184
Lead	46.7	220.0	1,000	142	391	157	521	79.0	453	349	63.5	12.5	2.29	178	139	4.50	119	71.3	4.93	630	151	218	71.6	75.6	33.1	67.0	32.3	37.8	88.5	84.5
Mercury	0.2	0.7	20	1.83	2.62	3.14	20.4	1.55	8.13	7.21	1.75	<0.116	<0.106	2.39	3.52	<0.103	2.21	2.69	0.11	3.45	1.63	4.92	1.26	2.26	1.22	1.09	0.56	0.21	0.75	2.00
Nickel	20.9	51.6	2,000	28.8	33.3	26.3	31.5	27.1	17.8	25.3	23.4	13.4	7.80	61.4	37.4	5.79	47.1	19.7	8.72	30.4	34.6	39.4	24.6	20.4	9.56	39.1	17.6	25.7	59.2	43.2
Selenium	-	-	100	3.01	2.74	2.32	1.27	2.98	1.65	2.34	1.82	<0.694	<0.633	5.01	3.34	<0.617	3.31	1.32	0.70	2.71	5.65	2.48	1.95	1.64	<0.704	2.00	0.90	1.70	3.40	3.12
Silver	1.0	3.7	500	1.28	0.93	0.55	0.75	1.80	0.78	2.44	0.73	0.23	0.23	1.39	0.86	0.20	1.00	0.71	0.15	0.93	0.81	1.20	0.66	0.61	0.33	0.87	0.57	1.03	0.92	1.35
Zinc	150	410	5000	478	2220	782	769	350	1130	1440	238	69	32	601	575	29	388	248	42	1230	784	660	225	543	106	269	123	166	386	361
Aroclor (μg/kg)																														
Aroclor-1016	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Aroclor-1221	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Aroclor-1232	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Aroclor-1242	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Aroclor-1248	-	-	-	<29	540	340	4300	<29	1400	2800	110	<14	<13	370	270	<12	240	150	<13	560	170	3200	220	940	<14	130	<15	<15	370	660
Aroclor-1254	-	-	-	<29	3200	250	2000	<29	1100	5400	75	<14	<13	240	810	<12	160	73	<13	750	110	2200	180	530	<14	87	<15	<15	240	1300
Aroclor-1260	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Aroclor-1262	-	-	-	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Total Aroclors	22.7	180	50000	0	3740	590	6300	0	2500	8200	185	0	0	610	1080	0	400	223	0	1310	280	5400	400	1470	0	217	0	0	610	1960
Pesticides (μg/kg)																														
2,4'-DDD	-	-	1000	<2.9	5.20	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<21	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<16	<1.4	<1.8	<1.5	<1.5	<2.1	<18
2,4'-DDE	-	-	1000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	4.60	<1.4	<1.3	13.0	46.0	<1.2	9.50	<1.6	<1.3	<1.9	5.80	<1.8	<1.7	31.0	<1.4	5.70	<1.5	<1.5	6.30	43.0
2,4'-DDT	-	-	1000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<21	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<16	<1.4	<1.8	<1.5	<1.5	<2.1	<18
4,4'-DDD	2.00	20.00	1000	<2.9	24.0	12.0	62.0	<2.9	47.0	<69	<1.7	<1.4	<1.3	<2.6	13.0	<1.2	<2.0	<1.6	<1.3	43.0	5.60	<1.8	<1.7	5.50	<1.4	<1.8	<1.5	<1.5	<2.1	<18
4,4'-DDE	2.20	27.00	1000	19.0	120	92.0	170	11.0	160	590	66.0	<1.4	<1.3	110	420	<1.2	110	29.0	3.70	140	52.0	430	49.0	370	<1.4	56.0	5.40	<1.5	47.0	460
4,4'-DDT	1.00	7.00	1000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Total DDTs	1.58	46.10	-	19.0	149.2	104	232	11.0	207	590	70.6	0.0	0.0	123	479	0.00	119.5	29.0	3.70	183	63.4	430	49.0	406.5	0.0	61.7	5.40	0.0	53.3	503
Aldrin	-	-	1400	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Alpha-BHC	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Beta-BHC	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Chlordane	-	-	2500	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180
Delta-BHC	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Dieldrin	0.02	8.00	8000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endosulfan I	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endosulfan II	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endosulfan Sulfate	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endrin	-	-	200	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endrin Aldehyde	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Endrin Ketone	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Gamma-BHC	-	-	4000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Heptachlor	-	-	4700	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Heptachlor Epoxide	-	-	-	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Methoxychlor	-	-	100000	<2.9	<1.7	<1.9	<1.4	<2.9	<1.4	<69	<1.7	<1.4	<1.3	<2.6	<2.1	<1.2	<2.0	<1.6	<1.3	<1.9	<1.9	<1.8	<1.7	<1.6	<1.4	<1.8	<1.5	<1.5	<2.1	<18
Toxaphene	-	-	5000	<57	<34	<38	<29	<59	<28	<1400	<34	<28	<25	<51	<42	<25	<39	<32	<26	<38	<38	<36	<33	<32	<28	<36	<29	<29	<42	<360
Total Chlordane	-	-	2500	<29	<17	<19	<14	<29	<14	<690	<17	<14	<13	<26	<21	<12	<20	<16	<13	<19	<19	<18	<17	<16	<14	<18	<15	<15	<21	<180

Table 5 Con't.

Analyte	ER-L	ER-M	TTLC	AL4-13	AL4-13	AL4-14	AL4-14	AL4-15	AL4-15	AL4-15	FH-16	FH-16	FH-16	FH-17	FH-17	FH-17	FH-18	FH-18	FH-18	FH-19	FH-19	FH-19	FH-20	FH-20	FH-20	FH-21	FH-21	FH-21	FH-22	FH-22
Depth (ft.)	-	-	-	0-1	2-3	0-1	2-3	0-1	2-3	3-4	0-1	1-2	2-3	0-1	2-3	4-5	0-1	1-2	2-3	0-1	2-3	4-5	0-1	2-3	4-5	0-1	1-2	2-3	0-1	2-3
Organotins (μg/kg)																														
Dibutyltin	-	-	-	182	885	563	1720	106	2230	455	14.8	<1	<1	17.5	<1	<1	24.8	<1	<1	154	90.4	290	26.8	<1	<1	10.3	<1	<1	<1	<1
Monobutyltin	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrabutyltin	-	-	-	25.3	62.1	180	83.4	9.80	53.8	35.8	5.90	<1	<1	<1	<1	<1	<1	<1	<1	93.4	79.5	50.0	10.4	<1	<1	<1	<1	<1	<1	<1
Tributyltin	-	-	-	1360	4200	3260	5460	715	2680	1140	197	<1	<1	151	40.2	<1	175	1.60	<1	4840	3530	1040	475	14.3	<1	90.3	<1	<1	17.0	<1
PAHs (μg/kg)																														
Acenaphthene	16.0	500	-	**<290**	**<170**	**<190**	**<1400**	**120**	**<140**	**<280**	**<35**	**<28**	**<25**	**<52**	**<42**	**<25**	**<39**	**<1600**	**<28**	**840**	**<380**	**<360**	**<33**	**<32**	**<28**	**<36**	**<29**	**<29**	**<42**	**<36**
Acenaphthylene	44.0	640	-	**<290**	**<170**	**<190**	**<1400**	**60.0**	**<140**	**<280**	<35	<28	<25	**<52**	<42	<25	<39	**<1600**	<28	**<380**	**<380**	**<360**	<33	32.0	<28	<36	<29	<29	<42	<36
Anthracene	85.3	1100	-	**500**	**210**	**350**	**<1400**	**370**	**160**	**<280**	<35	<28	<25	56.0	<42	<25	<39	**<1600**	<28	**950**	**<380**	**750**	<33	41.0	<28	<36	<29	<29	<42	<36
Benzo (a) Anthracene	261	1600	-	**1200**	**610**	**860**	**<1400**	**630**	**500**	**680**	64.0	28.0	<25	110	110	<25	61.0	**<1600**	42.0	**1600**	**630**	**2500**	73.0	130	140	60.0	170	<29	<42	58.0
Benzo (a) Pyrene	430	1600	-	**1600**	**1000**	**1300**	**1600**	**650**	**970**	**880**	110	<28	<25	260	160	<25	78.0	**<1600**	47.0	**1700**	**480**	**1500**	170	210	87.0	89.0	190	37.0	<42	42.0
Benzo (b) Fluoranthene	-	-	-	2100	1200	1800	1600	860	1100	990	120	32.0	<25	350	170	<25	95.0	<1600	40.0	2000	580	2000	220	170	120	92.0	180	31.0	43.0	40.0
Benzo (g,h,i) Perylene	-	-	-	390	310	250	<1400	130	340	<280	57.0	<28	<25	110	45.0	<25	<39	<1600	<28	410	<380	<360	77.0	82.0	38.0	<36	67.0	<29	<42	<36
Benzo (k) Fluoranthene	-	-	-	2400	1600	1700	1800	920	1300	1100	140	38.0	<25	360	200	<25	99.0	<1600	46.0	2100	600	2000	240	260	130	130	190	42.0	<42	53.0
Chrysene	380	2800	-	**2200**	**900**	**1600**	**1500**	**1200**	**610**	**930**	83.0	32.0	<25	200	120	<25	93.0	**<1600**	35.0	**2400**	**870**	**3200**	130	110	160	96.0	190	<29	<42	75.0
Dibenz (a,h) Anthracene	63.0	260	-	**<290**	**<170**	**<190**	**<1400**	<59	**<140**	**<280**	<35	<28	<25	<52	<42	<25	<39	**<1600**	<28	**<380**	**<380**	**<360**	<33	<32	<28	<36	<29	<29	<42	<36
Fluoranthene	600	5100	-	**2200**	**920**	**1400**	**2600**	**1500**	**920**	**930**	81.0	26.0	<20	93.0	100	<20	81.0	**<1300**	29.0	**3800**	**910**	**2500**	86.0	150	380	110	150	29.0	<33	65.0
Fluorene	19.0	540	-	**<290**	**<170**	**<190**	**<1400**	**120**	**<140**	**<280**	**<35**	**<28**	**<25**	**<52**	**<42**	**<25**	**<39**	**<1600**	**<28**	**620**	**<380**	**<360**	**<33**	**<32**	**<28**	**<36**	**<29**	**<29**	**<42**	**<36**
Indeno (1,2,3-c,d) Pyrene	-	-	-	450	330	280	<1400	140	340	<280	52.0	<28	<25	100	43.0	<25	<39	<1600	<28	470	<380	<360	67.0	74.0	35.0	<36	61.0	<29	<42	<36
Naphthalene	160	2100	-	**<290**	**<170**	**<190**	**<1400**	60.0	<140	**<280**	<35	<28	<25	<52	<42	<25	<39	**<1600**	<28	**<380**	**<380**	**<360**	<33	<32	<28	<36	<29	<29	<42	<36
Phenanthrene	240	1500	-	**630**	**530**	**580**	**1800**	**750**	**520**	**510**	42.0	<28	<25	63.0	45.0	<25	<39	**<1600**	<28	**2200**	**<380**	**500**	43.0	57.0	<28	63.0	31.0	<29	<42	44.0
Pyrene	665	2600	-	**4500**	**5000**	**2100**	**3700**	**1500**	**2500**	**3100**	440	260	<25	310	630	38.0	120	**2000**	200	**4700**	**1400**	**7500**	300	**1600**	530	160	640	110	<42	240
Total LMW PAHs	552	3160	-	**1130**	**740**	**930**	**1800**	**1480**	**680**	510	42.0	0	0	119	45.0	0	0	0	0	**4610**	0	**1250**	43.0	130	0	63.0	31.0	0	0	44.0
Total HMW PAHs	1700	9600	-	**11700**	**8430**	**7260**	**9400**	**5480**	**5500**	**6520**	778	346	0	973	1120	38.0	433	**2000**	353	**14200**	**4290**	**17200**	759	**2200**	1297	515	1340	176	0	480
Total PAH	4022	44792	-	**18170**	**12610**	**12220**	**14600**	**9010**	**9260**	**9120**	1189	416	0	2012	1623	38.0	627	2000	439	**23790**	**5470**	**22450**	1406	2916	1620	800	1869	249	43.0	617
Phenols (μg/kg)																														
2,4,5-Trichlorophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2,4,6-Trichlorophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2,4-Dichlorophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2,4-Dimethylphenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2,4-Dinitrophenol	-	-	-	<1400	<860	<940	<7200	<300	<700	<1400	<170	<140	<130	<260	<210	<120	<200	<8000	<140	<1900	<1900	<1800	<170	<160	<140	<180	<150	<150	<210	<180
2-Chlorophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2-Methylphenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
2-Nitrophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
3/4-Methylphenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
4,6-Dinitro-2-Methylphenol	-	-	-	<1400	<860	<940	<7200	<300	<700	<1400	<170	<140	<130	<260	<210	<120	<200	<8000	<140	<1900	<1900	<1800	<170	<160	<140	<180	<150	<150	<210	<180
4-Chloro-3-Methylphenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
4-Nitrophenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
Pentachlorophenol	-	-	17000	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
Phenol	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36
Phthalates (μg/kg)																														
Bis(2-Ethylhexyl) Phthalate	-	-	-	1100	570	500	<720	260	990	520	61.0	45.0	42.0	3100	260	36.0	320	<800	660	5000	430	380	150	24000	46.0	59.0	24.0	17.0	100	36.0
Butyl Benzyl Phthalate	-	-	-	<140	<86	<94	<720	<30	<70	<140	<17	<14	<13	<26	<21	19.0	<20	<800	<14	<190	<190	<180	23.0	<16	67.0	<18	<15	<15	36.0	<18
Di-n-Butyl Phthalate	-	-	-	<140	<86	<94	<720	<30	<70	190	<17	<14	<13	<26	<21	<12	<20	<800	<14	<190	<190	<180	<17	<16	<14	<18	27.0	<15	<21	<18
Di-n-Octyl Phthalate	-	-	-	<140	<86	<94	<720	<30	<70	<140	<17	<14	<13	<26	<21	<12	<20	<800	<14	<190	<190	<180	<17	<16	62.0	<18	<15	<15	<21	<18
Diethyl Phthalate	-	-	-	<140	<86	<94	<720	<30	<70	<140	<17	<14	24.0	<26	<21	<12	<20	<800	<14	<190	<190	<180	<17	<16	<14	24.0	<15	<15	<21	<18
Dimethyl Phthalate	-	-	-	<290	<170	<190	<1400	<59	<140	<280	<35	<28	<25	<52	<42	<25	<39	<1600	<28	<380	<380	<360	<33	<32	<28	<36	<29	<29	<42	<36

4.2.1 Chemical and Physical Characteristics of Fish Harbor Sediments – January 2005

4.2.1.1 Surface sediment (0-1 ft in depth)

Surface sediment, consisting of material residing between 0 and 1 ft in depth below the mudline, was analyzed for each of the 21 stations.

Physical Analyses and General Chemistry
Grain sizes varied widely among the 21 analyzed surface (0-1 ft) sediment samples and are shown in Table 5. Generally, stations that were located further offshore consisted of significantly higher percentages of fine materials (silts and clays) than did the coarser grained nearshore locations. For example, FH-17, an offshore station, was comprised of 94% clay and silt, while AL4-9, a nearshore sample location, was comprised of 93% sand and gravel.

Total solids, not surprisingly were also reflective of shoreline proximity, with some of the sandier nearshore stations having 70-80% total solids while locations further offshore generally contained closer to an average of 52 % total solids. TOC ranged from 0.42% at AL1-7 (Parcel 1), to 3.56% at AL4-11 (Parcel 4), while specific gravity ranged from 1.14 at FH-17 to 2.21 at AL4-10. Total sulfides ranged from below the detection limit at FH-18 to 1400 mg/kg at AL4-11. No dissolved sulfides were detected. Oil and grease concentrations were highest in stations AL4-12 and FH-19. TRPH concentrations were highest in AL4-12 and FH-16, and ammonia levels in AL1-5, AL4-11, AL4-15, and FH-19 were above 40 mg/kg.

Metals
Metals were detected at significantly elevated concentrations within many surface sediment samples from the ALBS leasehold and surrounding areas (Table 5). Specifically, arsenic, copper, lead, mercury, nickel and zinc were detected at concentrations greater than ER-M values at many stations within the ALBS leasehold and surrounding areas.

Arsenic concentrations in surface sediment were higher than the ER-M value of 70 mg/kg at one station within Parcel 4 (AL4-12). Within the ALBS leasehold, arsenic concentrations ranged from 5.33 mg/kg at AL1-2 (Parcel 1) to 80.2 mg/kg at AL4-12 (Parcel 4). In Fish Harbor, arsenic concentrations ranged from 10.0 mg/kg at FH-20 to 25.1 mg/kg at FH-17.

Copper concentrations in surface sediment samples from stations within Parcel 1 (AL1-1, 3, 4, 5, 7), Parcel 4 (all stations), and Fish Harbor (FH-17 to 20) were above the ER-M value of 270 mg/kg. Copper concentrations at two stations within Parcel 4 (AL4-10 and AL4-12) were above the TTLC of 2,500 mg/kg. Within the ALBS leasehold area, copper concentrations in surface sediment ranged from 118 mg/kg at AL1-2 (Parcel 1) to 11,300 mg/kg at AL4-12 (Parcel 4). In Fish Harbor, copper concentrations ranged from 202 mg/kg at FH-16 to 1,970 mg/kg at FH-19.

Lead concentrations in surface sediment were above the ER-M value of 218 mg/kg at stations within Parcel 4 (AL4-9, 10, 12) and Fish Harbor (FH-19). Within the ALBS leasehold area, lead concentrations in surface sediment ranged from 28.4 mg/kg at AL1-2 (Parcel 1) to 740 mg/kg at AL4-12 (Parcel 4). In Fish Harbor, lead concentrations in surface sediment ranged from 63.5 mg/kg at FH-16 to 630 mg/kg at FH-19.

Mercury concentrations in surface sediment samples from stations within Parcel 1 (AL1-1, 2-5, 7), Parcel 4 (AL4-9, 11-14), and Fish Harbor (all stations) were detected above the ER-M value of 0.71 mg/kg. Within the ALBS leasehold area, mercury concentrations in surface sediment ranged from 0.13 mg/kg at

AL4-10 (Parcel 4) to 6.79 mg/kg at AL4-12 (Parcel 4). In Fish Harbor, mercury concentrations ranged from 0.75 mg/kg at FH-22, the reference station, to 3.45 mg/kg at FH-19.

Nickel concentrations in surface sediment samples were higher than the ER-M value of 51.6 mg/kg at only two stations within Fish Harbor (FH-17 and FH-22). Within the ABLS leasehold area, nickel concentrations in surface sediment ranged from 6.31mg/kg at AL1-2 (Parcel 1) to 47.2 mg/kg at AL1-4 (Parcel 1). In Fish Harbor, nickel concentrations ranged from 23.4 mg/kg at FH-16 to 61.4 mg/kg at FH-17.

Zinc concentrations in surface sediment samples from stations within Parcel 1 (AL1-3 to 7), Parcel 4 (AL4-9 to 14), and Fish Harbor (FH-17, 19) were detected above the ER-M value of 410 mg/kg. Within the ALBS leasehold area, zinc concentrations in surface sediment ranged from 93 mg/kg at AL1-2 (Parcel 1) to 3,480 mg/kg at AL4-12 (Parcel 4). In Fish Harbor, zinc concentrations ranged from 225 mg/kg at FH-20 to 1230 mg/kg at FH-19.

<u>PAHs</u>
Surface sediment PAH concentrations varied greatly between stations (Table 5). Total low molecular weight (LMW) PAH concentrations in surface sediment samples from one station within Parcel 1 (AL1-2) and one station within Parcel 4 (AL4-9) were detected above the ER-M value of 3,160 µg/kg. Within the ALBS leasehold area, total LMW PAH concentrations in surface sediment ranged from 98 µg/kg at AL4-10 (Parcel 4) to 26,000 µg/kg at AL1-2 (Parcel 1). In Fish Harbor, total LMW PAH concentrations ranged from below the detection limit at two stations (FH-18 and 22) to 4,610 µg/kg at FH-19.

Total high molecular weight (HMW) PAH concentrations in surface sediment samples from stations within Parcel 1 (AL1-2), Parcel 4 (AL4-9, 12, 13), and Fish Harbor (FH-19) were above the ER-M value of 9600 µg/kg. Within the ALBS leasehold area, total HMW PAH concentrations ranged from 652 µg/kg at AL4-10 (Parcel 4) to 35,300 µg/kg at AL1-2 (Parcel 1). In Fish Harbor area, total HMW PAH concentrations ranged from below the detection limit at FH-22, the reference station, to 14,200 µg/kg at FH-19.

Total PAH[3] concentrations in surface sediment samples were only above the ER-M value of 44,792 µg/kg at one station within Parcel 1 of the ALBS leasehold area (AL1-2). Within the ALBS leasehold, total PAH concentrations ranged from 864 µg/kg at AL4-10 (Parcel 4) to 67,800 µg/kg at AL1-2 (Parcel 1). In Fish Harbor, total PAH concentrations ranged from 43 µg/kg at FH-22, the reference station, to 23,790 µg/kg at FH-19.

<u>Organotins</u>
Dibutyltin (DBT), tetrabutyltin (TTBT), and TBT were found in the surface sediment samples from most stations within the ALBS leasehold area and surrounding areas (Table 5). However, monobutyltin (MBT) was below the detection limit (<1 µg/kg) at all stations. In addition, TBT concentrations were higher than DBT and TTBT concentrations in surface sediment samples from all stations in and surrounding the ALBS leasehold area.

Within the ALBS leasehold area, DBT concentrations in surface sediment ranged from 10.8 µg/kg at AL1-8 (Parcel 1) to 4880 µg/kg at AL4-12 (Parcel 4). In Fish Harbor, DBT concentrations in surface sediment ranged from below the detection limit at FH-22, the reference station, to 154 µg/kg at FH-19.

[3] Total PAHs are the sum of all PAHs measured above the MDL.

Within the ALBS leasehold area, TBT concentrations in surface sediment ranged from 238 µg/kg at AL1-1 (Parcel 1) to 46,800 µg/kg at AL4-12 (Parcel 4). In Fish Harbor, TBT concentrations ranged from 17 µg/kg at FH-22, the reference station, to 4,840 µg/kg at FH-19. Within the ALBS leasehold area, TTBT concentrations in surface sediment ranged from 4.6 µg/kg at AL1-8 (Parcel 1) to 860 µg/kg at AL4-12 (Parcel 4). In Fish Harbor, TTBT concentrations ranged from below the detection limit at most stations to 93.4 µg/kg at FH-19. While there are no ER-L or ER-M values to use as guidelines for assessing the potential biological significance of TBT or other organotin concentrations in sediment, a number of studies have evaluated sediment associated TBT effects at concentrations ranging from 100 to 7,000 µg/kg (McGee et al. 1995; Austen and McEvoy 1997; Meader et al. 1997; Stronkhorst et al. 1999; Meador and Rice 2001; Hallers-Tjabbes et al. 2003). It should be noted that the effect concentrations measured in the published literature are dependent on a number of factors including: the toxicity test organism/benthic community used, duration of exposure, the type of exposure (i.e., TBT-spiked sediment or natural sediment contaminated with TBT), endpoint of interest (e.g., growth), the sediment type (sandy/muddy/fine), and the TOC content found within the sediment. In addition to these studies, Meador (2000) used a tissue-residue effect concentration to derive a sediment TBT concentration protective of salmonids; a concentration of less than 120 µg/kg was determined to be protective, assuming a 2% organic carbon content of sediment. While less is known about the ecotoxicological effects of DBT and TTBT, previous studies on the chemistry and ecotoxicology indicate that these compounds likely exert similar effects in aquatic organisms to those observed for TBT (Mason and Jenkins 1995).

Total PCBs

Total PCBs: Individual PCB congeners were not measured in these sediment samples. Thus, total PCB estimates were based on levels of total Aroclors or PCB mixtures in samples.

Total Aroclors (PCB mixtures): Total Aroclors, consisting primarily of Aroclor 1248 and Aroclor 1254, were found in surface sediments throughout the ALBS leasehold area and in the Fish Harbor area (Table 5). Total Aroclor concentrations in surface sediment from stations within Parcel 1 (AL1-4, 5, 7), Parcel 4 (AL4-9, 12, 14), and Fish Harbor (all stations) exceeded the ER-M value for total PCBs[4] (180 µg/kg). In the ALBS leasehold area, total Aroclor concentrations in surface sediment ranged from below the detection limit at several stations to 4,660 µg/kg at AL4-12 (Parcel 4). In Fish Harbor, total Aroclor concentrations ranged from 185 µg/kg at FH-16 to 1310 µg/kg at FH-19.

Pesticides

The only pesticides detected in surface sediment samples from the ALBS leasehold area and the Fish Harbor area included lindane, DDT, and DDT derivatives (Table 5). Lindane (e.g., gamma-BHC) was only found above the detection limit at one station within the ALBS leasehold area (AL4-12). Total DDTs (consisting primarily of 2,4'-DDD, 2,4'-DDE, 4,4’-DDD and 4,4’-DDE) were detected at concentrations above the ER-M value of 46.1 µg/kg. Total DDT concentrations in surface sediment samples from stations within Parcel 1 (AL1-4, 7), Parcel 4 (AL4-9, 12, 14), and Fish Harbor (FH-16 to 22) were detected above the ER-M value of 46.1 µg/kg. Total DDT concentrations in surface sediment ranged from below the detection limit at AL1-3 (Parcel 1) to 246 µg/kg at AL4-12 (Parcel 4). In Fish Harbor, total DDT concentrations ranged from 49.0 µg/kg at FH-20 to 183.0 µg/kg at FH-19.

Phenols and Phthalates

Phenols were not detected in any of the surface sediment samples in the ALBS leasehold area or the Fish Harbor area. Phthalates including bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate,

---

[4] Total Aroclor concentrations were compared to ER-M values for total PCBs because Aroclors are PCB mixtures

di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate were detected in surface sediment samples from stations within the ALBS leasehold and the Fish Harbor area (Table 5); however, of these phthalates, only bis(2-ethylhexyl) phthalate was detected at significantly elevated levels within sediment samples. Within the ALBS leasehold area, concentrations of bis(2-ethylhexyl) phthalate in surface sediment ranged from below detection limits at one station within Parcel 1 (AL1-2) and two stations within Parcel 4 (AL4-9, 10) to 36,000 µg/kg at AL1-4 (Parcel 1). However, average concentrations in each of the locations were much lower than the highest concentration detected. Average bis(2-ethylhexyl) phthalate in Parcel 1, Parcel 4, and Fish Harbor were 5294, 481, and 1256 µg/kg, respectively. In Fish Harbor, concentrations of bis(2-ethylhexyl) phthalate in surface sediment ranged from 59 µg/kg at FH-21 to 5,000 µg/kg at FH-19.

4.2.1.2 Subsurface Sediment (below 1 ft deep)

Physical Analyses and General Chemistry
With the exception of sites AL1-4 (2-3 ft), AL4-13, FH-19, and FH-22 grain sizes of subsurface (below 1 ft) sediment across all stations were predominantly coarse grained, with most stations comprised of greater than 70 % sand and gravel (Table 5). The mean percentage of total solids for the coarse-grained stations was 72.8% and 53.8% for the finer-grained samples.

TOC ranged from 0.10 % at AL1-4 (3-4 ft) in Parcel 1 to 3.23 % at AL4-12 (4-5 ft) in Parcel 4, while specific gravity ranged from 1.30 at AL4 (2-3 ft) to 2.08 at AL4-10 (1-2 ft). Total sulfides ranged from below the detection limit at several stations to 1,300 mg/kg at AL4-12 (4-5 ft). In some cases, there was not sufficient pore water to conduct analyses for dissolved sulfides due to the sandy nature of the sample. No dissolved sulfides were detected in any of the samples for which analyses were performed. ALBS Parcel 4 sites AL4-12 (4-5 ft), 14 (2-3 ft), and 15 (3-4 ft) had concentrations of oil and grease above 1,000 mg/kg while in the Fish Harbor Area, stations FH-17 (2-3 ft), 18 (1-2 ft), 19 (2-3 ft and 4-5 ft) and 20 (2-3 ft and 4-5 ft) had oil and grease above 1,000 mg/kg. TRPH was also elevated in each of the stations with high amounts of oil and grease. Ammonia was greater than 40 mg/kg at AL1-4 (2-3 ft), AL4-12 (4-5 ft), FH-17 (2-3 ft), FH-19 (2-3 ft and 4-5 ft), FH-20 (2-3 ft), and FH-22 (2-3 ft).

Metals
Metals were detected at elevated concentrations within subsurface sediment samples from within the ALBS leasehold and surrounding areas (Table 5). Arsenic, cadmium, copper, lead, mercury, and zinc were detected at concentrations greater than ER-M values.

Arsenic concentrations in subsurface sediment were higher than the ER-M value of 70 mg/kg at one station within Parcel 4 (AL4-10, 1-2 ft). Within the ALBS leasehold, arsenic concentrations in subsurface sediment ranged from 0.59 mg/kg at AL1-3 (3-4 ft) in Parcel 1 to 82.4 mg/kg at AL4-10 (1-2 ft) in Parcel 4. In Fish Harbor, arsenic concentrations in subsurface sediment ranged from 2.37 mg/kg at FH-16 (2-3 ft) to 18.8 mg/kg at FH-19 (4-5 ft).

Cadmium concentrations were higher than the ER-M value of 9.6 mg/kg only in the subsurface sediment sample from FH-19 (4-5 ft). Within the ALBS leasehold, cadmium concentrations in subsurface sediment ranged from below the detection limit at several stations to 2.70 mg/kg at AL4-13 (2-3 ft) in Parcel 4. In Fish Harbor, cadmium concentrations ranged from below the detection limit at a few stations to 11.20 mg/kg at FH-19 (4-5 ft).

Copper concentrations in subsurface sediment samples from stations within Parcel 1 (AL1-4, 5), Parcel 4 (AL4-10 to 15), and the Fish Harbor area (FH-17, 19, 20) were above the ER-M value of 270 mg/kg. Within the ALBS leasehold area, copper concentrations ranged from 4.24 mg/kg at AL1-7 (2-3 ft) in Parcel 1, to 3,050 mg/kg at AL4-10 (1-2 ft) in Parcel 4. Moreover, at two stations within the ALBS leasehold area (AL4-10 and AL4-13), copper concentrations exceeded the TTLC (2,500 mg/kg). In Fish

Harbor, copper concentrations ranged from 6.28 mg/kg at FH-16 (2-3 ft) to 954 mg/kg at FH-19 (2-3 ft). With the exception of AL4-13 and AL4-15, copper concentrations were higher in surface samples than subsurface sediment samples. At stations AL4-13 and AL4-15, the highest copper concentrations were found in the 2-3 ft samples relative to other samples taken at these stations.

Lead concentrations in subsurface sediment were above the ER-M value of 220 mg/kg only at stations sampled within Parcel 4 (AL4-10 to 15). Within the ALBS leasehold area, lead concentrations in subsurface sediment ranged from 1.29 mg/kg at AL1-7 (2-3 ft) in Parcel 1 to 521 mg/kg at AL4-14 (2-3 ft) in Parcel 4. In Fish Harbor, lead concentrations ranged from 2.29 mg/kg at FH-16 (2-3 ft) to 218 mg/kg at FH-19 (4-5 ft). With the exception of FH-20, lead concentrations in Fish Harbor were higher in surface sediment samples relative to subsurface sediment samples. Within Parcels 1 and 4, lead concentrations were more variable with depth; changes in depth were dependent on the station from which samples were collected.

Mercury concentrations in subsurface sediment samples from stations within Parcel 1 (AL1-4, 5), Parcel 4 (AL4-10 to 15), and the Fish Harbor area (FH17-20, 22) were detected above the ER-M value of 0.71 mg/kg. The TTLC for mercury (20 mg/kg) also was exceeded at two stations, AL4-12 (4-5 ft) and AL4-14 (2-3 ft), within Parcel 4. Within the ALBS leasehold area, mercury concentrations in subsurface sediment ranged from below the detection limit at several stations within Parcel 1, to 45.9 mg/kg at AL4-12 (4-5 ft) in Parcel 4. In Fish Harbor, mercury concentrations ranged from below the detection limit at a few stations to 4.92 mg/kg at FH-19 (4-5 ft). Within Parcel 4 of the ALBS leasehold, mercury concentrations were higher in subsurface samples than in surface sediment samples. Within Parcel 1 and the Fish Harbor area, mercury concentrations were more variable with depth; changes in depth were dependent on the station from which samples were collected.

Zinc concentrations were above the ER-M value of 410 mg/kg in subsurface sediment samples from stations within Parcel 1 (AL1-4, 5), Parcel 4 (AL4-10, 12 to 15), and the Fish Harbor area (FH-17, 19, 20). Within the ALBS leasehold area, zinc concentrations in subsurface sediment ranged from 14.4 mg/kg at AL1-7 (2-3 ft) in Parcel 1 to 3,580 mg/kg at AL4-10 (1-2 ft) in Parcel 4. In Fish Harbor, zinc concentrations ranged from 28.7 mg/kg at FH-17 (4-5 ft) to 784 mg/kg at FH-19 (2-3 ft). Within Parcel 1, zinc concentrations were higher in surface sediment samples relative to subsurface sediment samples. However, within Parcel 4 and the Fish Harbor area, zinc concentrations were more variable with depth; changes in depth were dependent on the station from which samples were collected.

<u>PAHs</u>
Subsurface sediment PAH concentrations varied greatly between stations (Table 5). Total LMW PAH concentrations in subsurface sediment samples from all stations within and outside of the ALBS leasehold area were below the ER-M value of 3,160 µg/kg. Within the ALBS leasehold area, total LMW PAH concentrations in subsurface sediment ranged from below the detection limit at many stations, to 1800 µg/kg at AL4-10 (1-2 ft) and AL4-14 (2-3 ft), both in Parcel 4. In Fish Harbor, total LMW PAH concentrations ranged from below the detection limit at several stations to 1,250 µg/kg at FH-19 (4-5 ft).

Total HMW PAH concentrations in subsurface sediment samples from Parcel 4 (AL4-12) and the Fish Harbor area (FH-19) were above the ER-M value of 9,600 µg/kg. Within the ALBS leasehold area, total HMW PAH concentrations ranged from below the detection limit at many stations to 14,000 µg/kg at AL4-12 (4-5 ft) in Parcel 4. In Fish Harbor, total HMW PAH concentrations ranged from below the detection limit at FH-16 (2-3 ft) to 17,200 µg/kg at FH-19 (4-5 ft).

Total PAH concentrations in subsurface sediment samples from all stations were below the ER-M value of 44,792 µg/kg. Within the ALBS leasehold, total PAH concentrations ranged from below the detection limit at several stations to 14,600 µg/kg at AL4-14 (2-3 ft) in Parcel 4. In Fish Harbor, total PAH concentrations ranged from below the detection limit at FH-16 (2-3 ft) to 22,450 µg/kg at FH-19 (4-5 ft).

Organotins
DBT, TTBT, and TBT were found in subsurface sediment samples throughout the ABLS leasehold and Fish Harbor area (Table 5). MBT was below the detection limit (<1 µg/kg) at all stations. In addition, TBT concentrations were higher than DBT and TTBT concentrations in subsurface sediment samples from most stations in and surrounding the ALBS leasehold area.

Within the ALBS leasehold area, DBT concentrations in subsurface sediment samples ranged from below the detection limit at several stations to 2,230 µg/kg at AL4-15 (2-3 ft), located within Parcel 4. In the Fish Harbor area, DBT concentrations in subsurface sediment samples ranged from below the detection limit at most stations to 290 µg/kg at FH-19 (4-5 ft). Within the ALBS leasehold area, TTBT concentrations ranged from below the detection limit at many stations to 83.4 µg/kg at AL4-14 (2-3 ft) in Parcel 4. In Fish Harbor, TTBT concentrations ranged below the detection limit at most stations, to 79.5 µg/kg at FH-19 (2-3 ft). Within the ALBS leasehold area, TBT concentrations ranged from below the detection limit at several stations within Parcel 1 to 5,460 µg/kg at AL4-14 (2-3 ft) in Parcel 4. In Fish Harbor, TBT concentrations ranged from below the detection limit at many stations to 3,530 µg/kg at FH-19 (2-3 ft).

In the Fish Harbor area, organotin concentrations in most surface sediment samples were higher than those in subsurface sediment samples. However, within Parcels 1 and 4, organotin concentrations were more variable with depth; changes in depth were dependent on the station from which samples were collected.

Total PCBs
Total PCBs: Individual PCB congeners were not measured in these subsurface sediment samples so total PCB estimates were based on levels of total Aroclors or PCB mixtures in samples.

Total Aroclors (PCB mixtures): Total Aroclors in subsurface sediments consisted primarily of Aroclor 1248 and Aroclor 1254 (Table 5). Concentrations of total Aroclors at stations within Parcel 1 (AL1-4, 5), Parcel 4 (AL4-10 to 15), and the Fish Harbor area (FH-17 to 20, 22) exceeded the ER-M value for PCBs of 180 µg/kg. Within the ALBS leasehold area, total Aroclor concentrations in subsurface sediment ranged from below the detection limit at several stations to 8,200 µg/kg at AL4-15 (3-4 ft). In samples from AL4-14 (2-3 ft) and AL4-15 (3-4 ft), total Aroclor concentrations were greater than the ER-M value by 35 and 45 fold, respectively. In Fish Harbor, total Aroclor concentrations in subsurface sediment ranged from below the detection limit at several stations to 5400 µg/kg at FH-19 (4-5 ft). Within Parcel 1 of the ALBS leasehold area, total Aroclor concentrations were higher in the surface sediments relative to subsurface sediments. Within Parcel 4 and the Fish Harbor area, there were no consistent patterns in total PCBs with increasing depth.

Pesticides
In the ALBS leasehold and Fish Harbor areas, the only pesticides detected in subsurface sediments were DDT and DDT derivatives including 2,4'-DDD, 2,4'-DDE, 4,4'-DDD and 4,4'-DDE (Table 5). Total DDT concentrations in sediment samples from stations within Parcel 1 (AL1-4, 5), Parcel 4 (AL4-10 to 15) and the Fish Harbor area (FH-17, 19, 20, 22) were detected above the ER-M value of 46.1 µg/kg. Within the ALBS leasehold area, total DDT concentrations in subsurface sediment ranged from below the detection limit at several stations within Parcel 1 to 590 µg/kg at AL4-15 (3-4 ft) in Parcel 4. In Fish Harbor, total DDT concentrations in subsurface sediment ranged from below the detection limit at several stations to 503 µg/kg at FH-22 (2-3 ft). Within Parcel 4 of the ALBS leasehold area, total DDT

concentrations were higher in subsurface sediments relative to surface sediments. Within Parcel 1 and the Fish Harbor area, there were no consistent patterns in total DDTs with increasing depth.

Phenols and Phthalates

Phenols were not detected in any of the subsurface sediment samples in the ALBS leasehold area or the Fish Harbor area (Table 5). Phthalates including bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, and diethyl phthalate were detected in subsurface sediment samples at stations within the ALBS leasehold area and the Fish Harbor area (Table 5); however, of these phthalates, only bis(2-ethylhexyl) phthalate was detected at significantly elevated levels within most samples. Within the ALBS leasehold area, concentrations of bis(2-ethylhexyl) phthalate in subsurface sediment samples ranged from below detection limits at several stations to 1,600 µg/kg AL1-3 (3-4 ft) in Parcel 1. In Fish Harbor, concentrations of bis(2-ethylhexyl) phthalate in subsurface sediment ranged from below detection limits at FH-18 (1-2 ft) to 24,000 µg/kg at FH-20 (2-3 ft). However, average concentrations were much lower than the highest concentration detected. Average bis(2-ethylhexyl) phthalate concentrations for Parcel 1, Parcel 4, and Fish Harbor were 239, 476, and 1998 µg/kg, respectively. Although no bis(2-ethylhexyl) phthalate was detected at AL4-12, it should be noted that the detection limit was greater than 1,000 µg/kg because of the dilutions necessary prior to sample analysis.

Table 6. Chemical and geotechnical characteristics of surface and subsurface sediment from stations sampled in September 2005 within and outside the ALBS leasehold areas of Fish Harbor.

Analyte	ER-L	ER-M	TTLC	SV-1	SV-1	SV-7	SV-7	SV-7	SV-8	SV-8	SV-8	SV-8	SV-9	SV-9	SV-10	SV-10	SV-10	SV-11	SV-11	SV-12	SV-12	SV-12
Depth (ft.)	-	-	-	6-8	8-10	0-2	2-4	4-6	0-2	2-4	4-6	6-8	0-2	4-6	0-2	2-4	4-6	0-2	4-6	0-2	4-6	6-8
Physical Analyses																						
Gravel (%)	-	-	-	1.4	1.9	4.1	3.0	3.8	9.4	3.9	0.2	0.1	0.5	0.3	0.9	1.7	0.50	4.0	0.7	0.1	0.5	0.3
Sand (%)	-	-	-	75.2	69.3	71.1	68.4	86.8	69.4	71.1	70.1	44.2	74.5	72.4	74.5	83.1	92.5	37.3	94.3	10.2	13.3	51.9
Silt (%)	-	-	-	10.6	13.5	10.7	15.4	5.2	9.2	13.4	20.4	32.1	11.4	13.7	9.6	6.3	3.6	30.0	2.4	45.9	45.0	26.9
Clay (%)	-	-	-	12.8	15.3	14.0	13.2	4.2	11.7	11.6	9.3	23.6	13.6	13.6	15.0	8.8	3.4	28.7	2.6	43.8	41.2	20.9
Solids, Total (%)	-	-	-	60.0	63.4	62.9	61.8	76.8	-	-	78.3	73.9	70.6	69.4	-	-	75.2	57.9	79.9	46.4	52.5	64.9
General Chemistry			-																			
TOC (%)	-	-	-	2.45	2.96	1.72	1.92	0.21	1.18	0.77	0.44	0.90	0.90	0.47	0.89	0.43	0.52	1.60	0.10	2.99	2.70	1.49
Ammonia	-	-	-	84	80	8.5	12	5.8	-	-	7.2	4.9	12	20	-	-	3	20	12	79	140	49
Sulfide, Dissolved	-	-	-	<0.17	<0.16	<0.16	<0.16	<0.13	-	-	<0.13	<0.14	<0.14	<0.15	-	-	<0.13	<0.17	<0.13	<0.22	<0.19	<0.15
Sulfide, Total	-	-	-	470	160	480	740	27	-	-	0.13	2.6	6.3	44	-	-	<0.13	31	<0.13	150	<0.19	14
Oil and Grease	-	-	-	17000	18000	3000	1700	420	-	-	96	77	1800	730	-	-	290	3200	150	430	1600	470
TRPH	-	-	-	16000	17000	2800	1700	410	-	-	95	75	1800	720	-	-	280	3100	150	400	1600	410
Metals (mg/kg)																						
Arsenic	8.2	70.0	500	**53.4**	**50.7**	**42.4**	**25.7**	6.29	-	-	5.57	7.38	5.55	5.7	-	-	5.3	**10.2**	2.85	**19.6**	**15.1**	**10.4**
Cadmium	1.2	9.6	100	**2.05**	**2.23**	**2.83**	**2.07**	0.286	-	-	0.143	0.236	0.625	0.379	-	-	<0.133	**1.33**	<0.125	**3.17**	**2.79**	**1.74**
Chromium	81.0	370.0	500	**362**	**210**	**128**	49.9	19.5	-	-	24.2	32	25.6	24.8	-	-	22.2	47.4	11.6	**103**	70.6	56
Copper	34.0	270.0	2,500	**5410**	**3120**	**786**	**382**	**94.3**	-	-	19.5	**42**	**76.3**	**40.2**	-	-	**55**	**156**	8.78	**335**	**180**	**125**
Lead	46.7	220.0	1,000	**463**	**653**	**644**	**385**	**50.1**	-	-	5.42	22	36.7	23.3	-	-	11.6	**75**	4.02	**134**	**86.8**	**78.2**
Mercury	0.2	0.7	20	**33.6**	**157**	**4.37**	**5.94**	**0.297**	-	-	0.076	**0.161**	**0.613**	**0.17**	-	-	0.128	**0.852**	<0.0251	**2.66**	**2.72**	**1.29**
Nickel	20.9	51.6	2,000	**22.9**	**23.3**	**26.8**	**23**	10.4	-	-	17.4	**21.9**	15.7	16.9	-	-	13.6	**27.5**	8.74	**45**	**37.9**	**29.3**
Selenium	-	-	100	<0.833	0.944	4.04	2.37	3.32	-	-	3.55	3.65	<0.704	<0.725	-	-	3.05	<0.862	<0.625	4.12	3.42	4.13
Silver	1.0	3.7	500	0.418	0.367	0.637	0.333	<0.130	-	-	<0.128	<0.135	0.181	<0.145	-	-	<0.133	0.357	<0.125	0.962	**1.02**	0.77
Zinc	150.0	410.0	5,000	**2120**	**1760**	**2880**	**1140**	133	-	-	62.4	79.1	118	89	-	-	53.5	**226**	30.8	**456**	**316**	**259**
PCBs (ug/kg)																						
PCB018	-	-	-	25.5 MI	183 MI	16.5	-	<1 MI	-	-	2.20 E	1.30 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB028	-	-	-	260 MI	377 MI	13.8	-	<1 MI	-	-	2.20 E	<1	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB031	-	-	-	133 MI	393 MI	20.2	-	<1 MI	-	-	2.20 E	1.40 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB033	-	-	-	<1 MI	232 MI	14.2	-	<1 MI	-	-	1.50 E	<1	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB037	-	-	-	<1 MI	<1 MI	<1 MI	-	<1 MI	-	-	<1	1.10 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB044	-	-	-	208 MI	208 MI	13.3	-	<1 MI	-	-	12.4	1.30 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB049	-	-	-	172 MI	688 MI	<1 MI	-	<1 MI	-	-	6.5	1.10 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB052	-	-	-	528 MI	673 MI	22.5	-	<1 MI	-	-	30.2	1.00 E	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB066	-	-	-	198 MI	933 MI	23.0	-	<1 MI	-	-	8.10	<1	<1	<1	-	-	<1 MI	<1	<1	<1	<1	-
PCB070	-	-	-	313 MI	967 MI	29.5	-	<1	-	-	21.9	1.20 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB074	-	-	-	292 MI	577 MI	<1 MI	-	<1	-	-	4.60 E	1.30 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB077	-	-	-	48.2 MI	118 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB081	-	-	-	<1 MI	16.1 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB087	-	-	-	166 MI	248 MI	20.9	-	<1	-	-	18.5	1.30 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB095	-	-	-	241 MI	281 MI	50.9	-	1.60 E	-	-	35.2	1.90 E	<1	<1	-	-	7.30	<1	<1	3.30 E	<1	-
PCB097	-	-	-	203 MI	233 MI	31.2	-	<1	-	-	28.7	1.80 E	<1	<1	-	-	2.00 E	<1	<1	<1	<1	-
PCB099	-	-	-	349 MI	357 MI	28.4	-	<1	-	-	20.6	1.30 E	<1	<1	-	-	1.80 E	<1	<1	<1	<1	-
PCB101	-	-	-	42.2 MI	482 MI	79.3	-	2.90 E	-	-	56.4	3.20 E	<1	<1	-	-	10.2	<1	<1	4.60 E	<1	-
PCB105	-	-	-	184 MI	183 MI	11.7	-	<1	-	-	20.4	1.30 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB110	-	-	-	522 MI	775 MI	83.3	-	2.40 E	-	-	61.9	3.30 E	<1	<1	-	-	6.90	<1	<1	3.60 E	<1	-
PCB114	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	1.00 E	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB118	-	-	-	452 MI	631 MI	59.7	-	1.90 E	-	-	51.3	2.90 E	<1	<1	-	-	1.70 E	<1	<1	4.10 E	<1	-
PCB119	-	-	-	102 MI	116 MI	73.4	-	<1	-	-	<1	75.3	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB123	-	-	-	<1 MI	55.0 MI	<1 MI	-	<1	-	-	1.30 E	2.80 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB126	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB128+167	-	-	-	56.9 MI	24.7 MI	<1 MI	-	<1	-	-	9.5	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB138	-	-	-	270 MI	182 MI	75.6	-	<1	-	-	57.8	2.70 E	<1	<1	-	-	<1	<1	<1	6.20	<1	-
PCB141	-	-	-	46.0 MI	31.9 MI	5.90	-	<1	-	-	9.20	1.00 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB149	-	-	-	158 MI	161 MI	53.3	-	1 E	-	-	31.7	1.70 E	<1	<1	-	-	5.20	<1	<1	3.20 E	<1	-
PCB151	-	-	-	19.9 MI	28.7 MI	13.5	-	<1	-	-	6.90	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB153	-	-	-	206 MI	157 MI	58.9	-	<1	-	-	36.1	2.90 E	<1	<1	-	-	4.00 E	<1	<1	3.90 E	<1	-
PCB156	-	-	-	29.4 MI	24.87 MI	9.70	-	<1	-	-	5.50	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB157	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB158	-	-	-	27.3 MI	24.8 MI	<1 MI	-	<1	-	-	6.00	2.10 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB168+132	-	-	-	60.2 MI	81.9 MI	16.8	-	<1	-	-	16.0	3.30 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB169	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB170	-	-	-	29.7 MI	16.7 MI	12.4	-	<1	-	-	7.90	2.80 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB177	-	-	-	15.9 MI	14.5 MI	11.5	-	<1	-	-	4.10 E	3.10 E	<1	<1	-	-	<1	<1	<1	1.60 E	<1	-
PCB180	-	-	-	67.5MI	57.3 MI	61.4	-	<1	-	-	16.2	6.50	<1	<1	-	-	<1	<1	<1	3.60 E	<1	-
PCB183	-	-	-	19.8 MI	12.8 MI	14.5	-	<1	-	-	3.90 E	5.90	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB187	-	-	-	55.8 MI	28.7 MI	38.9	-	<1	-	-	8.10	5.70	<1	<1	-	-	<1	<1	<1	1.90 E	<1	-
PCB189	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB194	-	-	-	<1 MI	<1 MI	<1 MI	-	<1	-	-	3.60 E	4.20 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB200	-	-	-	7.60 MI	2.7 E	4.60 E	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB201	-	-	-	70.6 MI	16.1 MI	35.0	-	<1	-	-	5.30	7.60	<1	<1	-	-	<1	<1	<1	<1	<1	-
PCB206	-	-	-	163 MI	8.80 MI	11.3	-	<1	-	-	2.90 E	2.20 E	<1	<1	-	-	<1	<1	<1	<1	<1	-
Total PCBs	22.7	180	50000	**5743**	**9601**	**1015**	-	9.80	-	-	**618**	**157**	0	0	-	-	**39.1**	0	0	**36.0**	0	-
Aroclor (ug/kg)																						
Aroclor-1016	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Aroclor-1221	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Aroclor-1232	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Aroclor-1242	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Aroclor-1248	-	-	-	<17	86.0	2500	<16	120	-	-	<13	110	1400	15000	-	-	56.0	<17	<13	1100	290	<17
Aroclor-1254	-	-	-	<17	<16	2400	630	<13	-	-	<13	<14	<14	<150	-	-	<13	87.0	50.0	770	230	<17
Aroclor-1260	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Aroclor-1262	-	-	-	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Total Aroclors	22.7	180	50000	0	**86.0**	**4900**	**630**	**120**	-	-	0	**110**	**1400**	**15000**	-	-	**56.0**	**87.0**	**50.0**	**1870**	**520**	0

Table 6 Con't.

Analyte	ER-L	ER-M	TTLC	SV-1	SV-1	SV-7	SV-7	SV-7	SV-8	SV-8	SV-8	SV-8	SV-9	SV-9	SV-10	SV-10	SV-10	SV-11	SV-11	SV-12	SV-12	SV-12
Depth (ft.)	-	-	-	**6-8**	**8-10**	**0-2**	**2-4**	**4-6**	**0-2**	**2-4**	**4-6**	**6-8**	**0-2**	**4-6**	**0-2**	**2-4**	**4-6**	**0-2**	**4-6**	**0-2**	**4-6**	**6-8**
Pesticides (ug/kg)																						
2,4'-DDD	-	-	1000	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<11	<1.9	<1.7
2,4'-DDE	-	-	1000	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	21	<1.9	<1.7
2,4'-DDT	-	-	1000	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<11	<1.9	<1.7
4,4'-DDD	2	20	1000	<1.7	<1.6	**39.0**	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	**<15**	-	-	<1.3	<1.7	<1.3	**3.90**	**13.0**	<1.7
4,4'-DDE	2.2	27	1000	**8.80**	**2.90**	**250**	**52.0**	**11.0**	-	-	**3.20**	**5.30**	**60.0**	**430**	-	-	**4.20**	**13.0**	**8.50**	**180**	**35.0**	**24.0**
4,4'-DDT	1	7	1000	**<1.7**	**<1.6**	**<1.6**	**<1.6**	**<1.3**	-	-	**<1.3**	**<1.4**	**<1.4**	**<15**	-	-	**<1.3**	**<1.7**	**<1.3**	**<2.2**	**<1.9**	**<1.7**
Total DDTs	1.58	46.1	-	**8.80**	**2.90**	**289**	**52.0**	**11.0**	-	-	**3.20**	**5.30**	**60.0**	**430**	-	-	**4.20**	**13.0**	**8.50**	**205**	**48.0**	**24.0**
Aldrin	-	-	1400	<1.7	<1.6	<1.6	1.8	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Alpha-BHC	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Beta-BHC	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Chlordane	-	-	2500	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Delta-BHC	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Dieldrin	0.02	8	8000	**<1.7**	**<1.6**	**<1.6**	**<1.6**	**<1.3**	-	-	**<1.3**	**<1.4**	**<1.4**	**<15**	-	-	**<1.3**	**<1.7**	**<1.3**	**<2.2**	**<1.9**	**<1.7**
Endosulfan I	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Endosulfan II	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Endosulfan Sulfate	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Endrin	-	-	200	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Endrin Aldehyde	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Endrin Ketone	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Gamma-BHC	-	-	4000	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Heptachlor	-	-	4700	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Heptachlor Epoxide	-	-	-	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Methoxychlor	-	-	100000	<1.7	<1.6	<1.6	<1.6	<1.3	-	-	<1.3	<1.4	<1.4	<15	-	-	<1.3	<1.7	<1.3	<2.2	<1.9	<1.7
Toxaphene	-	-	5000	<33	<32	<32	<32	<26	-	-	<26	<27	<28	<290	-	-	<27	<34	<25	<43	<38	<34
Total Chlordane	-	-	2500	<17	<16	<16	<16	<13	-	-	<13	<14	<14	<150	-	-	<13	<17	<13	<22	<19	<17
Organotins (ug/kg)																						
Dibutyltin	-	-	-	29.0	12.0	290	94.0	49.0	-	-	60.0	12.0	57.0	8.10	-	-	150	91.0	<3.8	290	6.00	8.00
Monobutyltin	-	-	-	<5.0	<4.8	93.0	<4.8	17.0	-	-	15.0	<4.1	18.0	<4.4	-	-	82.0	20.0	<3.8	27.0	<5.8	<5.2
Tetrabutyltin	-	-	-	<5.0	<4.8	9.30	<4.8	<3.9	-	-	<3.8	<4.1	<4.2	<4.4	-	-	<4.0	<5.2	<3.8	<6.5	<5.8	<5.2
Tributyltin	-	-	-	25.0	13.0	280	64.0	57.0	-	-	26.0	8.40	34.0	6.20	-	-	160	66.0	3.90	220	<5.8	<5.2
PAHs (ug/kg)																						
Acenaphthene	16	500	-	**<3300**	**<640**	**<320**	**<1600**	**<130**	-	-	**<26**	**<27**	**<28**	**<150**	-	-	**<130**	**<170**	**<25**	**<220**	**<190**	**<170**
Acenaphthylene	44	640	-	**<3300**	**<640**	**<320**	**<1600**	**<130**	-	-	<26	<27	<28	**<150**	-	-	**<130**	**<170**	<25	**<220**	**<190**	**<170**
Anthracene	85	1100	-	**<3300**	**770**	**<320**	**<1600**	**<130**	-	-	<26	<27	<28	**<150**	-	-	**<130**	**<170**	<25	**<220**	**<190**	**<170**
Benzo (a) Anthracene	261	1600	-	**<3300**	**1400**	**1200**	**2000**	190	-	-	<26	<27	97.0	<150	-	-	<130	<170	<25	<220	<190	<170
Benzo (a) Pyrene	430	1600	-	**<3300**	**1100**	**1600**	**2000**	220	-	-	<26	<27	160	<150	-	-	180	180	<25	380	<190	<170
Benzo (b) Fluoranthene	-	-	-	<3300	1200	1700	<1600	190	-	-	<26	<27	150	<150	-	-	210	<170	<25	490	<190	<170
Benzo (g,h,i) Perylene	-	-	-	<3300	690	1400	<1600	130	-	-	<26	<27	150	<150	-	-	<130	<170	<25	290	<190	<170
Benzo (k) Fluoranthene	-	-	-	<3300	1700	1800	<1600	240	-	-	28	<27	160	<150	-	-	210	230	<25	590	<190	<170
Chrysene	380	2800	-	**<3300**	**1900**	**1600**	**2700**	220	-	-	<26	<27	120	<150	-	-	210	<170	<25	310	<190	<170
Dibenz (a,h) Anthracene	63	260	-	**<3300**	**<640**	**420**	**<1600**	**<130**	-	-	<26	<27	34.0	**<150**	-	-	**<130**	**<170**	<25	**<220**	**<190**	**<170**
Fluoranthene	600	5100	-	**5700**	**4300**	**1600**	**3900**	350	-	-	26	28	140	170	-	-	150	210	22	<170	<150	<140
Fluorene	19	540	-	**<3300**	**1100**	**<320**	**<1600**	**<130**	-	-	**<26**	**<27**	**<28**	**<150**	-	-	**<130**	**<170**	**<25**	**<220**	**<190**	**<170**
Indeno (1,2,3-c,d) Pyrene	-	-	-	<3300	<640	1100	<1600	<130	-	-	<26	<27	100	<150	-	-	<130	<170	<25	<220	<190	<170
Naphthalene	160	2100	-	**8200**	**920**	**<320**	**<1600**	<130	-	-	<26	<27	<28	<150	-	-	<130	**<170**	<25	**<220**	**<190**	**<170**
Phenanthrene	240	1500	-	**5200**	**3500**	**1200**	**3900**	210	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
Pyrene	665	2600	-	**6000**	**10000**	**9200**	**5500**	**930**	-	-	77.0	74.0	**850**	300	-	-	270	**760**	75.0	**2000**	**870**	190
Total LMW PAHs	552	3160	-	**13400**	**6290**	**1200**	**3900**	210	-	-	0	0	0	0	-	-	0	0	0	0	0	0
Total HMW PAHs	1700	9600	-	**11700**	**18700**	**15620**	**16100**	**1910**	-	-	103	102	1401	470	-	-	810	1150	97.0	**2690**	870	190
Total PAH	4022	44792	-	**25100**	**28580**	**22820**	**20000**	2680	-	-	131	102	1961	470	-	-	1230	1380	97.0	**4060**	870	190
Phenols (ug/kg)																						
2,4,5-Trichlorophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2,4,6-Trichlorophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2,4-Dichlorophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2,4-Dimethylphenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2,4-Dinitrophenol	-	-	-	<17000	<3200	<1600	<8100	<650	-	-	<130	<140	<140	<730	-	-	<670	<860	<130	<1100	<960	<860
2-Chlorophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2-Methylphenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
2-Nitrophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
3/4-Methylphenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
4,6-Dinitro-2-Methylphenol	-	-	-	<17000	<3200	<1600	<8100	<650	-	-	<130	<140	<140	<730	-	-	<670	<860	<130	<1100	<960	<860
4-Chloro-3-Methylphenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
4-Nitrophenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
Pentachlorophenol	-	-	17000	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
Phenol	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<27	<28	<150	-	-	<130	<170	<25	<220	<190	<170
Phthalate (ug/kg)																						
Bis(2-Ethylhexyl) Phthalate	-	-	-	<1700	<320	570	<810	<65	-	-	25.0	30.0	<14	<73	-	-	130	<86	15.0	210	<96	<86
Butyl Benzyl Phthalate	-	-	-	<1700	<320	<160	<810	<65	-	-	<13	<14	<14	<73	-	-	<67	<86	<13	<110	<96	<86
Di-n-Butyl Phthalate	-	-	-	<1700	<320	<160	<810	<65	-	-	17.0	22.0	<14	<73	-	-	<67	<86	25	<110	<96	<86
Di-n-Octyl Phthalate	-	-	-	<1700	<320	<160	<810	<65	-	-	<13	<27	<14	<73	-	-	<67	<86	<13	<110	<96	<86
Diethyl Phthalate	-	-	-	<1700	<320	<160	<810	<65	-	-	<13	22.0	<14	<73	-	-	<67	<86	<13	<110	<96	<86
Dimethyl Phthalate	-	-	-	<3300	<640	<320	<1600	<130	-	-	<26	<14	<28	<150	-	-	<130	<170	<25	<220	<190	<170

4.2.2 Chemical and Physical Characteristics of Fish Harbor Sediments – September 2005

Surface sediment, material residing between 0 and 2 ft in depth below the mudline, and subsurface sediment (below 2 ft depth) from each station were analyzed.

Physical Analyses and General Chemistry
Sediment samples were analyzed for grain size, total solids, and TOC. The average coarse grain composition for all surface sediment sampled was 59.3% (Table 6). Whereas the average coarse grain composition for all subsurface sediment sampled was 70.1%. The individual stations demonstrating the largest percentage of coarse grain material among surface samples were sampling location SV-8 with 78.8%, and among subsurface samples both SV-7 and SV-11 with 90.6% and 95.0% coarse grain material. The average fine grain composition for all surface sediment samples was 40.6%, and for all subsurface sediments the composition was 29.9%. Station SV-12 had the highest fine grain sediment composition out of all surface and subsurface samples with 89.7% and 86.2%, respectively, of the sediment being comprised of silt and clay.

The average total solids percentage was 59.5% for all surface sediment sampled, and 68.7% for subsurface sediment. The highest percentage of total solids were found in surface sediment from SV-9 with a value of 70.6%, and in subsurface sediment from SV-8 (4-6 ft) and SV-11 (4-6 ft), with percentages of 78.3% and 79.9%, respectively. The average TOC percentage in surface sediment was 1.5%. TOC in surface sediment ranged from 0.9% at SV-9 and SV-10 to 3.0% at SV-12. The average TOC percentage in subsurface sediment was 1.2%, with TOC values ranging from 0.1% at SV-11 (4-6 ft) to 3.0% at SV1 (8-10 ft).

In surface sediment, total sulfides ranged from below the detection limit at two stations to 480 mg/kg at SV-7, and in subsurface sediment total sulfides ranged from below the detection limit at several stations to 740 mg/kg at SV-7 (2-4 ft). No dissolved sulfides were detected in any of the samples for which analyses were performed. In surface sediment, all of the stations had oil and grease above 1000 mg/kg, except for SV-12, and in subsurface sediment, oil and grease values ranged from 77 mg/kg at SV-8 (6-8 ft), equivalent to AL4-15, to 18,000 mg/kg at SV-1 (8-10 ft), equivalent to FH-19. TRPH values were also elevated in each of the stations with high amounts of oil and grease. Ammonia was greater than 40 mg/kg in surface and subsurface sediments from SV-12, and in subsurface sediments from station SV-1 (equivalent to FH-19).

Metals
In the second round of sampling that occurred in September of 2005, many metals were detected at significantly elevated concentrations within surface sediment samples from within the ALBS leasehold and surrounding areas (Table 6). Specifically, at many stations and depths, copper, lead, mercury, and zinc were detected at concentrations greater than ER-M values.

Copper concentrations in samples from stations re-sampled at greater depths within Parcel 4 (SV-8 and SV-10, equivalent to AL4-15 and AL4-13, respectively) were below the ER-M value at the depths examined (SV-8, 4-6 ft and 6-8 ft, and SV-10, 4-6 ft). In Fish Harbor, copper concentrations were above the ER-M value of 270 mg/kg for several stations and depths. Surface sediment samples from stations SV-7 and SV-12, and subsurface sediment samples from SV-1 and SV-7 demonstrated copper concentrations that exceeded the ER-M value. Copper concentrations in surface sediment ranged from 76.3 mg/kg at SV-9, located just outside of the ALBS leasehold area, to 786 mg/kg at SV-7, also located just outside of the ALBS leasehold area. In subsurface sediment, copper concentrations ranged from 8.78 mg/kg at SV-11 (4-6 ft) to 5,410 mg/kg in the 6-8 ft sample from station SV-1 (equivalent to FH-19 in previous sampling efforts). Similar to mercury, copper concentrations in subsurface sediment samples (6-8 ft and 8-10 ft) from SV-1 exceeded the TTLC of 2,500 mg/kg.

Lead concentrations in samples from stations re-sampled at greater depths within Parcel 4 (SV-8 and SV-10, equivalent to AL4-15 and AL4-13, respectively) were below the ER-M value at the depths examined (SV-8, 4-6 ft and 6-8 ft, and SV-10, 4-6 ft). In Fish Harbor, lead concentrations were above the ER-M value of 220 mg/kg for several stations and depths. Surface sediment samples from stations SV-7, and subsurface sediment samples from SV-1 and SV-7 (2-4 ft) demonstrated lead concentrations that exceeded the ER-M value. Lead concentrations in surface sediment ranged from 36.7 mg/kg at SV-9, located just outside of the ALBS leasehold area, to 644 mg/kg at SV-7, also located just outside of the ALBS leasehold area. In subsurface sediment samples, lead concentrations ranged from 4.02 mg/kg at SV-11 (4-6 ft) to 653 mg/kg in the 8-10 ft sample from station SV-1 (equivalent to FH-19 in previous sampling efforts).

Mercury concentrations in sediment samples from stations re-sampled at greater depths within Parcel 4 (SV-8 and SV-10, equivalent to AL4-15 and AL4-13, respectively) were below the ER-M value at the depths examined (SV-8, 4-6 ft and 6-8 ft, and SV-10, 4-6 ft). In Fish Harbor, mercury concentrations were above the ER-M value of 0.71 mg/kg for several stations and depths. Surface sediment samples from stations SV-7, SV-11, and SV-12, and subsurface sediment samples from SV-1, SV-7, and SV-12 demonstrated mercury concentrations that exceeded the ER-M value. Mercury concentrations in surface sediment ranged from 0.61 mg/kg at SV-9, located just outside of the ALBS leasehold area, to 4.37 mg/kg at SV-7, also located just outside of the ALBS leasehold area. In subsurface sediment, mercury concentrations ranged from below the detection limit at SV-11 (4-6 ft) to 33.6 and 157 mg/kg in the 6-8 ft and 8-10 ft samples, respectively, from station SV-1 (equivalent to FH-19 in previous sampling efforts). Mercury concentrations in both subsurface sediment samples from SV-1 (6-8 ft and 8-10 ft) exceeded the TTLC of 20 mg/kg.

Zinc concentrations in sediment samples collected from the sampling effort in September of 2005 demonstrated similar spatial patterns to those of mercury in and surrounding the ALBS leasehold area. Samples from stations re-sampled at greater depths within Parcel 4 (SV-8 and SV-10, equivalent to AL4-15 and AL4-13, respectively) were below the ER-M value at the depths examined (SV-8, 4-6 ft and 6-8 ft, and SV-10, 4-6 ft). In Fish Harbor, zinc concentrations were above the ER-M value of 410 mg/kg for several stations and depths. Surface sediment samples from stations SV-7 and SV-12, and subsurface sediment samples from SV-1 and SV-7 demonstrated zinc concentrations that exceeded the ER-M value. Zinc concentrations in surface sediment ranged from 118 mg/kg at SV-9, located just outside of the ALBS leasehold area, to 2,880 mg/kg at SV-7, also located just outside of the ALBS leasehold area. In subsurface sediment, zinc concentrations ranged from 30.8 mg/kg at SV-11 (4-6 ft) to 2,120 mg/kg in the 6-8 ft sample from station SV-1 (equivalent to FH-19 in previous sampling efforts).

<u>PAHs</u>
In the second round of sampling that occurred in September of 2005, there were only two stations (SV-1 and SV-7) in which total LMW and total HMW PAH concentrations were higher than the ER-M values of 3,160 µg/kg and 9,600 µg/kg, respectively (Table 6). Total PAHs did not exceed the ER-M value of 44,792 µg/kg at any stations.

Total LMW PAHs were below the ER-M value in surface sediment samples from all stations and ranged from below the detection limit at several stations to 1,200 µg/kg at SV-7. Total LMW PAH concentrations in both subsurface sediment samples from SV-1 were higher than the ER-M value. Total LMW PAH concentrations in subsurface sediment ranged from below the detection limit at many stations to 13,400 µg/kg at SV-1 (6-8 ft). Total HMW PAHs in the surface sediment sample from SV-7 was higher than the ER-M value. Total HMW PAHs in surface sediment ranged from 1,150 µg/kg at SV-11, located just outside of the ALBS leasehold area, to 15,620 µg/kg at SV-7, also located just outside of the ALBS leasehold area. Total HMW PAH concentrations in the subsurface sediment samples from SV-1 and SV-7 (2-4 ft) were higher than the ER-M value. Total HMW PAH concentrations in subsurface sediment ranged from 97 µg/kg at SV-11 (4-6 ft), located just outside the ALBS leasehold area, to 18,700 µg/kg at SV-1 (8-10 ft), equivalent to FH-19 in previous sampling efforts.

Total PAH concentrations were below the ER-M value of 44,792 µg/kg in both surface and subsurface sediment samples from all stations and depths. In surface sediment, total PAH concentrations ranged from 1380 µg/kg at SV-11, located just outside of the ALBS leasehold area, to 22,820 µg/kg at SV-7, also located just outside of the ALBS leasehold area. Total PAH concentrations in subsurface sediment ranged from 97 µg/kg at SV-11 (4-6 ft) to 28,580 µg/kg at SV-1 (8-10 ft).

Organotins

There were only a few stations (SV-7, SV-10, and SV-12) from the sampling effort of September 2005 in which DBT and TBT were detected at concentrations (>100 µg/kg) that have been shown to cause toxicity to aquatic organisms (see section 4.2.1 for further discussion; Table 6). MBT and TTBT were also detected in sediment samples, but were only slightly above the detection limits for these compounds. DBT concentrations in surface sediment ranged from 57 µg/kg at SV-9, located just outside of the ALBS leasehold area, to 290 µg/kg at SV-7 and SV-12. In subsurface sediment, concentrations ranged from below the detection limit at SV-11 (4-6 ft) to 150 µg/kg at SV-10 (4-6 ft), which is equivalent to station AL4-13 from previous sampling efforts. TBT concentrations in surface sediment ranged from 34 µg/kg at SV-9 to 280 µg/kg at SV-7. In subsurface sediment, TBT concentrations ranged from below the detection limit at SV-12, located in the channel to Fish Harbor, to 160 µg/kg at SV-10 (4-6 ft), equivalent to station AL4-13 from previous sampling efforts.

Total PCBs

Total PCBs: Total detectable PCBs were measured by summing the individual PCB congeners detected in the ALBS leasehold area and the Fish Harbor area (Table 6). Total PCBs ranged from below the detection limit in surface sediment from two stations to 1015 µg/kg at SV-7, the only station at which total PCB concentrations in surface sediment exceeded the ER-M value of 180 µg/kg. Total PCBs in subsurface sediment ranged from below the detection limit at several stations to 9,601 µg/kg at SV-1 (8-10 ft). Total PCB concentrations in subsurface sediment from SV-8 exceeded the ER-M value.

Total Aroclors (PCB mixtures): Total Aroclors, consisting of Aroclor 1248 and Aroclor 1254, were higher than the ER-M value for PCBs (180 µg/kg) at stations in the Fish Harbor area and one of the ALBS leasehold stations. Total Aroclor concentrations in surface sediment samples were above the ER-M value at SV-7, SV-9, and SV-12. Total Aroclor concentrations in surface sediment ranged 87 µg/kg at SV-11, located just outside of the ALBS leasehold, to 4900 µg/kg at SV-7, located just outside of ALBS Parcel 4. Total Aroclor concentrations in subsurface sediment samples were above the ER-M values for PCBs at SV-7 (2-4 ft), SV-9 (4-6 ft), and SV-12 (4-6 ft). Total Aroclor concentrations in subsurface sediment ranged from below the detection limit at several stations to 15,000 µg/kg at SV-9 (4-6 ft).

Pesticides

Aldrin and total DDTs (consisting primarily of 4,4'-DDD and 4,4'-DDE) were the only pesticides detected in sediment samples from the ALBS leasehold area and the Fish Harbor area (Table 6). Aldrin was only found above the detection limit at one station, SV-7 (2-4 ft), located just outside of the ALBS leasehold. Total DDTs were detected at concentrations above the ER-M value of 46.1 µg/kg at several stations and depths. Total DDTs in surface sediment samples were above the ER-M value at SV-7, SV-9, and SV-12, and ranged from 13 µg/kg at SV-11, located just outside of the ALBS leasehold area, to 289 µg/kg at SV-7, located just outside of the ALBS leasehold. Total DDTs in subsurface sediment were above the ER-M value at SV-7, SV-9, and SV-12, and ranged from 2.9 µg/kg at SV-1 (8-10 ft), equivalent to FH-19 from previous sampling efforts, to 430 µg/kg at SV-9 (4-6 ft), located just outside of the ALBS leasehold.

Phenols and Phthalates

Phenols were not detected in any of the surface or subsurface sediment samples in the ALBS leasehold area or the Fish Harbor area (Table 6). Phthalates including bis(2-ethylhexyl) phthalate, di-n-butyl phthalate, and diethyl phthalate were detected in surface sediment samples from stations within the ALBS leasehold area and the Fish Harbor area; however, of these phthalates, only bis(2-ethylhexyl) phthalate was detected at levels that were significantly elevated above the detection limit. Bis(2-ethylhexyl) phthalate concentrations in surface sediment ranged from below the detection limit at stations SV-9 and SV-11 to 570 µg/kg at SV-7, located just outside of the ALBS leasehold. Bis(2-ethylhexyl) phthalate concentrations in subsurface sediment ranged from below the detection limit several stations to 130 µg/kg at SV-10 (4-6 ft), equivalent to AL4-15 in previous sampling efforts.

4.3 QUALITY CONTROL SUMMARY

4.3.1 Physical and Chemical Analysis of Fish Harbor Project Sediments

Method reporting limits (MRLs) for target analytes were greater than or equal to MDLs and above instrument detection limits as described by USEPA SW-846 protocol. MRLs are listed in Appendix C for the sediment analyses.

All laboratory control sample analyses met the percent recovery criteria established for the appropriate methods, except where noted below. All duplicate analyses met or were within the relative percent difference (RPD) criteria established for the appropriate methods unless otherwise noted below. Additionally, unless otherwise discussed below, all of the surrogate recoveries and spike recoveries for organic analysis and spike recoveries for metals were within the appropriate recovery range established for the method.

4.3.1.1 Physical Analysis of Fish Harbor Project Sediments

Analysis of TOC and grain size met all established laboratory QA/QC criteria.

4.3.1.2 Chemical Analysis of Fish Harbor Project Sediments

Metals

The matrix spike recoveries for silver and zinc were above established control limits in one of the sample batches. Additionally, the relative percent difference (RPD) for silver and zinc was outside of control limits. However, the associated laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) recoveries were within control limits, indicating a matrix interference effect.

Organochlorine Pesticides

Endrin Aldehyde had a matrix spike recovery and RPD above the established control limits. However, the associated LCS/LCSD samples and RPDs were in control, suggesting a matrix interference effect. Matrix spike recoveries for Delta-BHC were also above the control limit in one of the sample batches. Several compounds also had RPDs above the acceptable limits in each of the sample batches. However, the associated LCS/LCSD recoveries were within control limits, indicating a matrix interference effect.

PCBs

Analysis of PCBs met established laboratory QA/QC criteria.

PAHs

Acenaphthene and pyrene had matrix spike recoveries above the established control limits. However, the associated LCS/LCSD and RPDs were in control, suggesting a matrix interference effect. The surrogate recovery of terphenyl-14 was above established control limits likely due to high dilution factors and matrix interference

Phenols & Phthalates

The surrogate recovery of terphenyl-14 was above established control limits likely due to high dilution factors and matrix interference.

Organotins

The surrogate recovery of tripentyltin was outside of acceptance range in testing the FH-19 sample from the Fish Harbor Area. The surrogate recoveries of TBT and TTBT were outside the relative percent difference acceptance range for the AL1-8 QA/QC sample.

5. SUMMARY

5.1 CHEMICAL AND PHYSICAL CHARACTERISTICS OF SEDIMENT

Maps illustrating the concentration of contaminants in surface (0-1 ft) and subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold have been created for copper, mercury, lead, zinc, 4,4'-DDE, Aroclor 1254, LMW PAHs, HMW PAHs, and TBT (Figure 7 thru Figure 24). Interpolation was used to produce these maps based on data from Table 5 and Table 6 above, using an inverse distance weighted method. The first concentrations, depicted with dark blue, light blue, green, and yellow, represent the concentrations of contaminants below the ER-M value. Orange depicts concentrations that exceed the ER-M value, for each contaminant separately, while red depicts concentrations that exceed the TTLC value.

ALBS Parcel 1

Surface sediment (0-1 ft in depth): Elevated concentrations of many heavy metals including copper, mercury, and zinc were found in surface sediment from stations within Parcel 1 of the ALBS leasehold (Figure 7 thru Figure 10). The ER-M value for copper was exceeded at all of the stations except AL1-2 and AL1-8, the ER-M for mercury was exceeded at all stations except AL1-8, and zinc concentrations exceeded the ER-M at all stations except AL1-1, AL1-2, and AL1-8.

Concentrations of total PCBs, measured as Aroclors, were also above the ER-M value at several stations within Parcel 1 of the ALBS leasehold (AL1-4, 5, and 7; Figure 11). In addition, station AL1-5 demonstrated the highest concentration of total PCBs. Total DDTs exceeded the ER-M value of 46.1 µg/kg at stations AL1-4 and 7. Total DDT is represented in Figure 12 by mapping the distribution of 4,4' DDE, the predominant compound comprising total DDT. Across all stations within Parcel 1 of the ALBS leasehold area, PAHs were relatively low with the exception of AL1-2. Station AL1-2 exceeded ER-M values for ten individual PAH analytes and had the highest total PAH concentrations of all stations (67,800 µg/kg), exceeding the ER-M value of 44,792 µg/kg. Figure 13 and Figure 14 illustrate the LMW and HMW PAHs, respectively, which constitute total PAHs. Stations AL1-2 and 3 had high concentrations of TBT with concentrations of 2,030 µg/kg and 1,400 µg/kg, respectively (Figure 15), while AL1-4 had high levels of bis(2-ethylhexyl) phthalate (36,000 µg/kg). It should be noted that while there are no ER-M values for organotins, TBT was detected at AL1-2 and 3 at concentrations that have been demonstrated to cause detrimental biological effects (see section 4.2.1).

Subsurface sediment (1-5 ft in depth): Subsurface sediment from ALBS Parcel 1 stations had reduced metal contamination in comparison to surface sediment samples (Figure 16 thru Figure 19). The ER-M values for copper, mercury, and zinc were exceeded at AL1-4 and AL1-5 down to a depth of 3 ft. A deeper sample taken from a station near AL1-5 (i.e., AL1-4, 3-4 ft) had lower metal concentrations than the AL1-5 (2-3 ft) sample, indicating that metal contamination at this station was likely limited to the upper 3 ft of sediment in this parcel. Total PCBs (i.e., measured as total Aroclors) and total DDTs exceeded the ER-M values in 2-3 ft samples from stations AL1-4 and AL1-5 (Figure 20 and Figure 21). While PAH concentrations in subsurface sediment from Parcel 1 were below the ER-M values, AL1-5 had elevated total PAHs (8,300 µg/kg) relative to other Parcel 1 stations. However, station AL1-2, which had high levels of PAH contamination in its surface sediment, was not analyzed for subsurface contamination due to piston core refusal during initial sample collection. Figure 22 and Figure 23 illustrate the LMW and HMW PAHs, respectively, which constitute total PAHs. Elevated concentrations of TBT were also detected at depths of 2-3 ft at stations AL1-4 (902 µg/kg) and AL1-5 (3,160 µg/kg), and were higher at these depths than in surface samples from the same stations (Figure 24). In contrast, at all other stations within Parcel 1 of the ALBS leasehold, organotin concentrations were lower in subsurface sediment samples as compared to surface sediment samples. At AL1-4 and AL1-5, organotins were not detected below 3 ft in depth.

ALBS Parcel 4

Surface sediment (0-1 ft in depth): Significant metal contamination was found in surface sediment samples from all stations within Parcel 4 of the ALBS leasehold (Figure 7 thru Figure 10). Specifically, the ER-M value for copper was exceeded at all stations within Parcel 4, the ER-M value for mercury was exceeded at all stations except AL4-10, and the ER-M value for zinc was exceeded at all stations except AL4-15. Copper concentrations in surface sediment from Parcel 4 were the highest at stations AL4-10 and AL4-12, and exceeded the TTLC at both stations. Similarly, the highest mercury concentration was found at AL4-12.

Concentrations of PCBs (i.e. measured as total Aroclors) were also above ER-M values at several stations within Parcel 4 of the ALBS leasehold. Stations AL4-9, 12, and 14 exceeded ER-Ms for total PCBs, and station AL4-12 had the highest levels of Aroclors 1248 and 1254 (Figure 11). Total DDTs exceeded the ER-M value in surface sediment from AL4-9, AL4-12, and AL4-14. Total DDT is represented in Figure 12 by mapping the distribution of 4,4' DDE, the predominant compound comprising total DDT. Stations AL4-9 and 12 demonstrated the highest total PAH concentrations within Parcel 4 surface sediments. Figure 13 and Figure 14 illustrate the LMW and HMW PAHs, respectively, which constitute total PAHs. All of the stations within Parcel 4 had elevated levels of organotins (i.e., DBT and TBT), with extremely high levels (46,800 µg/kg) measured at AL4-12 (Figure 15). Numerous studies have demonstrated that TBT-contaminated sediment at concentrations ranging from 100 µg/kg to 7,000 µg/kg causes toxicity to aquatic organisms (see section 4.2.1). Other organotins such as DBT may also cause toxicity to organisms (Mason and Jenkins, 1995).

The highest concentrations of most chemicals or chemical groups in Parcel 4 of the ALBS leasehold were found at station AL4-12. Specifically, the highest concentrations of mercury, copper, lead, zinc, arsenic, total DDTs, organotins, and total Aroclors were detected in the surface sediment sample from AL4-12, and many chemicals at this station were above ER-M values (mercury, copper, lead, zinc, arsenic, total Aroclors, and total DDTs). In contrast, AL4-15, while exceeding ER-M values for copper and mercury, had some of the lowest metal concentrations of the seven stations sampled within ALBS Parcel 4.

Subsurface sediment (1-5 ft in depth): Of all subsurface sediment samples assessed in this study, the highest concentrations of many chemicals including PCBs, organotins, and some metals were detected in subsurface sediment samples from Parcel 4 of the ALBS leasehold. Metal concentrations in subsurface sediment samples from Parcel 4 were significantly elevated at many stations (Figure 16 thru Figure 19). With the exception of AL4-11 (below 3 ft in depth), all of the ALBS stations within Parcel 4 had three to five metal analytes which exceeded ER-M values. Moreover, the TTLC was exceeded for mercury at AL4-12 (4-5 ft) and AL4-14 (2-3 ft) and for copper at AL4-10 (1-2 ft) and AL4-13 (2-3 ft). Mercury contamination was higher in subsurface sediment samples (below 1 ft) as compared to surface sediment samples, while for other metals there were no consistent patterns in concentration with increasing depth

Similar to the contamination pattern observed in Parcel 1, total PCB and total DDT concentrations in most subsurface sediment samples were higher than corresponding surface sediment samples from the same stations in Parcel 4 (Figure 20 and Figure 21). Total DDTs and PCBs exceeded ER-M values in at least one of the subsurface sediment samples from each station within Parcel 4 and PCB contamination was present to a depth of 6 ft at SV-8 (*i.e.,* AL4-15). Station AL4-12, which had high total PCBs in surface sediments (4,600 µg/kg) had only 590 µg/kg total PCBs in the subsurface sediment sample (4-5 ft). With the exception of AL4-11 and AL4-15, total PAHs were greater than 10,000 µg/kg at each station to a depth of 3 ft, and total HMW PAHs exceeded the ER-M value at a depth of 4-5 ft at AL4-12. Figure 22 and Figure 23 illustrate the LMW and HMW PAHs, respectively, which constitute total PAHs. Organotins (i.e., DBT and TBT) were elevated levels at stations AL4-13, AL4-14, and AL4-15 (>2680 µg/kg; Figure 24).

Subsurface sediment (below 5 ft in depth): The concentrations of many chemicals measured in subsurface sediment from stations re-sampled at greater depths in September of 2005 (SV-8 and SV-10, equivalent to AL4-15 and AL4-13, respectively) were below ER-M values. These chemicals included all metals examined, total PAHs, and total DDTs. In addition, concentrations of phenols and phthalates, were relatively low or below the detection limits at all stations. Organotin concentrations were low in samples from SV-8; however, in one subsurface sediment sample from SV-10 (4-6 ft), DBT and TBT concentrations exceeded levels that have been show to cause toxicity to aquatic organisms (>100 µg/kg). Similarly, the total PCB concentration in subsurface sediment (4-6 ft) from station SV-8 was also significantly elevated above the ER-M value of 180 µg/kg. These findings suggest that most of the contamination within Parcel 4 of the ALBS leasehold (i.e., metals, PCBs, PAHs, DDTs, organotins) was limited to a depth of 5 ft.

Fish Harbor Area

Surface sediment (0-1 ft or 0-2 ft in depth): Elevated concentrations of many heavy metals including copper, lead, mercury, nickel, and zinc were found in surface sediment from stations within the Fish Harbor area. All of the stations from Fish Harbor had at least one of these metals exceeding the ER-M value. Mercury contamination, in particular, was widespread throughout this area, with all of the stations having concentrations above 0.7 mg/kg. Station FH-19 and SV-7 demonstrated some of the highest metals contamination of all the stations.

Concentrations of total DDTs and PCBs[5] were also above the ER-M value at most of the stations within the Fish Harbor area. Across all stations within the Fish Harbor area, PAHs were relatively low with the exception of stations FH-19 and SV-1. However, stations FH-19 and 20 demonstrated concentrations of TBT in surface sediment (4,840 µg/kg and 475 µg/kg, respectively) that have been demonstrated to cause detrimental biological effects (see section 4.2.1).

In surface sediment samples collected from the Fish Harbor area, the highest concentrations of most chemicals or chemical groups were found at station FH-19 (mercury, copper, lead, zinc, total DDTs, total PAHs, organotins, phthalates, and total Aroclors). Many chemicals were above ER-M values (mercury, copper, lead, zinc, total LMW and HMW PAHs, total Aroclors, and total DDTs).

Subsurface sediment (below 1 ft in depth): At most stations in the Fish Harbor area, subsurface sediment had lower metal concentrations relative to surface sediment (0-1 ft). However, most of the stations within Fish Harbor had mercury concentrations that were higher in subsurface sediment than surface sediment, and were 1.7 to 7.9 fold higher than the TTLC of 20 mg/kg in the deepest sediment samples from SV-1 (equivalent to FH-19). At many stations from the Fish Harbor area, heavy metal contamination was concentrated within the top 3 ft of sediment (FH-17, 18, 20-22, and SV-9, 11). Heavy metal contamination (*i.e.,* mercury, lead, copper, zinc), measured as ER-M exceedances, was found at a depth of 4 ft at SV-7 and as deep as 10 ft at SV-1 (FH-19). In addition, at SV-12, mercury was also found above the ER-M value to a depth of 8 ft.

In addition to metals, concentrations of total PCBs and total DDTs in subsurface sediment were higher than those in surface sediment at many stations FH-17, 19, 20, and 22. Concentrations of total PCBs were

---

[5] Total PCBs were equivalent to the Total Aroclors in sediment samples collected in the January 2005 Sampling Event, whereas Total PCBs were the sum of individual PCB congeners in sediment samples collected in the September 2005 Sampling Event. Total Aroclors were also measured in September 2005, and closely reflect the Total PCB concentrations.

above the ER-M value in subsurface sediment from stations within the Fish Harbor area (FH-17 to 20, 22) and PCB contamination was present to a depth of 3 ft at FH-17, 20, and 22. In addition, PCB and Aroclor contamination was found to a depth of 10 ft at SV-1 (FH-19). DDT contamination was also present to a depth of 3 ft at two stations (FH-17 and 20), to 5 ft at FH-19, and reached 6 ft at SV-9 and 12. Across all stations within the Fish Harbor area, PAHs were relatively low with the exception of stations FH-19, or SV-1, and SV-7 (2-4), in which total LMW PAHs and total HMW PAHs, separately, exceeded ER-M values. PAH contamination was found to a depth of 10 ft at SV-1 (FH-19). Most subsurface sediment samples from the Fish Harbor area demonstrated low levels of organotins; however, the TBT concentration was elevated at FH-19.

Similar to surface sediment samples, in subsurface sediment collected from the Fish Harbor area, the highest concentrations of most chemicals or chemical groups were found at station FH-19, with heavy metals contaminating sediment to a depth of 10 ft at this station. Specifically, the highest concentrations of mercury, copper, lead, zinc, cadmium, total PAHs, organotins, and total PCBs were detected in subsurface sediment from this station. In addition, many chemicals were above ER-M values (mercury, copper, cadmium, zinc, total HMW PAHs, total PCBs, and total DDTs), and some chemicals were above TTLC values (mercury and copper). In addition to heavy metals, PCBs and PAHs were found at SV-1 (FH-19) to a depth of 10 ft.

Figure 14. HMW PAH concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

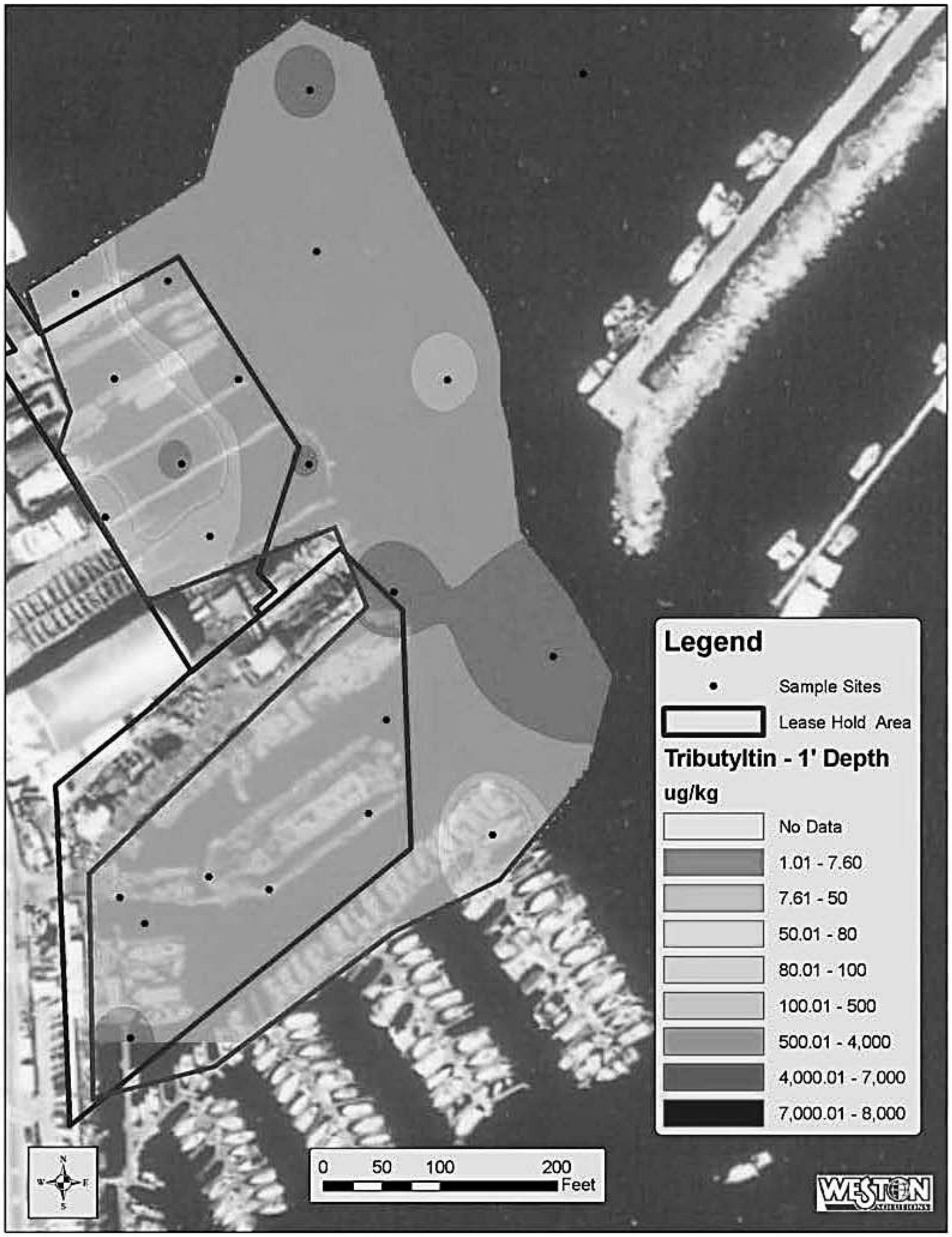


Figure 15. TBT concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

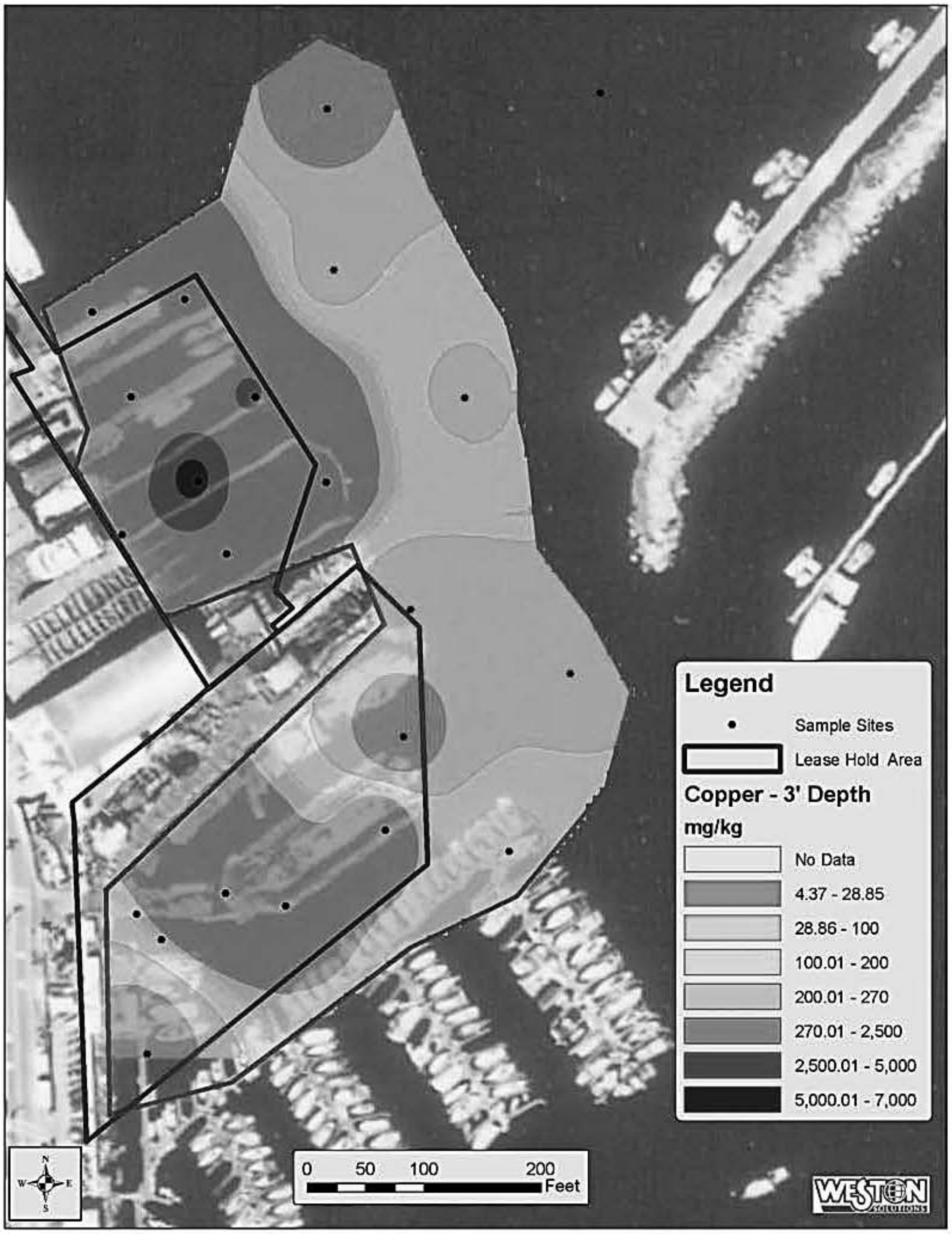


Figure 16. Copper concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

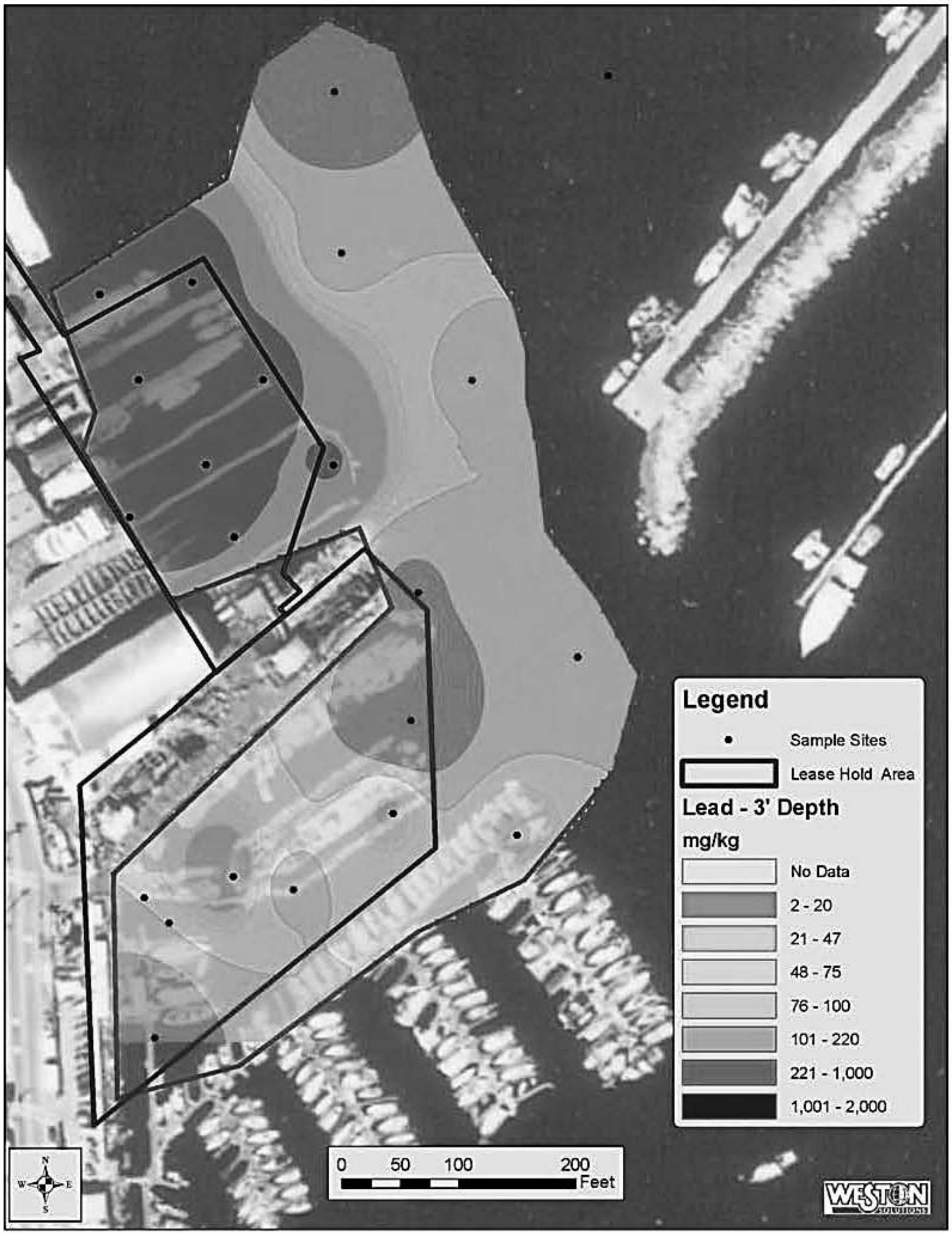


Figure 17. Lead concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

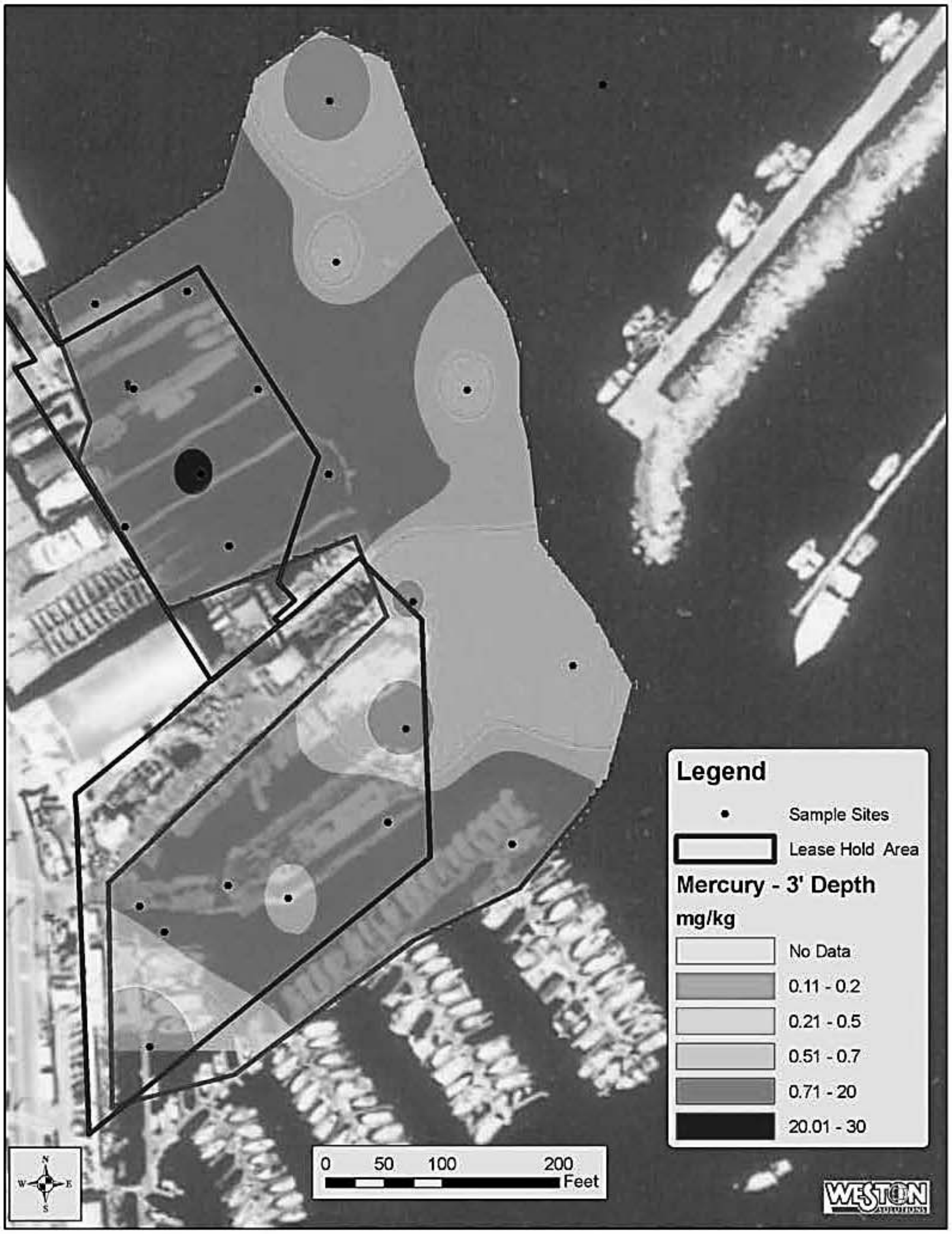


Figure 18. Mercury concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

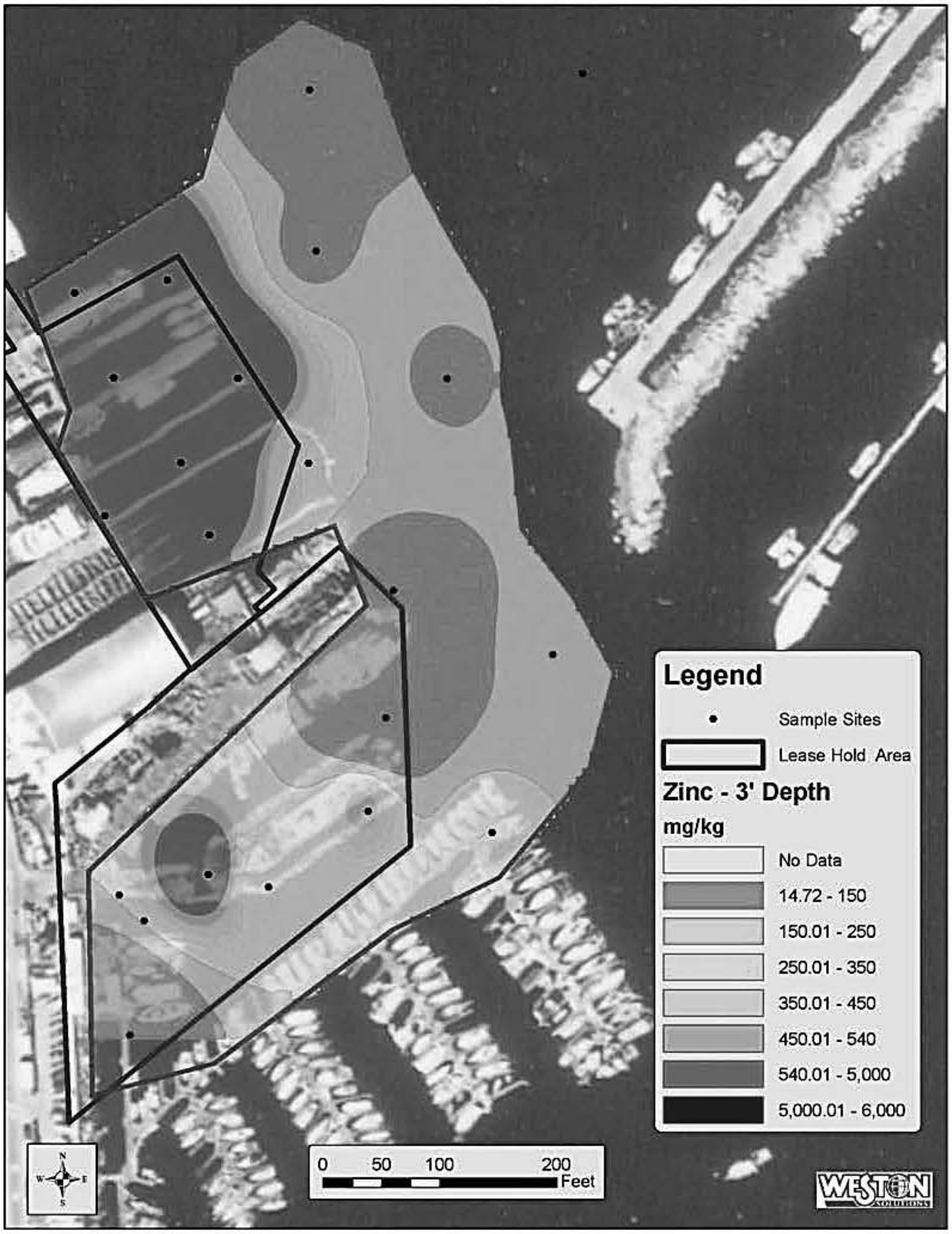


Figure 19. Zinc concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

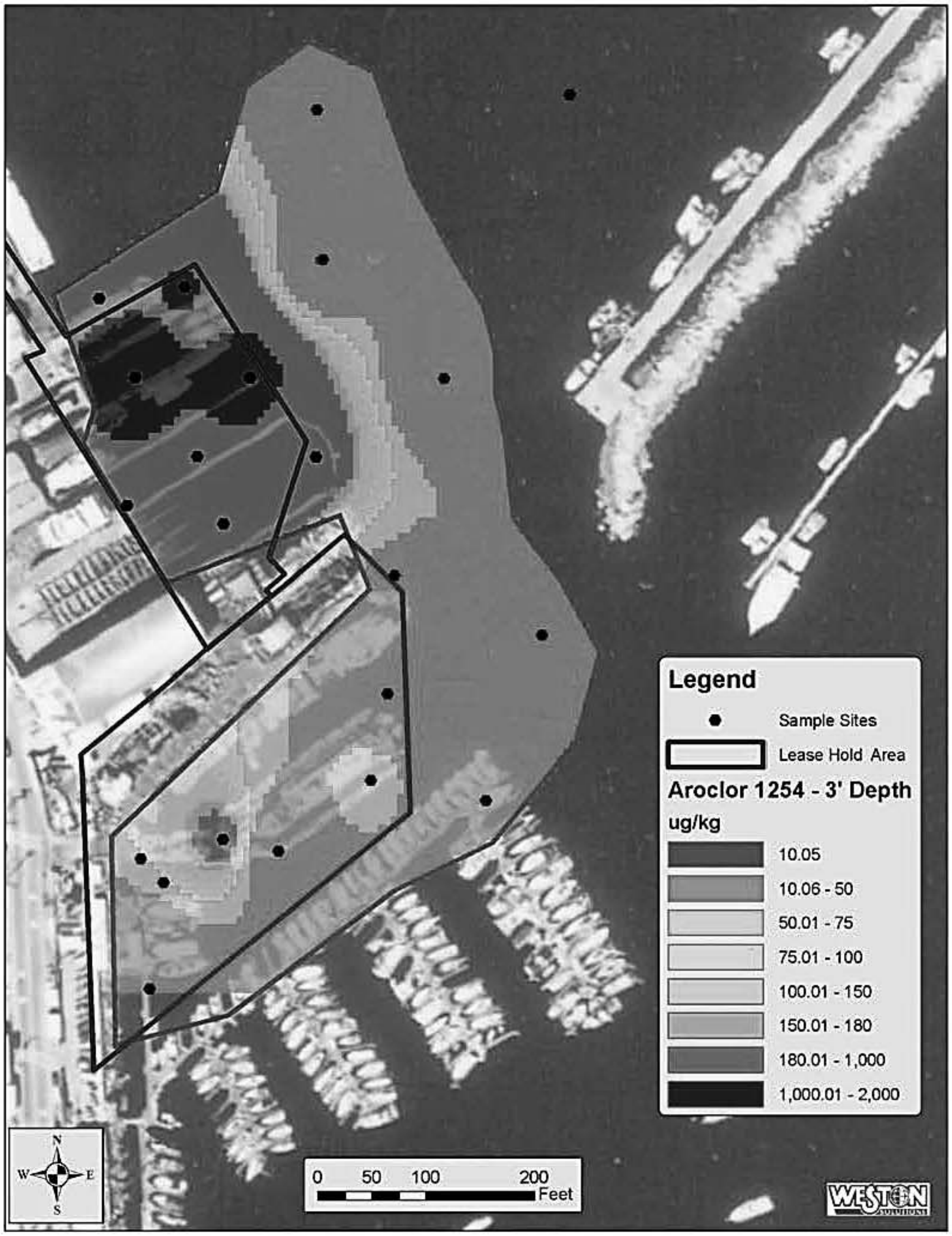


Figure 20. Aroclor 1254 concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

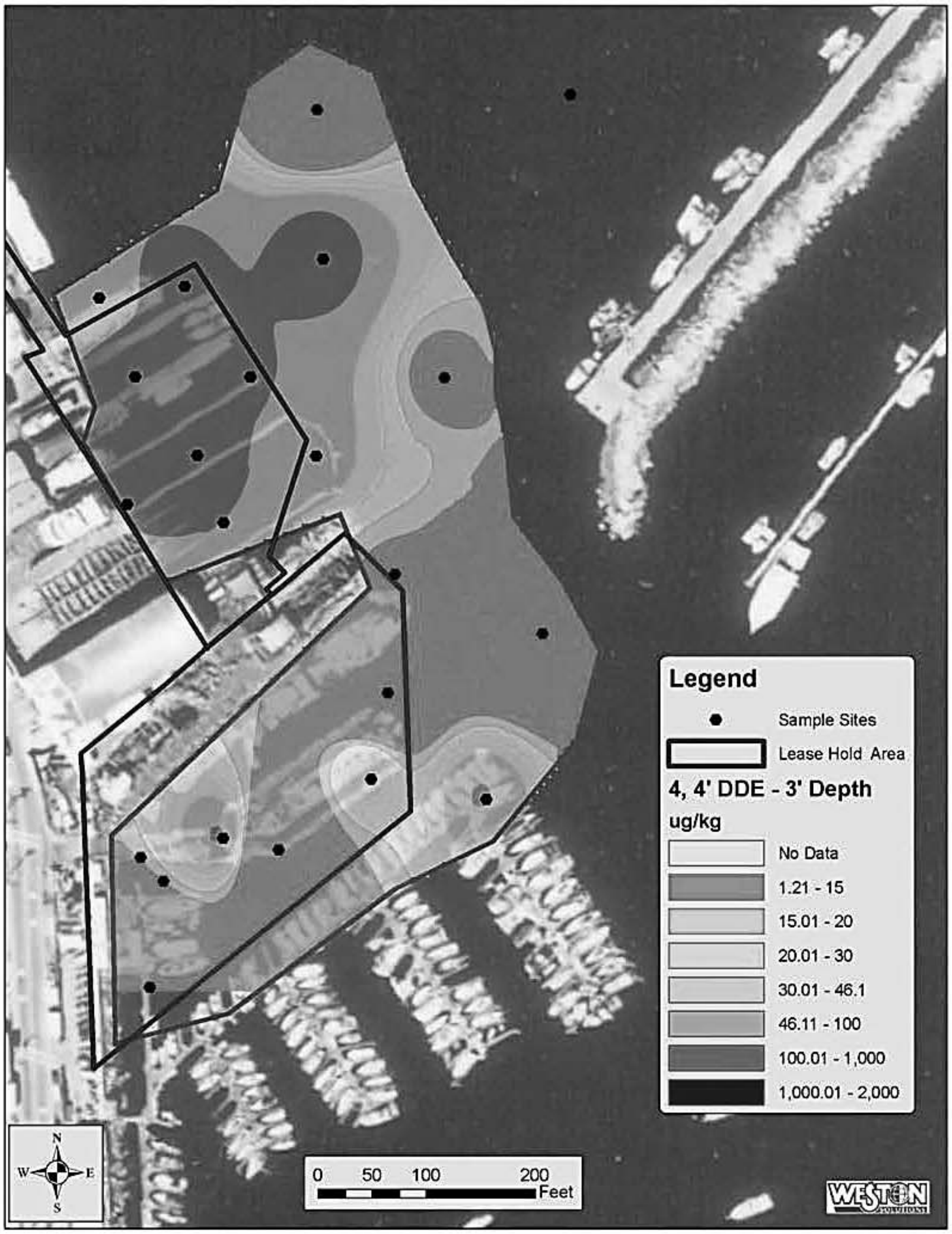


Figure 21. 4,4'-DDE concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

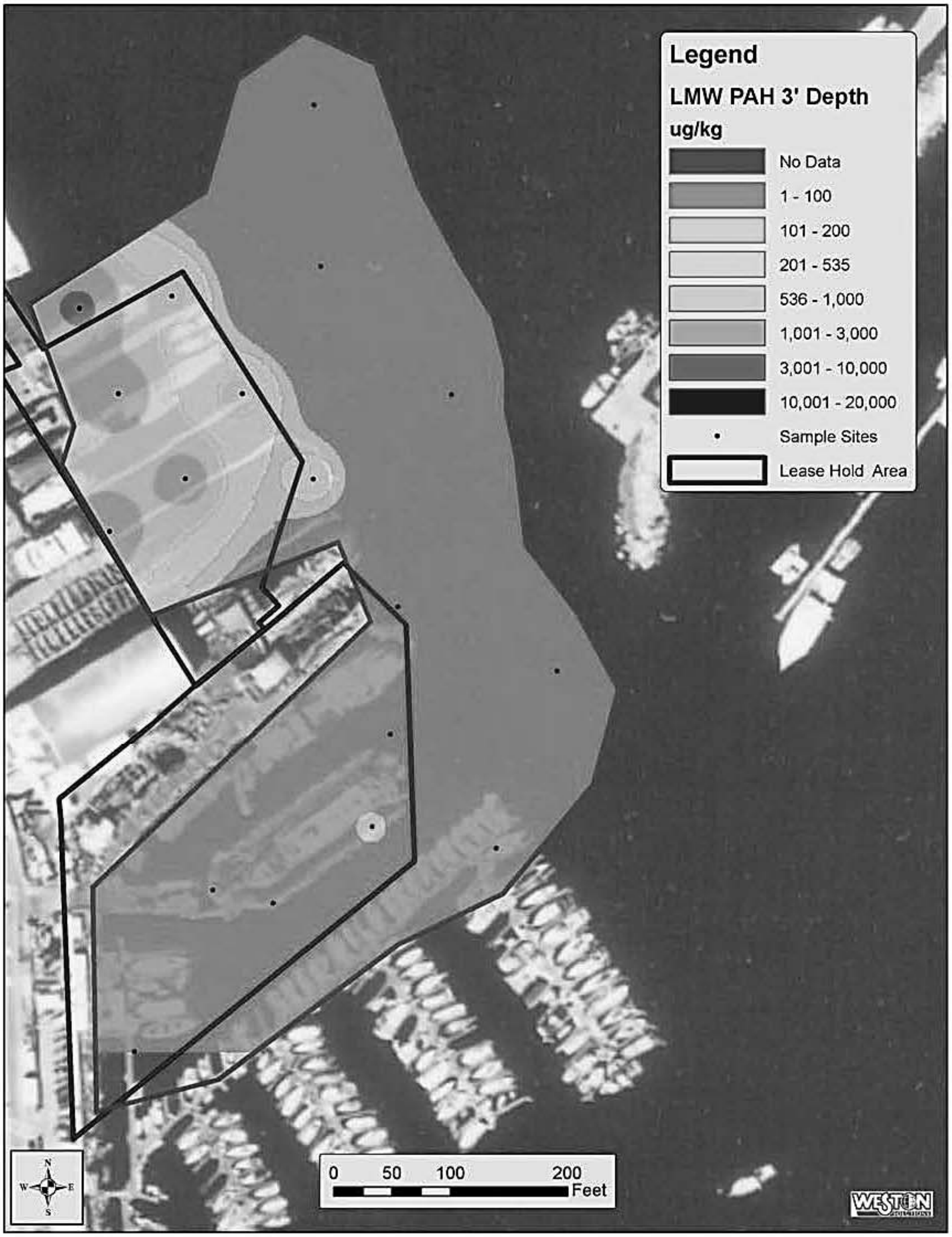


Figure 22. LMW PAH concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

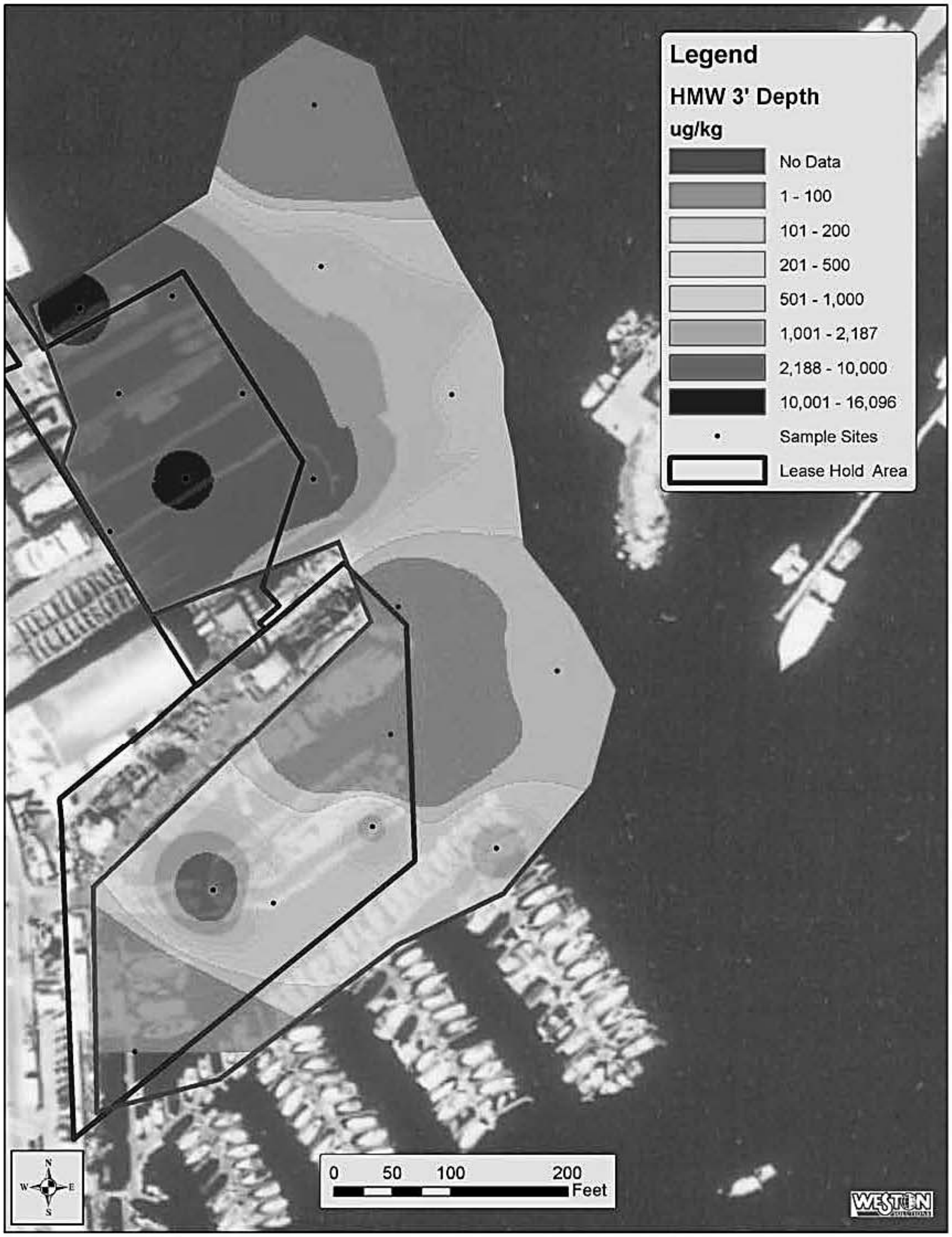


Figure 23. HMW PAH concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

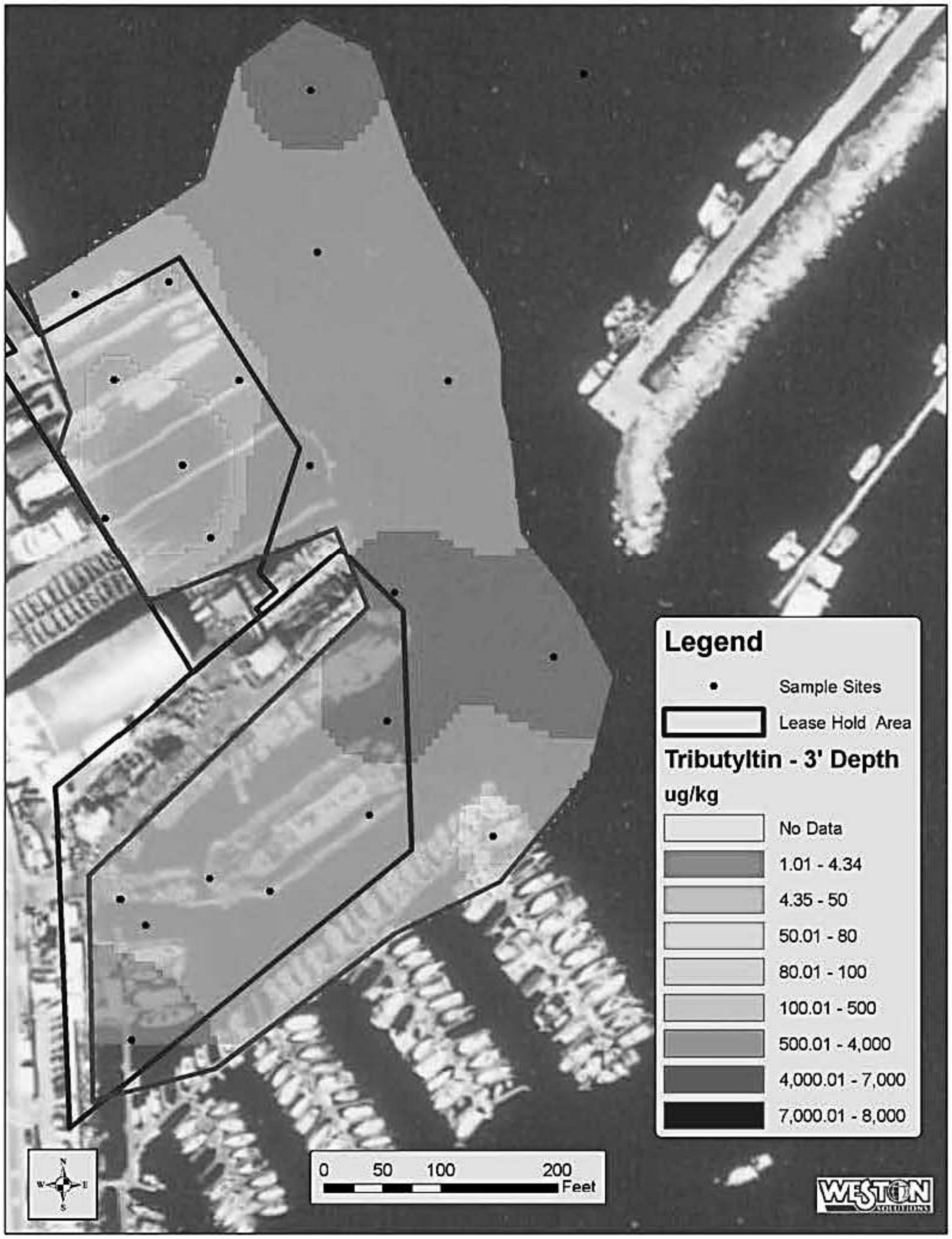


Figure 24. TBT concentrations in subsurface (2-3 ft) sediment within and adjacent to the ALBS leasehold area.

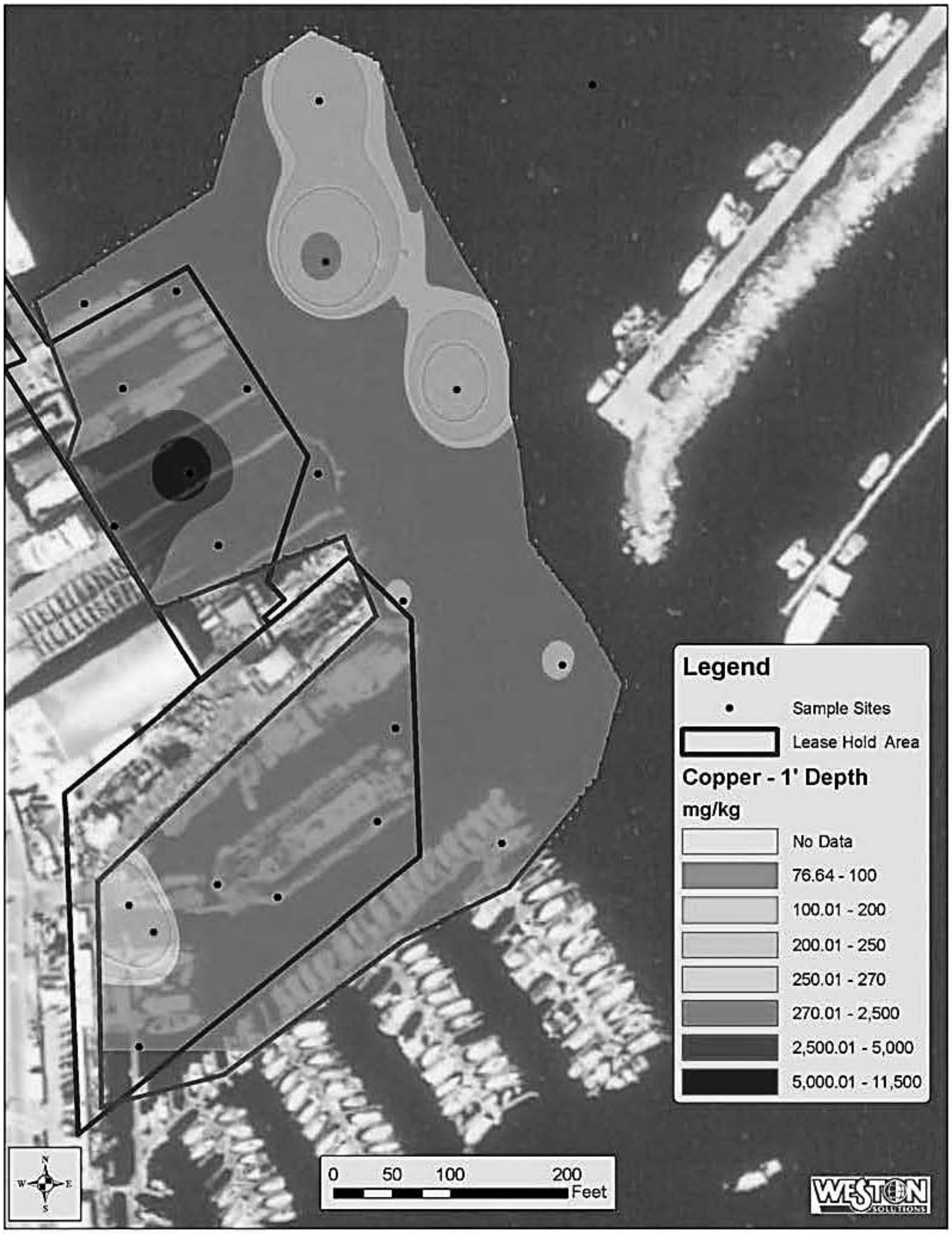


Figure 7. Copper concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

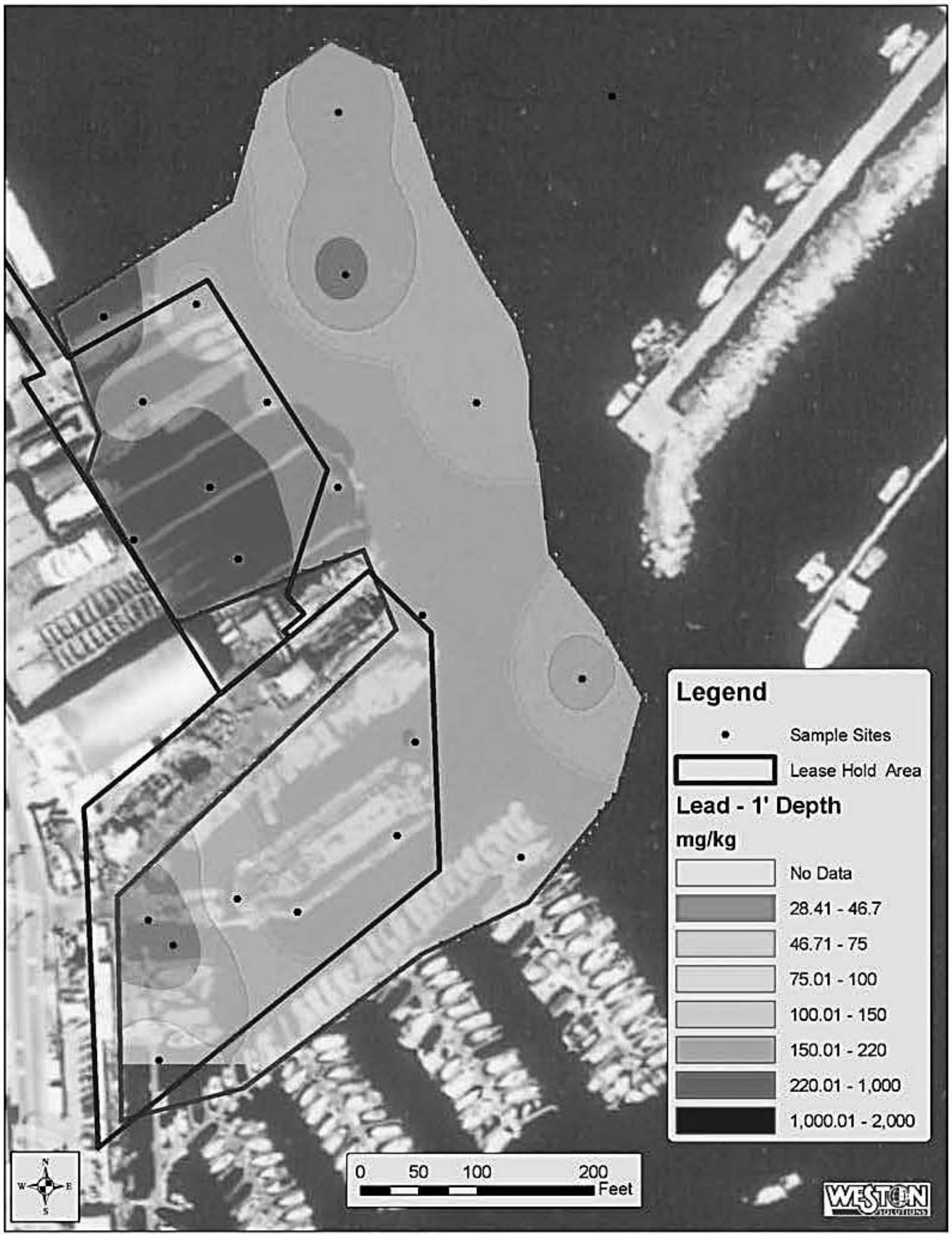


Figure 8. Lead concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

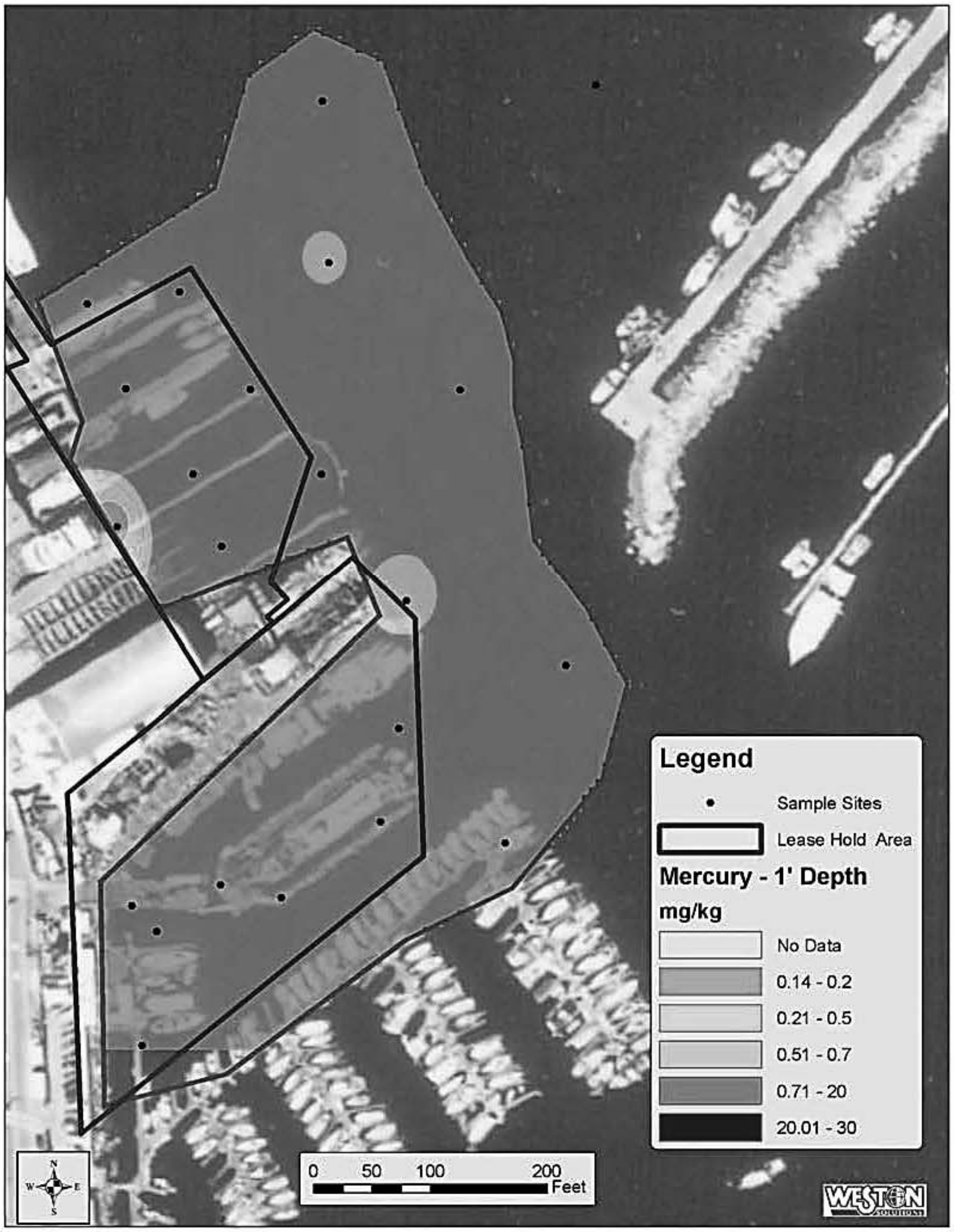


Figure 9. Mercury concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

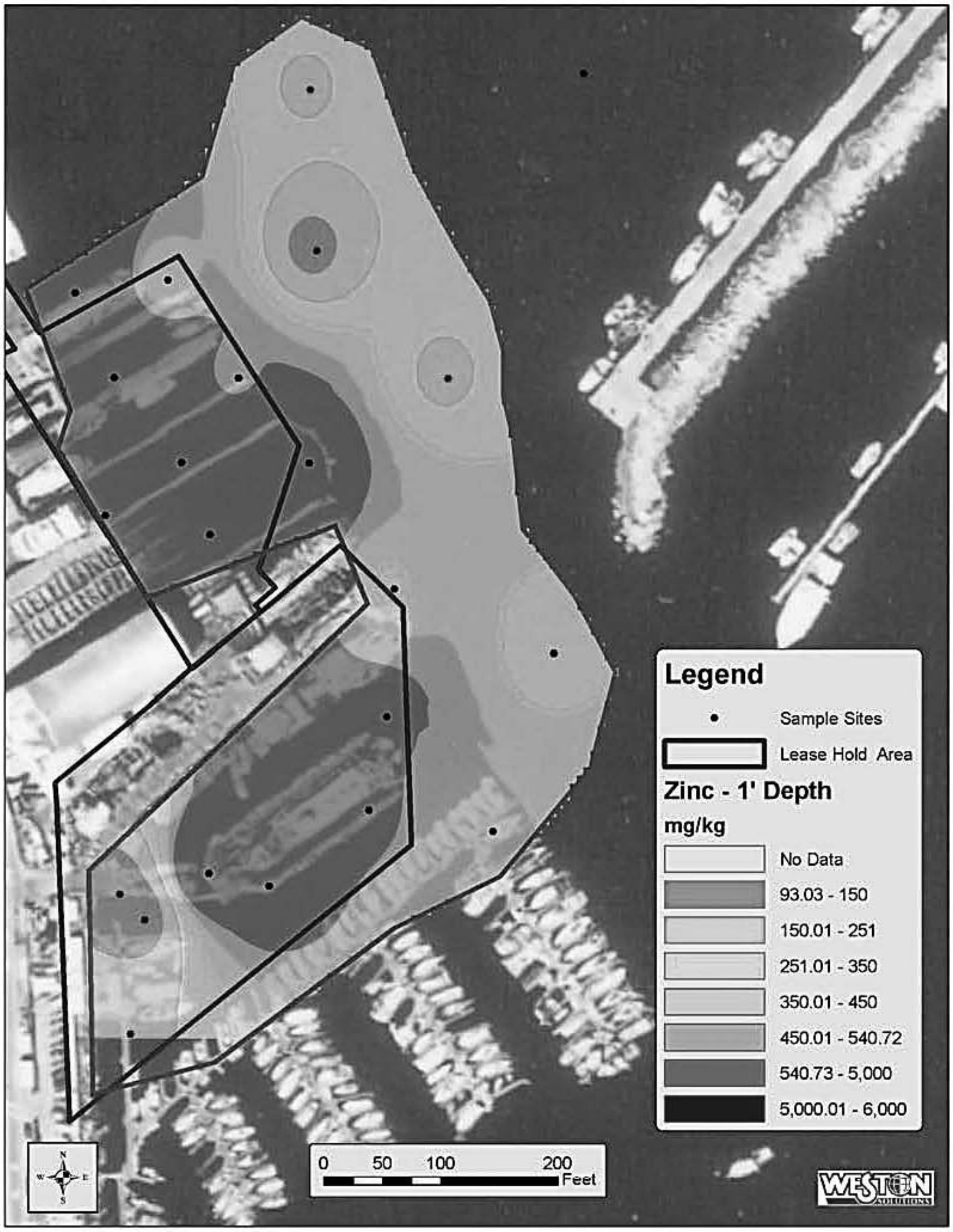


Figure 10. Zinc concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

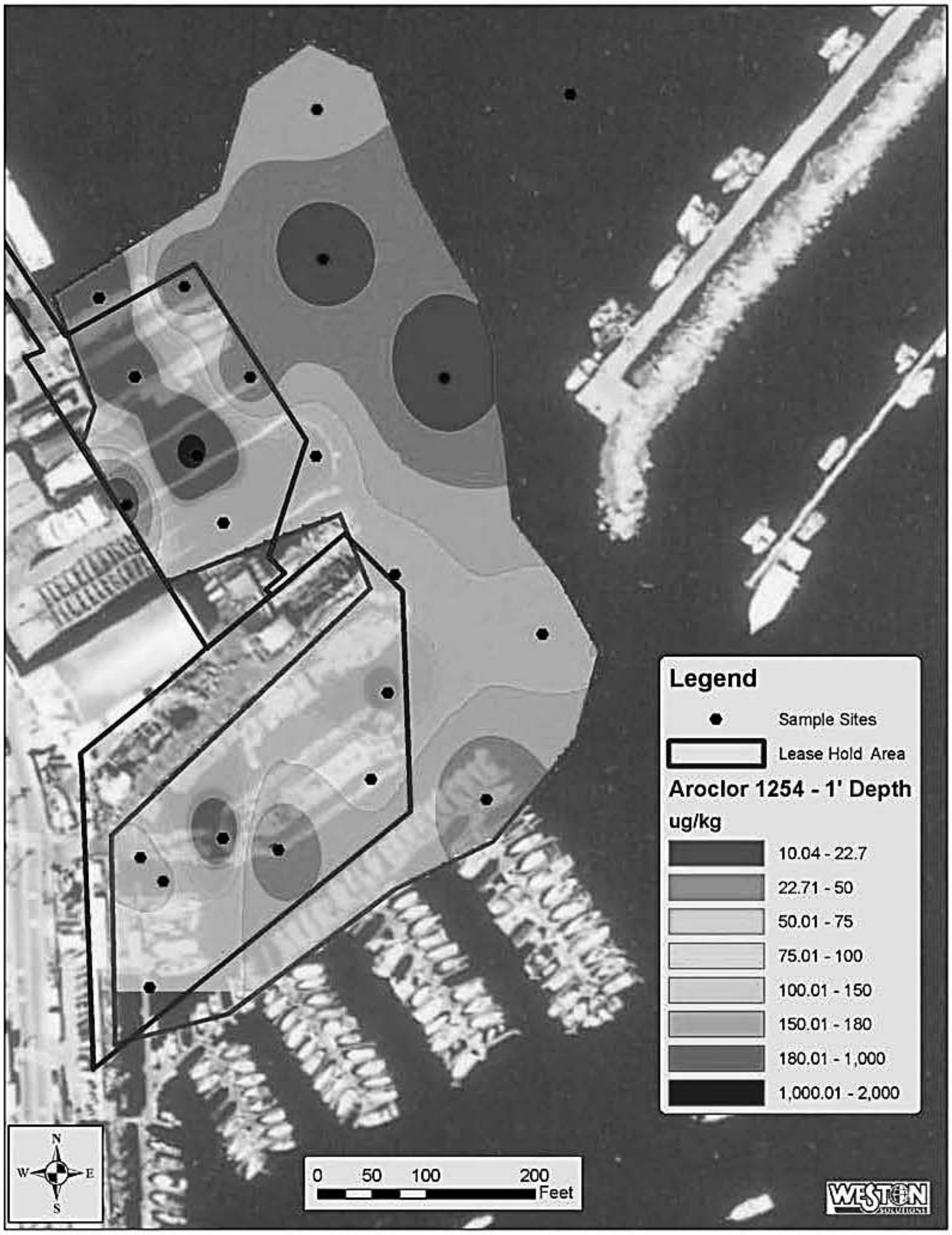


Figure 11. Aroclor 1254 concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

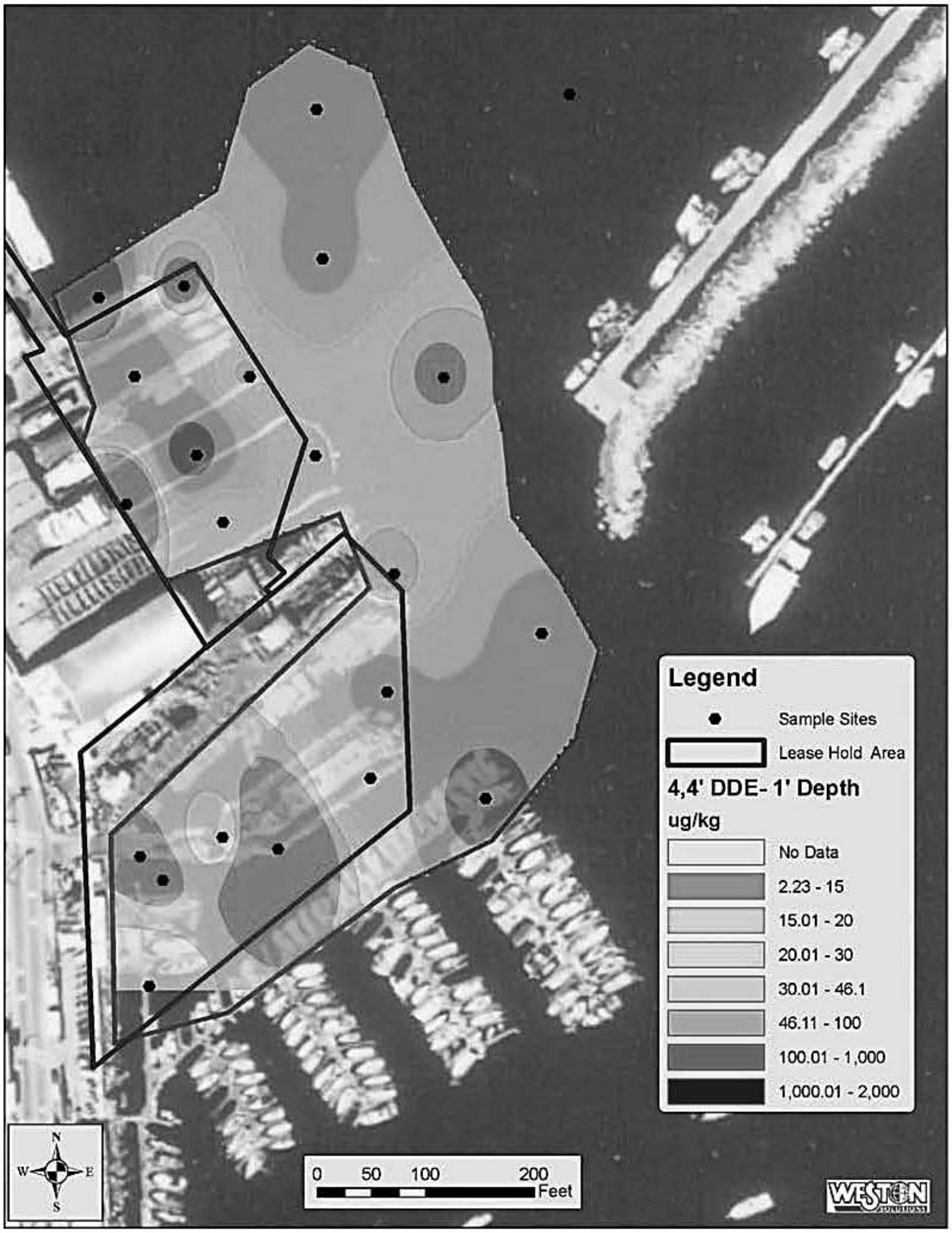


Figure 12. 4,4'-DDE concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

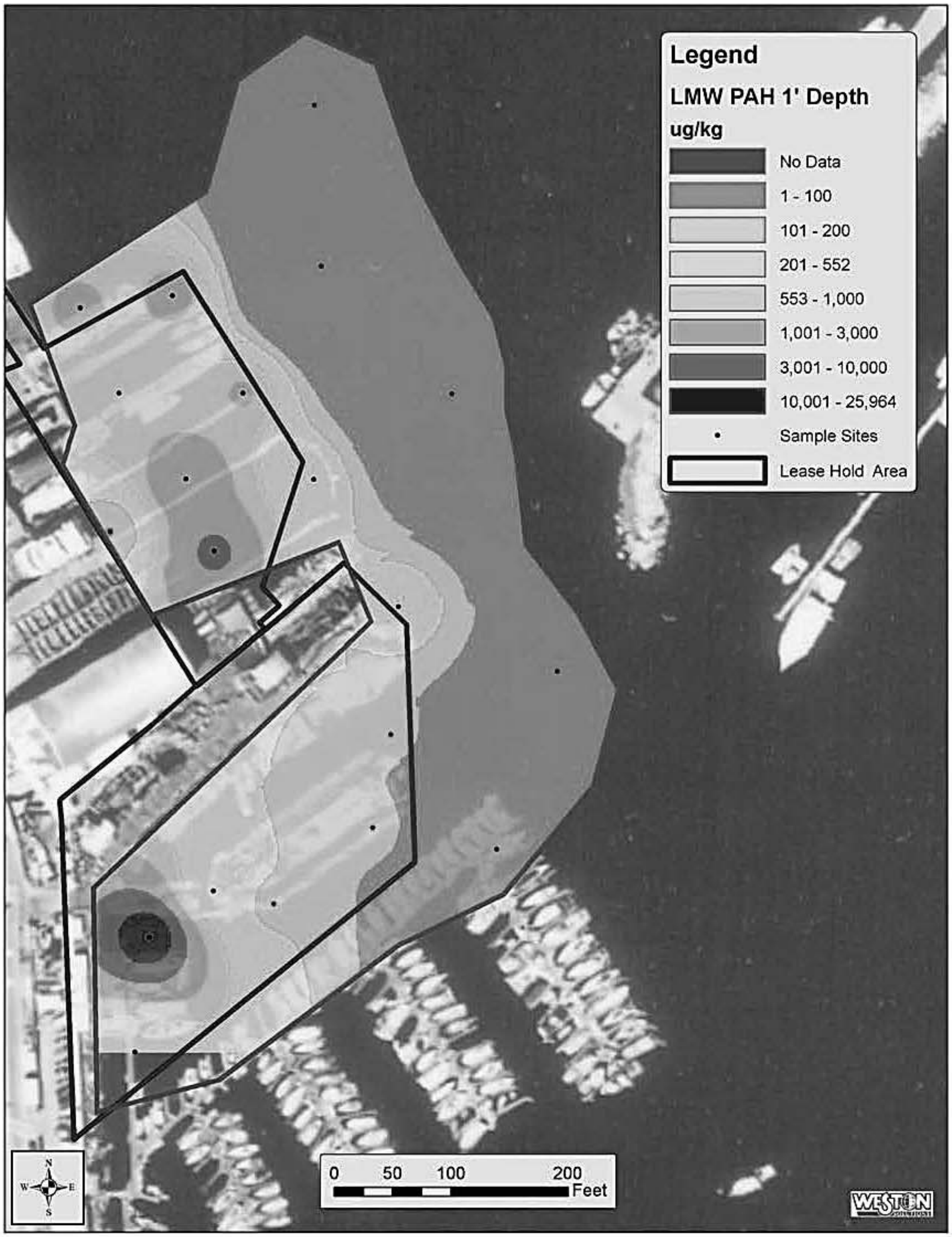


Figure 13. LMW PAH concentrations in surface (0-1 ft) sediment within and adjacent to the ALBS leasehold area.

6. STATISTICAL ANALYSES OF SEDIMENT CONTAMINANTS AMONG SAMPLING LOCATIONS

Elevated levels of multiple contaminants were detected in all sediment samples evaluated. Initially, spatial patterns of contaminants were mapped to demonstrate the relative concentrations of contaminants of concern within and adjacent to the ALBS leasehold. However, using this method, distinct spatial patterns were not apparent, likely due to the complexity of the horizontal and vertical distribution of contaminant concentrations, which varied by orders of magnitude across all sample locations. Therefore, statistical analyses were used to identify contaminant patterns. Sample locations were first categorized into five groups (Table 7) based on proximity to the leasehold areas and included: (1) samples located within Parcel 1, (2) samples located within Parcel 4, (3) samples adjacent to Parcels 1 and 4, (4) samples removed from Parcels 1 and 4, and (5) samples located near an old outfall in northwest corner of Fish Harbor. The sample locations were classified *a priori* in order to prevent biasing of statistical findings. Classifications were based on the physical parameters that are inherently linked to activities performed in each sample location (Table 7).

Prior to analysis, the number of variables was reduced by eliminating physical or chemical variables that were highly correlated ($R \geq 0.90$) to other physical/chemical variables[6] and those that were non-detect, thereby lowering the number of variables to 23. Next, a stepwise discriminant analysis was conducted to determine the set of physical/chemical variables most likely to be significant in discriminating the five groups. The physical/chemical data for samples from the surface (0 - 2 foot depth) and subsurface (2 – 4 foot depth) were used separately in the analysis. The contaminant concentrations were log transformed prior to analysis. The SAS procedure STEPDISC was used for this process with stepwise selection method and significance level of 0.15 (SAS Institute, 2002). The stepwise discriminant analyses found that sediment concentrations of dibutyltin, tributyltin, copper, cadmium, Aroclor 1248, 4,4'-DDD, and TRPH provided the highest level of discrimination between the five groups.

These seven variables were included in a canonical correlation analysis. Canonical correlation analysis is a multivariate method used to identify relationships between a set of independent variables (e.g. the five groups) and a set of dependant variables (e.g. physical/chemical properties) (Levine, 1982). This method can be used to determine which contaminants are associated with specific groups of samples. For canonical analysis, the SAS procedure CANDISC was used. This analysis derives canonical variables (linear combination of the quantitative variables) that summarize between-class (Sample Group) variation. The analysis identifies the combination of contaminants with the largest canonical correlation first, and then subsequently smaller correlations are estimated which are independent of the previous ones (*i.e.,* orthogonal). Through the process of calculating significant canonical correlations, the set of associations between contaminants and sample groups was revealed.

[6] The elimination of variables that are highly correlated is accepted in this analysis to provide more power for discriminating among groups. In this process one variable is retained in the analysis to represent all other variables that are highly correlated with it.

Table 7. Sample classification for Canonical correlation analysis.

Sample Locations	Sample Groups	Sample Group Identification for Statistical Analyses
AL1-1	Leasehold Area 1	1
AL1-2	Leasehold Area 1	1
AL1-3	Leasehold Area 1	1
AL1-4	Leasehold Area 1	1
AL1-5	Leasehold Area 1	1
AL1-6	Leasehold Area 1	1
AL1-7	Leasehold Area 1	1
AL1-8	Leasehold Area 1	1
AL4-9	Leasehold Area 4	2
AL4-10	Leasehold Area 4	2
AL4-11	Leasehold Area 4	2
AL4-12	Leasehold Area 4	2
AL4-13	Leasehold Area 4	2
AL4-14	Leasehold Area 4	2
AL4-15	Leasehold Area 4	2
SV-8	Leasehold Area 4	2
SV-10	Leasehold Area 4	2
FH-16	Adjacent to leasehold	3
FH-21	Adjacent to leasehold	3
SV-7	Adjacent to leasehold	3
SV-9	Adjacent to leasehold	3
SV-11	Adjacent to leasehold	3
SV-12	Adjacent to leasehold	3
FH-17	Far sites	4
FH-18	Far sites	4
FH-20	Fish Harbor	4
FH-22	Fish Harbor	4
FH-19	Outfall	5
SV-1	Outfall	5

6.1 Results

A stepwise discriminant analysis (SAS STEPDISC) was conducted to reduce the number of variables. The STEPDISC analysis found dibutyltin, tributyltin, copper, cadmium, Aroclor 1248, 4,4'-DDD, and TRPH to be the most important variables for detecting differences among the sample groups. With these selected variables, a canonical discriminant analysis (SAS CANDISC) was executed. Table 8 shows the results for the contaminant data set, conducted with each Sample Group as a class variable. Only the first three canonical variables were significant (<0.05). The R^2, given by the squared canonical correlation, ranged from 0.53 to 0.88 for the first three Canonical variables (CAN1, CAN2, and CAN3). Together CAN1, CAN2 and CAN3 account for 89% of the variance in sediment chemistry and provide the best discrimination among the sites. Relationships between CAN1 and CAN2, CAN1 and CAN3, and CAN2 and CAN3, respectively are shown in Figure 25 through Figure 27. The mean Area Type values on the first three Canonical variables are illustrated in Figure 28. The vector lines within the Canonical plots represent the weighting factors of the contaminants on the Canonical axes.

Table 8. Canonical correlation output.

Canonical Variable	Eigenvalue	Squared canonical correlation	Proportion of variance	Cumulative variance	Pr > F
1	7.68	0.88	0.63	0.63	<0.0001
2	2.13	0.68	0.17	0.80	<0.0001
3	1.11	0.53	0.09	0.89	0.005
4	0.68	0.41	0.06	0.94	0.060
5	0.52	0.34	0.04	0.99	0.249
6	0.13	0.12	0.01	1.00	0.835

In examining all three Canonical plots, the distinction of samples located within the leasehold areas (classified as Group 1 and 2) is primarily due to elevated concentrations of copper (most evident in Figure 25 and Figure 26). While samples located adjacent to the leasehold area (classified as Group 3) are distinguished from other samples due to elevated cadmium and TRPH concentrations (most evident in Figure 25 and Figure 26). Oil and grease concentrations were highly correlated with TRPH (R_2=0.99), and therefore are also important in characterizing these sample locations. Samples located near the outfall in the northeast corner of Fish Harbor were distinguished from other sites by elevated concentrations of tributyltin and 4,4'-DDD.

In summary, the separation between Sample Groups with the calculated canonical variables was significant. The relative concentrations of the seven contaminants in sediment samples collected in Parcel 1 were similar to samples collected in Parcel 4. Parcels 1 and 4 were significantly different from all other groups; separation of samples collected within the leasehold areas relative to those outside was most strongly influenced by elevated concentrations of copper. Therefore, the material within the leasehold area contains contaminants that are distinguished from those in outer Fish Harbor and are most likely a result of activities within the leasehold area.

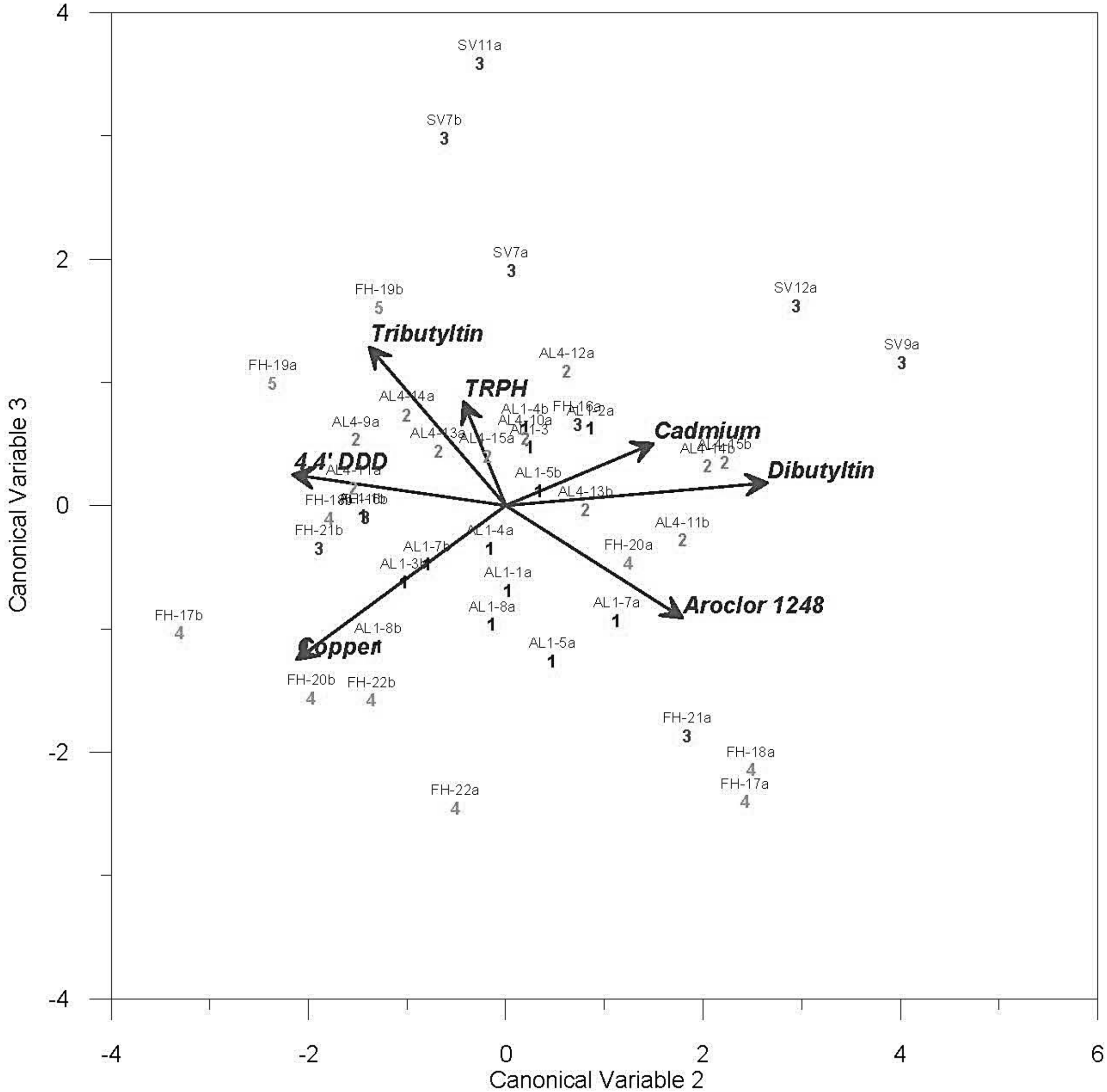


Figure 27. Canonical correlation plot of the second and third Canonical variables, displaying Sample Group (colored numbers) with corresponding sample location and depth (a-surface and b-subsurface).

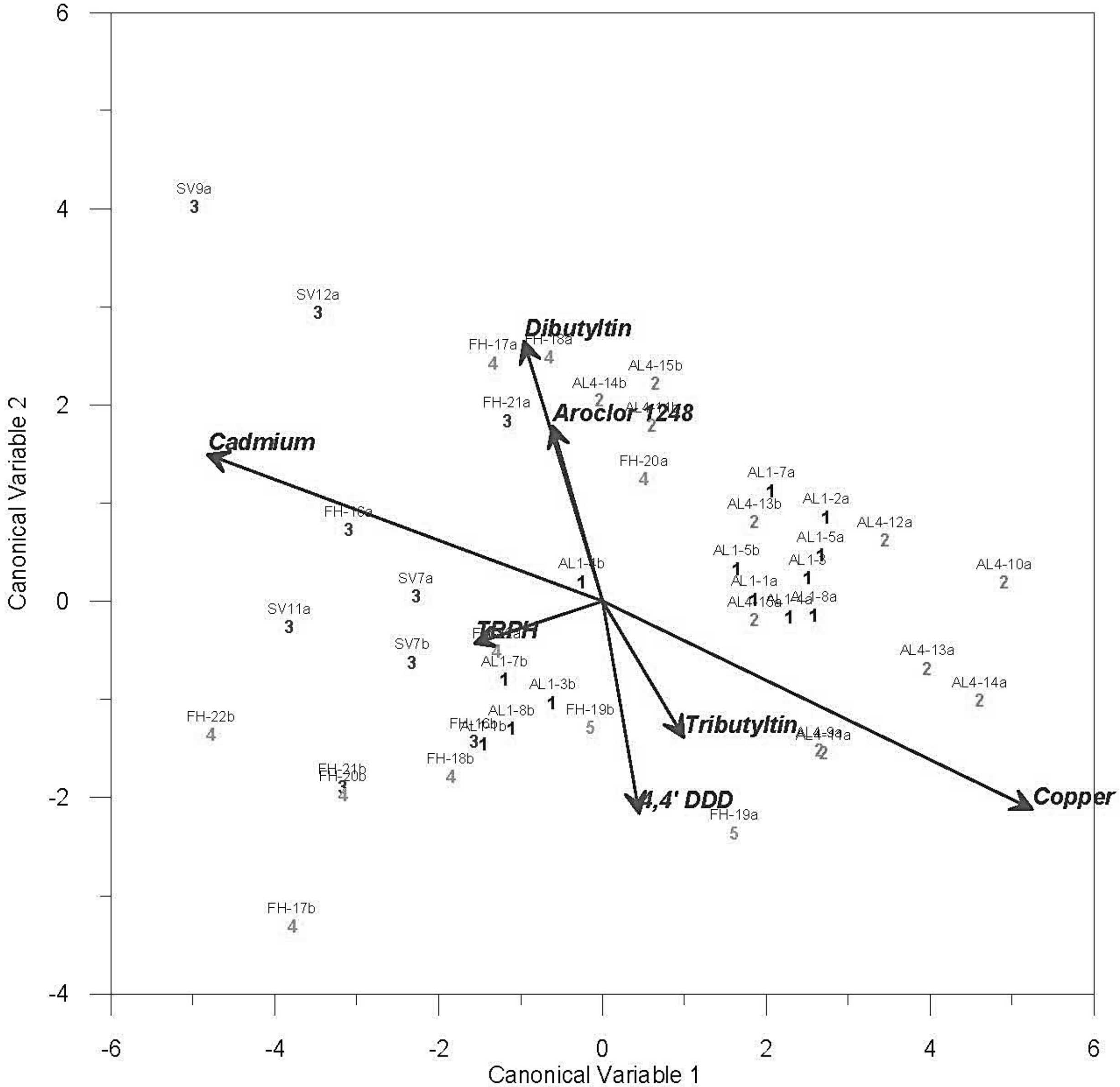


Figure 25. Canonical correlation plot of the first two Canonical variables, displaying Sample Group (colored numbers) with corresponding sample location and depth (a-surface and b-subsurface).

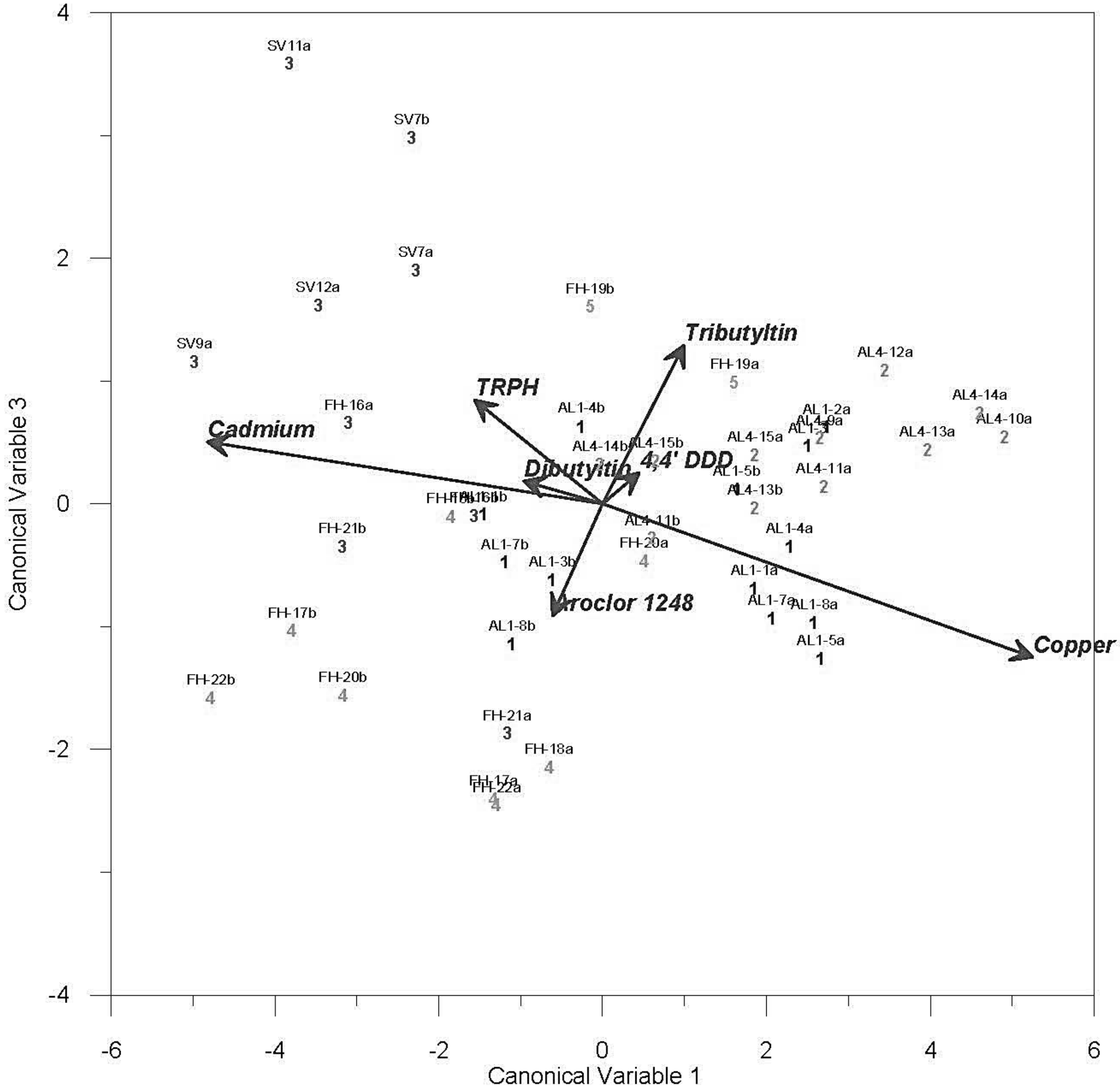


Figure 26. Canonical correlation plot of the first and third Canonical variables, displaying Sample Group (colored numbers) with corresponding sample location and depth (a-surface and b-subsurface).

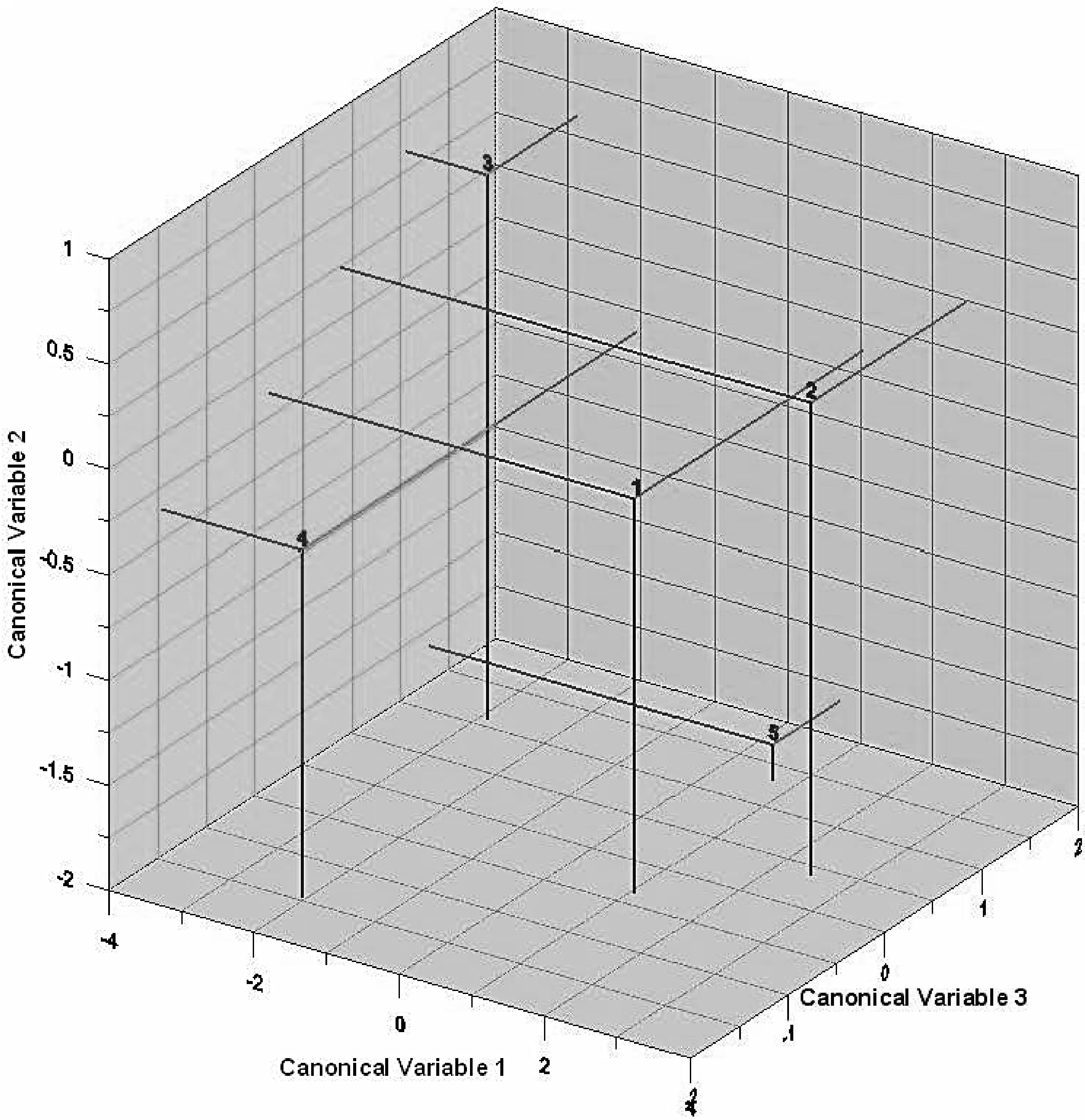


Figure 28. Canonical correlation plot of the first three Canonical variables, displaying mean Sample Group value in three-dimensional space.

7. REFERENCES

Anchor Environmental CA, L.L.C. 2005. BAE Systems San Diego Ship Repair Inc. (Formerly Southwest Marine, Inc.) POLA Leasehold. San Pedro, California. Sediment Evaluation Report. September.

Austen, M.C., and A.J. McEvoy. 1997. Experimental effects of tributyltin (TBT) contaminated sediment on a range of meiobenthic communities. *Environmental Pollution*, 96:435-444.

Environmental Protection Agency, United States, Region II (EPA Region II). 1988. *Determination of Total Organic Carbon in Sediment (Lloyd Kahn Method).* Edison, N.J. 27 July.

Hallers-Tjabbes, C.C., J.-W. Wegener, B. Van Hattum, J.F. Kemp, E.T. Hallers, T.J. Reitsema, J.P. Boon. 2003. Imposex and organotin concentrations in *Buccinum undatum* and *Neptunea antiqua* from the North Sea: relationship to shipping density and hydrographical conditions. *Marine Environmental Research*, 55:203-222.

Krone, C.A., D.W. Brown, D.G. Burrows, R.G. Bogar, S.L. Chan, and U. Varanasi. 1989. A method for analysis of butyltin species in measurement of butyltins in sediment and English sole livers from Puget Sound. Marine Environmental Research 27:1-18.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management, Vol. 19, No. 1*, pp 81-97.

Mason, A.Z., and K.D. Jenkins. 1995. Metal detoxification in aquatic organisms. In Tessier A., and D.R. Turner, eds., *Metal Speciation and Bioavailability in Aquatic Systems.* John Wiley & Sons, New York, NY, USA, pp. 479–608.

McGee, B.L., C.E. Schlekat, D.M. Boward, and T.L. Wade. 1995. Sediment contamination and biological effects in a Chesapeake Bay marina. 1995. *Ecotoxicology*, 4:39-59.

Meador, J.P., and C.A. Rice. 2001. Impaired growth in the polychaete *Armandia brevis* exposed to tributyltin in sediment. 2001. *Marine Environmental Research*, 51:113-129.

Meador, J.P., C.A. Krone, D.W. Dyer, and U. Varanasi. 1997. Toxicity of sediment-associated tributyltin to infaunal invertebrates: species comparison and the role of organic carbon. *Marine Environmental Research*, 43:219-241.

Meador, J.P. 2000. An analysis in support of a sediment quality threshold for tributyltin to protect prey species for juvenile salmonids listed by the Endangered Species Act. Environmental Conservation Division, Northwest Fisheries Science Center, NOAA. Copy available on line at http://www.nwfsc.noaa.gov/research/divisions/ec/ecotox/ whitepaperspdf/tbtwp8_2000.pdf

Mesa Environmental Services. 1998. Al Larson Boat Shop Site Characterization Report in Compliance With Worldport LA Site Characterization Requirements. May.

Plumb, R.H., Jr. 1981. *Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1*. U.S. Environmental Protection Agency/U.S. Army Corps of Engineers Technical Committee on criteria for dredged and fill material, U.S. Army Waterways Experimental Station. Vicksburg, MS.

Stronkhorst, J., B. vanHattum, and T. Bowmer. 1999. Bioaccumulation and toxicity of tributyltin to a burrowing heart urchin and an amphipod in spiked, silty marine sediments. *Environ. Tox. and Chem*. Vol. 18 No. 10:2343-2351.

Tetra Tech, Inc. 1994. Preliminary Site Assessment, Al Larson Boat Shop, 1046 South Seaside Ave., Terminal Island, California. November.

United States Environmental Protection Agency; and Department of the Army, U.S. Army Corps of Engineers (USEPA and USACE). 1991. Evaluation of Dredged Material Proposed for Ocean Disposal: Testing Manual. EPA 503/8-91/001. EPA Office of Water. February.

U.S. Environmental Protection Agency Region IX and U.S. Army Corps of Engineers LA District (USEPA Region IX and USACE-LA). 1993. *Regional Implementation Agreement (RIA) for the Evaluation of Dredged Material for Ocean Disposal.*

Weston Solutions Inc. 2005a. Sampling and Analysis Plan (SAP) for Chemical and Geotechnical Characterization of Sediments in the vicinity of Al Larson Boat Shop, Port of Los Angeles.

Weston Solutions Inc. 2005b. Sampling and Analysis Plan (SAP) for Chemical and Geotechnical Characterization of Sediments in the vicinity of Al Larson Boat Shop, Port of Los Angeles.

Appendix A
Chain-of-Custody Forms

Appendix B
Field Core Logs and Core Photos

Appendix B.1
Field Core Logs

Appendix B.2
Core Photos

Appendix C
Sediment Chemistry

Appendix D
Statistical Analyses