Second Five-Year Review Report

Harbor Island Superfund Site

Seattle, King County, Washington

September 2005

Prepared By:

U.S. Environmental Protection Agency, Region 10
Seattle, Washington

Approved by: Date:

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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	United States Environmental Protection Agency
CFR	Code of Federal Regulations
ESD	Explanation of Significant Difference
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
VOC	Volatile Organic Compound

Executive Summary
Second Five-Year Review
Harbor Island Superfund Site

The Harbor Island (Lead) Superfund site is a 420 acre site located in the Duwamish River delta in Elliott Bay in the City of Seattle, Washington. The island was created and enhanced by addition of bulkheads and filling since the early 1900s. Harbor Island site has evolved from an industrialized upland area into a complex cleanup involving both the upland area and the offshore sediment and has been divided into five active operable units (OUs) and two OUs which are either deleted (Lockheed Upland) or no remedial action is required (West Waterway) (Figures 1 and 2). The active cleanup OUs consist of: 1. Soil and Groundwater OU; 2. Tank Farms OU; 3. Lockheed Shipyards Sediments OU; 4. Todd Shipyard Sediment OU; and 5. East Waterway OU.

The overall cleanup strategy for the site has been Hot Spot removals and capping. The cleanup criteria are defined in the Record of Decision (ROD) for each operable unit. It was determined early on that total removal of all contamination was not reasonable given the industrial history of the site and its current and future uses as an industrial area. There are currently no residences on the island. The entire island and associated sediments is designated as the Superfund site.

Most of the OUs still have remedy implementation occurring. Many of the known Hot Spots on the island (Soil and Groundwater and Tank Farms OUs) have been removed, but subsurface soil cleanup actions continue. Petroleum product was found in several locations and implementation of extraction systems are in place but additional soil cleanup work is expected to reduce the total petroleum hydrocarbon (TPH) concentrations to the ROD cleanup levels. Dredging and capping actions are underway or planned for the sediment OUs. There are several more years of construction actions before all of the OUs are in full operations and maintenance mode.

The Hot Spot removals and capping actions have removed the dermal contact pathway from the human health risk which was a major driver of human health risk for the upland portion of this site. The capping actions also removed the inhalation pathway of contaminants which were a secondary concern. The remedial actions have been done according to the ROD requirements. The resulting cleanups have reduced the occupational exposures to the contaminants of concern for the workers on-site. Future sediment cleanups will continue to reduce the risk to the environment in the marine waters of Elliott Bay and the Lower Duwamish River.

The remaining sediment remedial actions are the Hot Spot removal (dredging) of highly contaminated sediments and capping the area to protect the habitat from recontamination.

This Second Five-Year Review is a required statutory review for sites having contamination remaining onsite after cleanup actions have been implemented. Soil contamination remains in both the uplands and sediments at concentrations greater than allowable for unrestricted use. Some institutional controls (ICs) are already in place by the City of Seattle such as restrictions on drilling wells and uncontrolled discharges to surface water. The most difficult institutional controls (ICs) to enforce will be those necessary to protect the integrity of the various capped areas including the sediments. Fortunately most of these areas are on properties owned by or under the control of large PRPs, i.e., Port of Seattle and major oil companies.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: **Harbor Island (Lead)**		
EPA ID *(from WasteLAN)*: **WAD980722839**		
Region: 10	**State: WA**	**City/County: Seattle/King County**
SITE STATUS		
NPL status: x Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): x Under Construction x Operating ☐ Complete		
Multiple OUs?* x YES ☐ NO	**Construction completion date:** 09 / 30 / 2010	
Has site been put into reuse? x YES ☐ NO		
REVIEW STATUS		
Lead agency: x EPA ☐ State ☐ Tribe ☐ Other Federal Agency _____		
Author name: Nell Thompson, Lynda Priddy, Ravi Sanga, Roger Nye (Ecology), Karen Keeley		
Author title: Project Manager	**Author affiliation: EPA Region 10/Ecology**	
Review period:** 3 /9 / 2005 to 9 / 16 / 2005		
Date(s) of site inspection: June, July, August 2005		
Type of review: X Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) x 2 (second) ☐ 3 (third) ☐ Other (specify) _____		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion x Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 09/ 28/ 2000		
Due date *(five years after triggering action date)*: 09 / 28 / 2005		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

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Issues:

Uncontrolled surface runoff from Lockheed Uplands may carry contamination on to the new sediment cap. The upland property is periodically used to store soil and other construction material that could contain contaminants. Uncontrolled surface runoff leaving the upland and entering the marine environment may contaminate surface water and the new sediment cap.

Contaminated sediments concentrations above the state sediment cleanup criteria remain in the East Waterway.

Long-term groundwater monitoring of the upland is currently being implemented, but has not generated any new data for groundwater evaluations.

There are still pockets of petroleum product found in the soil media in several locations. Those that have been identified are undergoing cleanup or are scheduled for remedial actions.

Recommendations and Follow-up Actions:

The PRP for the Lockheed Upland area needs to establish positive run-on/run-off controls for the property. Plans have been drafted, but the construction has not yet occurred.

The Port of Seattle is monitoring the temporary sand cap on the contaminated sediments in the East Waterway. There are still areas of high sediment contamination and additional dredging may have to occur to protect the marine habitat following the implementation of a supplemental remedial investigation and feasibility study for the entire waterway.

Full implementation of Phase I long-term groundwater monitoring is scheduled to begin in October 2005. The Plan also calls for the integration of several monitoring programs to be coordinated and consolidated among the various PRPs and OUs. Additional groundwater monitoring points are anticipated as the planning for a Phase II gets underway.

There are two active petroleum product removals ongoing to remove product from the soil. Final plans for the soil cleanup are needed once the product is removed.

Protectiveness Statement(s):

Soil and Groundwater OU – The remedy at this OU is expected to be protective of human heath and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

Tank Farms OU - The remedy at this OU is expected to be protective of human heath and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

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Lockheed Upland OU – The ROD remedy for this OU has been completed and the OU deleted from the NPL. The protective surface soil cap upgrade will provide additional protection to the marine environment. The remedy at this OU is expected to be protective of human heath and the environment upon completion of the cap upgrade, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Lockheed Sediment OU - The remedy at this OU is expected to be protective of human heath and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

Todd Shipyard OU - The remedy at this OU is expected to be protective of human heath and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

West Waterway OU – This OU is considered protective of human health and the environment and a No Action ROD was written for this OU

East Waterway OU - The ROD has not yet been completed for this OU. The final protectiveness determination of the remedy at this OU cannot be made. The following additional removal actions are planned: implementing a supplemental remedial investigation and feasibility study that would lead to further clean up actions along the waterway

Second Five-Year Review Report

Harbor Island Superfund Site
Seattle, Washington
2005

I. Introduction

The purpose of the five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The U.S. Environmental Protection Agency (EPA), Region 10, and the Washington Department of Ecology (Ecology) conducted the Five-Year Review of the remedy implemented at the Harbor Island Superfund Site in Seattle, Washington. This review was conducted by the Remedial Project Managers

(RPMs) for the entire site from May 2005 through August 2005. This report documents the results of the review.

This is the second sitewide five-year review for the Harbor Island site. The triggering action for this statutory review is the First Five-Year Review Report dated September 28, 2000. The five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Operable Unit (OU) Identification

The Harbor Island Site began as an investigation of a secondary lead smelter located on the island site. Because of the distribution of lead and other metals over the entire island, the investigation became island-wide. After the investigation began it was realized that creating separate operable units (OUs) would be advantageous for managing the cleanup processes (Figures 1 and 2). Investigations began site-wide for soil and groundwater contamination. The Lockheed OU was soon established to facilitate a cleanup of a particular land parcel on a separate time and management schedule. The investigation of contaminated sediments both near shore and in Elliott Bay were separated and added as new OUs. Part of the island investigation was at petroleum tank farms and management of these parcels was given to Washington Department of Ecology (Ecology) as the Tank Farms OU. The OU# is a data base number used to identify each of the OUs and is for reference only as the official OU name does not include a number. The following is a list of the operable units in current use:

OU#	Description
N/A	Harbor Island Lead Site; initial island-wide investigation
01	Soil and Groundwater Operable Unit (S&GWOU1)
02	Tank Farms OU (TFOU2)
03	Lockheed Upland OU (LockheedOU3)
04, 05, 06	No longer considered as operable units
07	Lockheed Shipyards Sediment OU (LSSOU7)
08	West Water Sediments OU (West Waterway OU8)
09	Todd Shipyards Sediments OU (TSSOU9)
10	East Waterway Sediments OU (East Waterway OU10)

Activities are occurring at the different operable units concurrently. In addition there are several PRPs that have interests in particular land parcels on the island and are involved in more than one OU.

Chronology

The following is a listing of significant events that occurred at the Site. The chronology for each OU is listed separately since each has its own specific dates.

Table 1 – Chronology of Site Events

A. Harbor Island (Lead) (Initial Site-wide Actions)

Event	Date
Initial discovery of site under CERCLA	01/01/80
Preliminary Assessment, Site Investigation	03/01/80
NPL Listing, Site-wide	09/08/83

B. Soil and Groundwater OU (S&GWOU1)

RI/FS start for Island Wide Soil and Groundwater OU (S&GOU1)	09/07/88
Administrative Order RI/FS, with Lockheed, OU3	09/14/90
ROD for S&GOU1	09/30/93
ROD for Lockheed Property, OU3	06/28/94
RD/RA start at Lockheed Property, OU3	09/30/94
Consent Decree for Cleanup of Lockheed Upland Property, OU3	02/27/95
Completion of Construction for Lockheed Upland Property, OU3	12/27/95
Consent Decree with rest of PRPs, for RD/RA, S&GOU1	08/06/96
Partial Delisting for Lockheed Upland Property, OU3	11/07/96

C. Tank Farms OU (Ecology lead) (TFOU2)

RI/FS start for Tank Farms	1994
Completion of RI/FS	1997
Restrictive Covenant Equilon	10/98
CAP* issued for Equilon	11/98
Consent Decree, Equilon	04/99
CAP* issued for GATX	12/99
CAP* issued for ARCO	01/00
Engineering Design Report, Equilon	03/00
Consent Decree, GATX	04/00
Consent Decree, ARCO	04/00
Restrictive Covenant, ARCO	05/00
Restrictive Covenant, GATX	06/00
Engineering Design Report, ARCO	08/00

Soils Excavation Completion Report, ARCO	03/01
Engineering Design Report, Kinder Morgan (GATX)	06/01
Soils Excavation Completion Report - Shoreline Manifold and Main Terminal Areas, Equilon	02/02
Soils Excavation and Groundwater Remedy Construction Completion Report, Kinder Morgan (former GATX)	11/02
Groundwater Remedy Construction Completion Report, BP(ARCO)	09/03
Soils Excavation Completion Report – Main Tank Farm, Shell (Equilon)	11/04

*Cleanup Action Plan (CAP) is the Ecology equivalent to an EPA ROD
GATX facility is now owned and operated by Kinder Morgan Energy Partners
ARCO facility is now owned and operated by BP West Coast Products
Equilon facility is now owned and operated by Shell Oil Products US

D. Lockheed Upland OU, (OU3)

Administrative Order, RIFS	9/14/90
RIFS Completion	6/28/94
ROD	6/28/94
RA Completion	12/27/95
Partial Deletion, Lockheed Upland OU	11/07/96

E. Lockheed Shipyard Sediments OU, (LSSOU7)

Washington Department of Ecology performed preliminary investigation of the island to determine nature and extent of contamination	1985
EPA completed an initial Remedial Investigation of marine sediments around Harbor Island	1994
PRPs completed Supplemental Remedial Investigation to further characterize the extent of contamination in the Harbor Island sediments	1995
EPA issued a Record of Decision selecting the remedy for the Shipyard Sediments Operable Unit and subdivides the Shipyard Sediments Operable Unit into two separate OUs, Todd Shipyard Sediments Operable Unit and Lockheed Shipyard Sediments Operable Unit	1996
EPA issued Administrative Order on Consent for Remedial Design	7/16/1997
EPA issued an Explanation of Significant Differences	2/22/2002
EPA issued an Explanation of Significant Differences	3/31/2003

Consent Decree finalizing settlement for responsible party performance of remedy entered by Federal Court	7/23/2003
EPA approved PRP Remedial Design for demolition	7/2/2003
Start of Phase 1 remedial action – pier demolition	7/7/2003
EPA approved PRP Remedial Design for dredging and capping	10/25/2003
Completion of Phase 1 construction season	3/10/2004
EPA approved PRP Remedial Design for Phase 2 construction season	10/18/2004
Start of Phase 2 remedial action – dredging and capping of contaminated sediments	10/22/04
Completion of Phase 2 remedial action – dredging and capping of contaminated sediments	2/4/2005
Final Construction Inspection	under EPA review
Final Construction Completion Report	under EPA review
Final OMMP	under EPA review
Final Source Control Report	under EPA review

F. West Waterway OU (West Waterway OU8)

Preliminary Investigation	1984
Completed Storm Drain Cleanup	1989
Initial RI Sediment Sampling	1990
Completed Sediment RI	1993
Completed Sediment FS	1994
Conducted Supplementary RI Sediment Sampling	1995
Initiate Tributyltin Studies	1996
Human Health Risk Assessment for Sediments in West Waterway OU	1998
Completed Tributyltin Studies	1998
Proposed Plan for West Waterway OU	1998
Updated Risk Assessment Information for West Waterway OU	2002
No Action ROD for West Waterway OU	9/11/03

G. Todd Shipyards Sediment OU (TSSOU9)

EPA completed an initial Remedial Investigation of marine sediments around Harbor Island	1994
PRPs completed Supplemental Remedial Investigation to further characterize the extent of contamination in the Harbor Island sediments	1995
EPA issued a Record of Decision selecting the remedy for the Shipyard Sediments Operable Unit and subdivides the Shipyard Sediments Operable Unit into two separate OUs, Todd Shipyard Sediments Operable Unit and Lockheed Shipyard Sediments Operable Unit	1996
EPA issued an Explanation of Significant Differences	12/27/1999
EPA issued AOC for Remedial Design	4/25/2000
EPA issued an Explanation of Significant Differences	4/7/2003
Consent Decree finalizing settlement for responsible party performance of remedy entered by Federal Court	7/21/2003
EPA approved PRP Remedial Design	5/25/2004
Start of on-site construction for building/structures demolition (1st phase of TSSOU Remedial Action).	7/6/04
Start of contaminated sediment dredging and capping for 2004/5 season	8/15/04

H. East Waterway OU (East Waterway OU10)

Initial RI Sediment Sampling	1990
Completed Sediment RI	1993
Completed Sediment FS	1994
Conducted Supplementary RI 1 Sediment Sampling	1995
Supplementary RI 2 Sediment Sampling	1996
Human Health Risk Assessment for Sediments in West Waterway OU (this included seafood tissue samples from East Waterway)	1998
Dredge characterization study Terminals 18, 25, 30	1998
Completed Stage 1 maintenance dredging	2000
Completed Post Dredge Monitoring of Stage 1 Area	2000
Conducted Supplementary RI Stage 3 Sediment Sampling	2001
Identified 12 areas for Early Removal Action	2002
Started Phase 1 Removal Action of Contaminated Sediments	2004
Complete Phase 1 Removal Action of contaminated sediments	2005

III. Background

Physical Characteristics

Harbor Island is among the largest man-made islands in the United States and is located approximately one mile southwest of downtown Seattle in King County, Washington. This upland lies at the mouth of the Duwamish River on the southern edge of Elliott Bay, in Puget Sound. The 420-acre island was created during the dredging of the lower Duwamish River between 1903 and 1905. The dredge spoil was deposited across the island. Subsequent bulkhead construction and filling has brought the island into its current configuration (Figures 1 and 2). The island upland is divided into three operable units; Soil and Groundwater OU (S&GWOU1), Tank Farms OU (TFOU2), and Lockheed Upland OU (Lockheed Upland OU3). The island is currently over 90% covered with impervious surfaces. The island is within the Seattle City Limits. The closest residential properties to Harbor Island are approximately one-half mile away. Public access to the water is limited to a small boat launch on the east shoreline at Terminal 30 and a fishing bridge at the very southern end of the East Waterway.

The Lockheed Shipyard Sediment OU (LSSOU7) consists of contaminated nearshore sediments within and adjacent to the former Lockheed Shipyard on Harbor Island out to the edge of the steep slope of the West Waterway, which occurs at approximately the minus 36 (-36) foot MLLW contour (Figure 2). The Todd Shipyard Sediment OU (TSSOU9) consists of contaminated nearshore sediments within and adjacent to the Todd Shipyard on Harbor Island (Figure 2). Todd Shipyard is located at the northwest corner of Harbor Island and faces Elliott Bay to the north and the West Waterway of the Duwamish River to the west.

The West Waterway OU (West Waterway OU8) includes approximately 70 acres of estuarine sediments located in the West Waterway on the western side of Harbor Island (Figure 2). The West Waterway is a dredged navigable channel used extensively for industrial and port purposes. The waterway consists primarily of subtidal sediments, which remain under water even at low tides. The shoreline of the West Waterway is predominantly pilings, bulkhead, and riprap. Areas of intertidal sediments along the shorelines adjacent to the West Waterway OU are generally nonexistent. No shoreline public access areas exist in the West Waterway OU.

The East Waterway Operable Unit (East Waterway OU10) consists of the East Waterway (EWW) adjacent to the east side of Harbor Island and its associated contamination. The bed of the EWW is owned by the State of Washington and managed by the Department of Natural Resources. The EWW is channelized, has a south-to-north orientation, and is approximately 5,800 ft long and 800 ft wide. The southern 1,500-ft section of the EWW varies in width from

225 ft to approximately 130 ft near the West Seattle Bridge. The depth of the EWW ranges from 29 to 51 ft MLLW. Depths diminish to 7.2 ft MLLW at the southern end, in the vicinity of the West Seattle Bridge (Figure 3).

The former Duwamish River channel and surrounding floodplains were filled and graded to form the present-day topography. Dredging in 1903-1905 created the East and West Waterways, and dredged material from the river was used to create Harbor Island. The present urban and developed shoreline is primarily composed of piers, riprap bank lines, and constructed bulkheads for industrial and commercial use.

Land and Resource Use

The island was primarily used for commercial and industrial activities including ocean and rail transport operations, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding, and metal plating. Warehouses, laboratories, and offices also existed historically on the island. The land use on the island is changing from a variety of smaller businesses to large operations: Port of Seattle shipping container handling and storage, bulk fuel storage, and shipbuilding and repair. Marine activities occur around the entire island and dredging has allowed deep draft (40 feet) vessels to berth along piers on the eastern side of the site. The groundwater has never been used as a domestic water source.

Todd Shipyards, the last remaining shipyard, initiated shipbuilding activities on the island in 1916. Todd Shipyards is currently a ship repair, construction, and conversion facility that services approximately 275 vessels a year including: Navy vessels, Coast Guard vessels, passenger ferries, barges, fishing vessels, cruise ships, tank vessels and tug boats. The shipyard operates three dry docks at Piers 4, 5, and 6 for vessel repair and maintenance. A west sloping building berth is located on the West Waterway of the Duwamish River at Piers 1A and 1 for construction and launching of new vessels. Moorage berths are located along Piers 1, 2, 3, 4, 5, and 6. The existing facilities at Todd Shipyards include bulkheads, riprap protection of buttress fill slopes, pile-supported piers, floating dry docks, a pile-supported building berth, a pile supported side launching way, and miscellaneous access ramps.

The Harbor Island waterways are located within the boundaries of the federally-adjudicated Usual and Accustomed Fishing Area for the Muckleshoot and Susquamish Indian Tribes.

History of Contamination

The Site has been investigated on numerous occasions beginning in 1980. Based on these studies, Harbor Island was listed on the National Priorities List (NPL) on September 8, 1983, due to elevated concentrations of lead in soil associated with the former lead smelter operations, as well as elevated

concentrations of other inorganic and organic substances. The soil on Harbor Island had lead, arsenic, and TPH concentrations will above health based levels which were identified and quantified in the remedial investigation and feasibility studies that have been completed.

Harbor Island has been the location of active petroleum tank farms. The tank farms (TFOU2) have been a major distribution point for truck and marine supplies since the 1950's. The tanks are a terminus of a major northwest fuel pipeline. Spills and leaks of product have created several areas of localized soil contamination in both the Tank Farms OU and in the Soil and Groundwater OU. Active product extraction is occurring both in the Tank Farms OU and at Todd Shipyards in the S&GWOU1.

General sources of potential contamination to the sediments surrounding Harbor Island were identified as direct discharge of waste, spills, historical disposal practices, atmospheric deposition, groundwater seepage, storm drains, combined sewer overflow systems, and other nonpoint discharges. Sediment contamination of the estuarine environment surrounding Harbor Island may also have resulted from upstream sources.

Shipbuilding and ship maintenance activities at Lockheed Shipyards and Todd Shipyard have resulted in the direct disposal of waste into sediments of the West Waterway and Elliott Bay adjacent to the shipyards. Much of the waste is believed to have originated from sandblasting, which is a process used to remove paint and paint preparations containing copper, lead, mercury, and zinc. Hazardous substances released from both shipyards include: arsenic, copper, lead, mercury, tributyltin (TBT) and zinc, which were additives to marine paints used on ships. Other hazardous substances potentially associated with shipyard activities include polychorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). Other sources of contamination at the Lockheed and Todd Shipyards which may have contaminated sediments include: public and private storm drains, non-point surface runoff from contaminated soil, direct waste disposal, floating petroleum product on groundwater and contaminated groundwater. Contaminants in sediments include polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), TBT, arsenic, copper, lead, mercury, and zinc.

Initial Response

An initial EPA inspection in 1982 of the lead smelter facility formerly located on Harbor Island identified lead-contaminated soil, which resulted in the listing of the entire island including the sediments in the adjacent waterways on the National Priorities List (NPL) in 1983. The remedial investigation goal was to examine the nature and extent of the soil and groundwater contamination and the sediments lying just off-shore. In 1988 the Remedial Investigation began for the upland soil and groundwater part of the site (S&GWOU1). By 1993 the

completed Feasibility Study had identified the type and extent of the soil and groundwater contamination and proposed removal and containment actions.

The first investigation of marine sediments around Harbor Island was completed by EPA in 1988 as part of the Elliott Bay Action Program (EBAP). The nature and extent of contamination in Harbor Island sediments was characterized in an RI Report issued by EPA in September 1994. A Supplemental RI conducted by a group of PRPs in 1996 further characterized the chemical contamination in Harbor Island sediments and reported results of biological effects tests conducted on sediments in the West Waterway of Harbor Island which included a few locations in the Todd Shipyard which became Todd Shipyard Sediment Operable Unit (TSSOU9).

The shipyard operable units were established because the sediments were identified as distinct from other contaminated sediments at Harbor Island. They are predominately contaminated with hazardous substances and shipyard wastes (primarily sandblast grit) released by shipbuilding and maintenance operations from Todd and Lockheed.

No removal or early actions were completed in the West Waterway (West Waterway OU8). The initial RI/FS for sediments associated with this Harbor Island OU was performed as a fund-lead, with subsequent investigations performed by Respondents pursuant to Administrative Orders on Consent with EPA.

In 1996, the Port of Seattle, under EPA oversight, sampled the East Waterway (East Waterway OU10) as part of a dredging characterization in order to complete dredging as a navigational improvement in East Waterway along Terminals 18, 30 and 25. A summary of dredging activities can be seen in Figure 3. This characterization revealed areas of the waterway that contained moderate to high levels of contamination and required moderate to high levels of dredging for navigation. In 1999, the US Army Corps of Engineers performed maintenance dredging along T-18 (Stage 1 Dredging). As required by the EPA, post dredge monitoring was completed in 2000, which indicated that contamination at depth in the area was higher than expected, although below the Washington State Sediment Management Standards (SMS) chemical contaminant screening level (CSL). Based on these findings, EPA decided that additional environmental dredging should be performed under EPA oversight.

Contaminants

The major hazardous substance contaminants found at Harbor Island that have been released to the different media in the environment include:

Soil
Lead
Arsenic
PCBs
TPH (Total Petroleum Hydrocarbon)
Trichloroethylene

Sediments
PCBs
PAHs

Arsenic
Copper
Lead
Mercury
TBT (Tributyltin)
Zinc

Groundwater
PAH
PCBs
Copper
Trichloroethylene
Tetrachloroethylene
TPH (TPHG, TPHD. TPHO, BTEX, CPAHs)
Arsenic
Lead
DO, Carbon Dioxide, Methane, Ferrous Iron, Nitrate, Sulfate, Alkalinity

IV. Remedial Actions

Remedy Investigations

The EPA-lead remedial investigation (RI) for the island-wide site was started in 1988 and was completed in 1990. From the island-wide RIFS came the decision to divide the site into several operable units. A Phase II RI and feasibility study (FS) was completed in February 1993. The RI characterized the soil and groundwater and presented a baseline risk assessment. The FS evaluated various remedial alternatives for the Site.

Soil and Groundwater (S&GWOU1)

Remedy Selection

The remedial action Record of Decision (ROD) for the S&GOU1 was signed on September 30, 1993. The ROD was subsequently amended on January 25, 1996. The primary remedial components of the ROD are listed below:

- Cap Exposed Areas Exceeding Soil Cleanup Goals,
- Excavate Hot Spot Soil Followed by Off-Site Disposal and/or Treatment,
- Invoke Specified Institutional Controls,
- Remove and Treat Floating Petroleum Product,
- Development of a Long-term Groundwater Monitoring program.

Implementation (S&GWOU1)

A Consent Decree for the S&GWOU1 was signed on August 6, 1996, which lists the Settling Defendants responsible for implementing the remedies described in the ROD. Work is underway by the principal responsible parties (PRPs) to implement the ROD. All of the Hot Spot Soil, those soils which had contaminants of concern above on-site containment concentrations, have been removed and disposed of off-site or properly treated. A large project that expanded the Port's shipping container operation effectively capped much of the area that was not already paved. The capping design is established in the ROD as a three inch asphalt cap with a permeability of 1×10^{-5} cm/sec, or a cap of 12 inches of clean fill (especially for railroad track bedding). Work on the floating petroleum product is underway at Todd Shipyards with removal projects and an extraction system in one area

The Port of Seattle's (Port's) $100,000,000 Terminal 18 Expansion project (T-18) which covers about 200 acres was completed in 2003. The petroleum recovery and soil cleanup at Todd Shipyard will take longer because there is contaminated soil under operating facilities which are using air enhanced bioventing to reduce the soil contamination to accepted cleanup criteria. Soil cleanup could take another ten years using bioventing as the cleanup process.

The Long-term Groundwater Monitoring Program for Harbor Island is in its Phase I implementation stage. Phase I is a series of 10 paired monitoring wells that will provide baseline groundwater data around the circumference of the island. Phase II will add additional monitoring wells in areas that appear to have significant groundwater flux, i.e. along utility corridors. The PRPs are working on a Phase II proposal and a schedule for implementation will be developed within the next year.

Operation and Maintenance (S&GWOU1)

The O&M for the S&GWOU1 is primarily associated with cap preservation and maintenance. The PRPs have a requirement to make annual inspections and to repair any damage. Todd Shipyards has responsibility for O&M on the pumping and bioventing systems that are being used to remove petroleum produce from soil beneath the facility. Once the Long-term Groundwater Monitoring Program is fully implemented, there will be quarterly sampling required.

Tank Farms OU (TFOU2)

Remedy Selection

The Tank Farms Operational Unit (TFOU2) consists of three petroleum bulk storage and distribution facilities. The facilities are owned and operated by Shell (formerly Equilon), Kinder Morgan (formerly GATX), and BP (formerly ARCO). The three facilities include 60 large above-ground tanks and numerous smaller ones that store a variety of petroleum products. Extensive pipelines run throughout the facilities and there are terminals to transfer petroleum to ships, rail cars, and trucks. The RI/FS work for each of the three tank farm properties in the OU was begun in 1994 and completed in 1997. Consent Decrees and associated Cleanup Action Plans (CAPs), which are Washington State Department of Ecology ROD equivalents, were established with owners at the time during 1999 (Equilon) and 2000 (GATX and ARCO).

Remedial components identified in the CAPs and which have been implemented include:

- Excavate and remove from the facilities accessible soil where identified in areas exceeding 1,000 ppm lead and 32 ppm arsenic.

- Excavate and remove from the facilities accessible soil where identified in areas exceeding either 10,000 ppm total TPH (areas near shore and a 1996 release) or 20,000 ppm total TPH (inland areas).

- Construct and/or operate in situ remedial systems to treat contaminated soil and groundwater. The systems include free product recovery, air sparging, and soil vapor extraction (SVE) components. Supplement active free product recovery by passive methods in specific wells as needed.

- Utilize natural attenuation processes to reduce contaminant levels in soil and groundwater.

- Perform long-term groundwater monitoring. Examine wells for free product. Sample wells and analyze for contaminants of concern (TPHG, TPHD. TPHO, BTEX, CPAHs, Arsenic, Lead). Applicable standards are for protection of surface water. Also analyze for natural attenuation parameters (DO, Oxygen Reduction Potential (ORP), Carbon Dioxide, Methane, Ferrous Iron, Nitrate, Sulfate, Alkalinity).

- Implement Restrictive Covenants.

Implementation (TFOU2)

The Consent Decrees and associated CAPs for the three individual petroleum bulk storage facilities comprising the Tank Farms OU were finalized prior to this five-year reporting period. All remedial actions in the Tank Farms OU were implemented during the last five years.

Excavation and Removal of Lead-Arsenic Contaminated Soil:

Excavation of near-surface lead-arsenic contaminated soil in areas throughout the Main Tank Farm at the Shell facility was completed during December, 2003 through February, 2004. Approximately 2,929 tons of soil was removed and disposed of at the Roosevelt Regional Landfill in Klickitat County, Washington. Soil cleanup standards for lead (1,000 ppm) and arsenic (32 ppm) were achieved throughout this area. A small area of lead-contaminated soil near an oil-water separator at the Shell facility was excavated during October 2001 and approximately 75 tons of contaminated soil was removed. Due to structural constraints some subsurface soil remains above the lead standard in this area and it was capped with 3 inches of low-permeability asphalt.

Excavation of near-surface lead-arsenic contaminated soil throughout large areas in B and C Yards at the Kinder Morgan (KM) facility was completed during April - May, 2002. Approximately 11,094 tons of impacted soil was removed and disposed of at the Waste Management Columbia Ridge Landfill and Recycling Facility in Arlington, Oregon. Soil cleanup standards for lead (1,000 ppm) and arsenic (32 ppm) were achieved throughout these areas.

No removal of lead/arsenic contaminated surface soil was required at the BP facility.

Removal of TPH-impacted Soil:

Numerous discrete areas of TPH contaminated soil above established MTCA cleanup standards of either 10,000 ppm or 20,000 ppm were identified throughout all three tank farms. The 10,000 ppm standard applied to areas adjacent to surface water (Shoreline Manifold area at the Shell facility and Plant 1 at the BP facility), and in the area of a 1996 release (C Yard) at the KM facility. The 20,000 ppm standard applied to inland areas of the tank farms. Contaminated soil above applicable standards was mostly removed in these areas and transported to appropriate facilities offsite for treatment or disposal. Some subsurface soil above applicable standards remains in most of these areas because of the constraints imposed on excavating by existing structures (primarily the above-ground tanks).

Three areas of TPH contaminated soil were excavated at the Shell facility. One area was completed near a former UST (20,000 ppm standard) during October 2001 (33 tons). Another area was completed in the Shoreline Manifold area (10,000 ppm standard) during November 2001 (111 tons). The third area

was completed in the Main Tank Farm (20,000 ppm standard) during February 2004 (57 tons).

Seven areas of TPH contaminated soil were excavated at the KM facility during April through May, 2002 (32,948 tons total). One area was in B Yard (20,000 ppm standard) and six areas were in C Yard (10,000 ppm standard). Applicable standards were achieved in four of these areas. Some cleanup work remains in two areas.

Six major areas of TPH contaminated soil were excavated at the BP facility during September through October, 2000 (5,205 tons total). Two areas were in Plant 1 (10,000 ppm standard) and four areas were in Plant 2 (20,000 ppm standard). Oxygen-release compound was emplaced in one excavation at Plant 2 to enhance biodegradation.

Construction and Operation of In Situ Remedial Systems:

A system to recover free product and perform vapor extraction had been constructed and was operating in the Shoreline Manifold area at the Shell facility prior to the Consent Decree. This system continued operating during the last five years as a requirement of the CAP. Product was not observed in any of the eight recovery wells however, and hydrocarbon recovery through vapor extraction was not significant since mid 2001. Minor passive free product recovery is ongoing in two wells in the Shoreline Manifold area and one well in the North Tank Farm.

Construction of a system at the KM facility to perform point-source free product recovery in five separate areas of localized floating product in A and B Yards was completed in October 2002. The system is still operating continuously and recoverable free product currently remains at only one recovery location in A Yard. Minor passive free product recovery is operating in two wells in C Yard and one well in A Yard. Construction of a separate system to perform air sparging was also completed in October 2002. The system consisted of 16 sparge wells throughout the southern half of C Yard to address the 1996 release. This system operated continuously until August 2004 when groundwater cleanup standards had been achieved and maintained. Another sparging system is currently being designed to further control and abate groundwater contamination in A Yard.

A system to recover free product/groundwater and perform vapor extraction had been constructed and was operating in the bulkhead area of Plant 1 at the BP facility prior to the Consent Decree. This system was expanded as a requirement of the CAP to include greater capacity for free product/groundwater recovery and vapor extraction, and add air sparging as a component to the system. Construction of the expanded system began in November 2000 and was completed in October 2002 after some delay caused by the earthquake in February, 2001. The final expanded system consists of 10 product/groundwater

recovery wells, 12 sparge wells, and 22 horizontal vapor-recovery wells. The expanded system has operated continuously after completion. It has removed the majority of free product in the bulkhead area and controlled sheen on the West Waterway that occasionally appeared in the past.

Groundwater Monitoring:

Many monitoring wells at the tank farms were in place prior to the Consent Decrees and some wells were installed afterwards. Monitoring wells throughout the tank farms were regularly examined for free product and/or sampled for the contaminants of concern and natural attenuation parameters. The wells include approximately 30 at the Shell facility, 80 at the KM facility, and 20 at the BP facility. Wells were sampled quarterly and examined for free product as often as monthly. Wells designated for particular monitoring activities are specified in the Groundwater Compliance Monitoring Plan for each facility. Two compliance monitoring wells in the Shoreline Manifold area at the Shell facility and five compliance monitoring wells in Plant 1 at the BP facility are screened in groundwater at depths below the bottom of each bulkhead to monitor possible discharge of contaminants to surface water. All other monitoring wells are screened at the unconfined groundwater level.

The monitoring well data indicate: (1) There is little recoverable free product left in the Tank Farms OU. The product that does remain is located in/near A Yard at the KM facility and in the bulkhead area of Plant 1 at the BP facility. (2) Dissolved contaminant levels remain above CAP cleanup standards in some wells in some areas of the TFOU, but the levels are either stable or declining. (3) There is no significant discharge of contamination in groundwater beneath the bulkheads at the Shell facility and at the BP facility. (4) Degradation of contamination is taking place naturally in areas of the TFOU2.

Operation and Maintenance (TFOU2)

The in situ remedial systems that were constructed to perform free product/groundwater recovery, air sparging, and soil vapor extraction at all three tank farms were operated and maintained during the five-year period.

Lockheed Shipyard Uplands OU (Lockheed Uplands OU3)

During the site-wide RI/FS two Lockheed Operable Units were established to allow the Lockheed Company to proceed with the cleanup of their property on a different schedule from the rest of the Site (Figure 2). The Lockheed Upland, OU3, RI/FS was begun in 1990 and completed in with a ROD signed in 1994. The remedial actions for this OU were completed on 12/27/95. The Lockheed Upland OU3 was partially delisted on 11/07/96.

Lockheed Shipyard Sediment OU (LSSOU7)

Remedy Selection

The ROD for the Lockheed and Todd Shipyard Sediment Operable Units was signed on November 30, 1996. This ROD also divided the Sediment OUs into separate OUs for Lockheed and Todd. Remedial Action Objectives (RAOs) were developed as a result of data collected during the Remedial Investigation to aid in the development and screening of remedial alternatives to be considered for the ROD. The RAO for the LSSOU7 is to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms.

The major components of the remedy selected in the ROD include the following:

1. All sediment exceeding the chemical contaminant screening level (CSL) of the State of Washington Sediment Management Standards (SMS) and shipyard waste be dredged and disposed of in an appropriate in-water or upland disposal facility.

2. All sediments exceeding the sediment quality standards (SQS) of the SMS will be capped with a minimum of 2 feet of clean sediment.

3. Specification of design criteria for acceptable habitat and to prevent future recontamination

4. Institution of long-term monitoring and maintenance of the remedy.

5. The extent of dredging of contaminated sediments and waste under piers at the LSSOU7 will be determined during remedial design based on cost, benefit and technical feasibility.

Subsequent to the ROD, pre-remedial design studies for the LSSOU7 better defined the nature and extent of contamination within the OU. The results of these studies indicated that certain elements of the ROD needed to be amended. The February 12, 2002, Explanation of Significant Differences (ESD) summarized the sediment characterization data, specified details regarding the dredge and cap remedy, and defined abrasive grit blast. The March 7, 2003, ESD established confirmation numbers to be used to distinguish contaminants characteristic of the West Waterway from contamination associated with the LSSOU7; summarized the long-term monitoring, maintenance and operational

parameters; and identified the disposal option for contaminated sediments dredged from the LSSOU7 as requiring upland disposal.

Remedy Implementation

In an Administrative Order on Consent (AOC) signed with EPA on July 16, 1997, Lockheed Martin agreed to perform the remedial design (RD) for implementing the remedy in conformance with the ROD as modified by the two ESDs. The RD was approved in parts. The RD for:

- Demolition of the wooden piers and piles was approved on July 2, 2003,
- 1st season dredging and capping was approved on October 25, 2003, and
- 2nd season dredging, capping and habitat enhancement was approved on May 25, 2004.

A Consent Decree (CD) between EPA and Lockheed was approved by the Court on July 23, 2003 to perform the remedial action (RA) and to pay past costs for cleaning up the site.

The RA was conducted in two phases. Phase 1 was completed on March 10, 2004 and Phase 2 was completed on February 4, 2005. The first phase of remedial construction efforts was focused on pier demolition and dredging of contaminated sediments. The second phase consisted of dredging, capping and habitat enhancement.

The major components of RA were the following:

- Replace the existing deteriorated bulkhead wall so the upland soils will remain stable during and after remedial activities, including the following:
    - Pier and timber bulkhead removal; and
    - Dredging adjacent to the bulkhead.
- Remove all existing pier structures including timber piling and portions of the existing shipway structures from aquatic areas of the site while maintaining the stability of the site.
- Dredge contaminated sediments from the channel and slope areas of the LSSOU7 while maintaining stable slopes and critical habitat elevations.

- Design the dredge prisms and constructed slopes such that they will be constructible.

- In the Channel Area, remove the depth of sediment exceeding SQS criteria and construct a berm to support the Slope Area and maintain critical habitat elevation.
- Perform post-dredge sediment verification sampling and analysis to confirm achievement of SQS in the Channel Area.

- In the Slope Area, limit changes in the post-remediation of critical habitat elevations (i.e., between -4 to 8 feet MLLW) from that of the existing condition while accommodating a 5-foot-thick cap.

- Construct an on-site mitigation area.

- Create intertidal habitat with clean soil in the vicinity of Pier 10 to mitigate habitat losses resulting from the partial filling of the South Shipway.

- Cap the Slope Area such that the cap will provide the following:

    - Chemical and physical isolation of the underlying contaminated sediments;

    - Protection of the chemical isolation portion of the cap from bioturbation and erosional forces; and

    - A final cap surface that is compatible with marine organisms.

- Limited dredging and a sand cover boundary line along the offshore perimeter of the site (as a placeholder concept pending the results of further characterization in this area) to provide the following:

    - Partial removal, coverage and enhanced natural recovery of contaminated off-site sediments located adjacent to the site; and

    - A final substrate surface that is habitat compatible for marine organisms.

The LSSOU7 was subdivided into Site Management Areas (SMAs) for the purposes of remedial design and action. The Channel (or open water) area, identified as SMA 1, is the area running the length of the piers, outward from the pier face to the edge of the steep slope of the West Waterway at approximately -36 feet (MLLW). SMA 1 consists of unobstructed open water. The enclosed water SMA, SMA 2, is behind Pier 9. This is also an unobstructed area of open water that is bounded by the bank or bulkhead on one side and pier structures on two sides. SMAs 3, 5 and 7 designate sediment areas under the pier structure.

Sediments under the shipways are designated as SMAs 4 and 6. Shipways are ramps that are used to move ships out of the water. These ramps contain decking like the pier structures and are held up by closely spaced pilings. SMAs 2-7 are collectively referred to as the Slope area.

Table 2 summarizes the amount of material dredged in LSSOU7 by material type. During this remedial action, 119,064 tons of contaminated sediments were dredged and transported to an approved upland facility for disposal.

Table 2 – Total Tons of Contaminated Sediments and Debris Dredged

Dredging and Disposal Events	Weight in Tons	Notes
First Construction Season		
Dredge and Debris Disposal by Rail	85,096	864 Rail Cars
Soil and Dredge Disposal by Truck	1,118	
Creosote Treated Wood Disposal by Bins	10,660	442 Bins
Wood Salvage for Reuse	205	
Concrete Recycle	121	
Concrete w/Rebar Recycle	1,113	
Steel Recycle	36	
Subtotal	**98,349**	
Second Construction Season		
Dredge and Debris Disposal by Barge	21,107	15 Barges
Rock and Soil Disposal by Truck	586	
Creosote Treated Wood Disposal by Bins	21	1 Bin
Sample Disposal by Bin	1	1 Roll Off
Subtotal	**21715**	
Total	**119,064**	

Capping was implemented using approximately 100,000 cubic yards of capping material. The Table below show the tonnage of each type of capping material placed on the slope area of the LSSOU7.

Table 3 – Tonnage of Capping Material Placed by Type

Capping Event	Weight in Tons	Notes
Phase 1 Construction Season		
Interim Cap	8,290	Covered entire OU
Subtotal	**8,290**	
Phase 2 Construction Season - Applied by Marine Equipment		
Toe Buttress Riprap	4,854	
Armor Riprap	13,501	
Sand Attenuation Cap Layer	21,479	
Filter Layer	5,951	
Rounded Filter/Armor Layer	1,451	1 Barge Load
Fish Mix	8,667	
Subtotal	**55,903**	
Phase 2 Construction Season – Applied by Upland Equipment		
Armor Riprap	2,446	
Sand Attenuation Cap Layer	13,052	Includes Habitat Mix in some areas
Rounded Filter/Armor Layer	17,018	
Fish Mix - Pit Run	3,001	
Subtotal	**35,517**	
Total	**99,710 Tons**	

A total of eight sediment samples were collected from the post-dredge surface of the channel area (SMAs 1-7) to evaluate compliance with the design criteria. All analytical results were compared to the SQS chemical criteria to evaluate compliance. Out of 248 chemical analytical results, from eight samples, three samples exceeded the SQS for PCBs only. Three other samples out of eight or 30 analytical results out of 248, exceeded the SQS for a combination of COCs. Therefore, a total of 33 of 243 analytical results failed the SQS. The

following table summarizes the nature and locations of exceedances and the corresponding remedial action.

Table 4 – Nature and Locations of Exceedances and the Corresponding Remedial Action.

Sampling Locations	SQS Compliance Criteria	Sampling Results	Remedial Decision
SED-200	PCBs – 12 mg/kg	13 mg/kg	Pass
SED-201	PCBs – 130 ug/kg	146.5 ug/kg	ENR*
SED-202		no exceedances	Pass
SED-203	As – 57 mg/kg LPAH – 370 mg/kg HPAH – 960 mg/kg PCB – 12 mg/kg	As – 73.4 mg/kg LPAH – 1620 mg/kg HPAH – 1937 mg/kg PCB – 21 mg/kg	ENR
SED-204	As – 57 mg/kg Cu – 370 mg/kg Zn – 960 mg/kg Hg – 0.41 mg/kg PCB – 12 mg/kg	As – 127 mg/kg Cu – 829 mg/kg Zn – 585 mg/kg Hg – 0.618 mg/kg PCB – 20 mg/kg	ENR
SED-205		no exceedances	Pass
SED-206	PCB – 12 mg/kg	PCB – 18 mg/kg	Pass
SED-207	As – 57 mg/kg Cu – 370 mg/kg Zn – 960 mg/kg Hg – 0.41 mg/kg LPAH – 370 mg/kg	As – 139 mg/kg Cu – 553 mg/kg Zn – 912 mg/kg Hg – 1.32 mg/kg LPAH – 1341 mg/kg	ENR

*ENR = Enhanced Natural Recovery

The remedial action for portions of the channel area, represented by samples SED 201, 203, 204 and 207, that failed to meet the clean up numbers was the addition of 6 inches of sand to the sediment surface, namely Enhanced Natural Recovery. Areas where there was an exceedance of PCBs only, no actions were taken because the exceedances were minor and were below the 90th percentile for PCBs present in the West Waterway based on bioassays.

Water quality monitoring during in-water remedial action was conducted according to the Water Quality Certification. Visual turbidity monitoring was

performed during demolition of over-water structures and intensive and routine water quality monitoring was performed during dredging and barge dewatering and filling/capping operations. Results of these monitoring events indicate that water quality remained within marine quality standards throughout the monitored events.

A Fish Coordination Plan was developed by Lockheed in consultation with EPA and affected Indian Tribes. There are two Treaty Indian Tribes that have reserved fishing rights in the lower Duwamish River including the area of the Lockheed sediment remediation. The Muckleshoot and Suquamish cooperatively fish in these waters. Because in-water demolition, dredging and capping activities would be occurring at the same time that Tribal fishing would be occurring, a Tribal Fishing Coordination Plan (Plan) was developed jointly with the affected Tribes and Lockheed. The objectives of the Plan were to:

1. Reduce the potential for conflicts between in-water construction operations and tribal fishing through effective communications and schedule planning.

2. Rapidly address any fishing equipment damaged as the result of construction operations within or adjacent to the site area.

3. Coordinate future construction activity (as practical) to reduce potential for further damage to fishing equipment.

According to the Plan, ongoing communications between the Lockheed contractors and the Tribes successfully minimized conflicts between in-water construction and tribal fishing activities despite a high level of fishing activity and record catches in the West Waterway.

Remedial activities were conducted as planned and cleanup goals were obtained for the first phase of the remedial action. EPA conducted a final inspection on March 7, 2005. The final inspection concluded that construction had been completed in accordance with the remedial design plans and specifications and did not result in the development of a punch list for the remedial action.

System Operation/Operation and Maintenance

An Operation, Maintenance and Monitoring Plan (OMMP) has not been finalized for LSSOU7. However, the 2003 ESD specified that the following activities would constitute as basis for the development of an OMMP:

- erosion monitoring by survey, video or other means of the under-pier granular materials, with contingencies for maintenance of the cap materials and potential sampling for chemicals of concern (COCs) in areas adjacent to the piers if erosion of cap materials has occurred;

- monitoring of storm water source control actions through documentation of compliance with NPDES requirements, and monitoring of potential NPDES system overflows for both NPDES and sediment chemicals of concern (COCs);

- monitoring of dry dock grit management source control actions through documentation of compliance with NPDES requirements; and

- EPA may require monitoring of the open water areas to be conducted as part of Five Year Reviews. If chemical monitoring for COCs is performed in open water areas along the outer areas of the LSSOU, results will be compared to the confirmation numbers listed above to determine whether recontamination has occurred at levels of concern.

Todd Shipyards Sediment OU (TSSOU9)

Remedy Selection

The ROD for the Todd and Lockheed Shipyard Sediment Operable Units Site was signed on November 30, 1996. Remedial Action Objectives (RAOs) were developed as a result of data collected during the Remedial Investigation to aid in the development and screening of remedial alternatives to be considered for the ROD. The RAO for the TSSOU9 is to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms.

The major components of the remedy selected in the ROD include the following:

1. All sediment exceeding the chemical contaminant screening level (CSL) of the State of Washington Sediment Management Standards (SMS) and shipyard waste be dredged and disposed of in an appropriate in-water or upland disposal facility.

2. All sediments exceeding the sediment quality standards (SQS) of the SMS will be capped with a minimum of 2 feet of clean sediment.

3. Specification of design criteria for acceptable habitat and to prevent future recontamination

4. Institution of long-term monitoring and maintenance of the remedy.

5. The extent of dredging of contaminated sediments and waste under piers at the TSSOU9 will be determined during remedial design based on cost, benefit and technical feasibility

Subsequent to the ROD, pre-remedial design studies for the TSSOU9 better defined the nature and extent of contamination within the OU. The results of these studies indicated that certain elements of the ROD needed to be amended. EPA issued an ESD on December 27, 1999. The purpose of the ESD is to designate the Todd Shipyards site as an independent operable unit identified as the Todd Shipyards Sediment Operable Unit (TSSOU9) and to redefine the boundary of the OU identified in the November 1996 ROD based on additional information gathered during two remedial design investigations associated with this OU.

On April 7, 2003, EPA issued a second ESD. The primary changes documented in this ESD were to:

(1) further define the selected remedial action for the under-pier areas;

(2) establish confirmation numbers characteristic of contamination present in the West Waterway for the purpose of defining the Todd Shipyard Sediments Operable Unit (TSSOU9) boundary;

(3) adjust the TSSOU9 boundary based on the use of confirmation numbers;

(4) summarize the long-term monitoring, maintenance and operational requirements for TSSOU9;

(5) define "predominately abrasive grit blast (AGB)"; and

(6) identify the disposal option.

Remedy Implementation

In an Administrative Order on Consent (AOC) signed with EPA on April 25, 2000, Todd Shipyards agreed to perform the remedial design (RD) for implementing the remedy in conformance with the ROD as modified by the 1999 ESD. The RD was approved by EPA on May 25, 2004. A Consent Decree (CD) between EPA and Todd was approved by the Court on 7/21/2003 to perform the remedial action (RA).

The RA is being conducted in two phases. Phase 1 was completed at the end of February 2005 and Phase 2 is expected to be completed in the spring of 2006. The first phase of remedial construction efforts was focused along the north end of the TSSOU9, and included pier demolition, dredging and disposal of contaminated sediments, and capping. The activities for this phase were initiated in July 5 2004 and were completed on February 25, 2005. The major components of this phase of the RA were the following:

- Completed demolition and disposal of side-launch shipways, located along the Northeast Shoreline of SMA 1, and Pier 2, located in SMA 8.

- Completed dredging and disposal of contaminated sediment and shipyard debris in SMAs 1,2, 3, 4, and 5, located on the north side of the Todd property.

- Completed placement of in-water fill, including reconstruction of the Northeast Shoreline slope in SMAs 1 and 2; filling of subtidal depressions in SMAs 3, 5, and 7; and placement of boundary sand in SMAs 1 and 5.

- Completed placement of under-pier cap material at Pier 4 North, Pier 5, Pier 6, and Pier 6 Platform.

- Initiated, but did not complete, dredging and disposal of contaminated sediment in SMAs 7, 8, and 9.

During this period 166,192 cubic yards of contaminated sediments were dredged and transported to an approved upland facility for disposal.

Table 5 – Amount of Dredged Material by Sediment Management Area (SMA) in TSSOU9

SMA	Dredged Material Weight in Tons	Estimated Dredge Material Volume in Cubic Yards
1 and 2	50, 713	35,217
3	77,619	53,902
4	52,524	36,475
5	27,687	19227
6	0	0
7	0	0
8	27,679	19,222
9	3,095	2,149
Total	**239,317**	**166,192**

Under-pier capping was implemented using special equipment consisting of a throwing conveyor mounted on a series of modular floats, a barge-mounted derrick crane, and a series of flat-decked material barges. The following table shows the total under-pier square footage capped per pier.

Table 6 – Amount of Cap Material Placed by Pier

Pier	Placement Area in Square Feet
4N	42,488
5	66,015
6	29,700
6P	12,700
Total	**150,903**

Placement techniques, using the throwing conveyor, were developed through implementation of a test program that took place in SMA 2, on the eastern side of Pier 6. Diver survey results of the underwater areas capped during the test program verified that the placement equipment and techniques met all specified criteria. The design criteria for capping under pier structures with timber piling was to place 1 foot (average thickness) of sand and to place 3 feet (average thickness) for pier structures supported by concrete piling. The capping test at Pier 6, a timber supported pier, was considered by EPA to be a worse case test because Pier 6 has a much greater density of piles than concrete pile supported piers.

A total of 45 sediment samples were collected from the post-dredge surface of SMAs 1-7 to evaluate compliance with the design criteria. Two of these samples were submitted for bioassay testing and evaluated for compliance using the SMS biological criteria. One of the bioassay locations did not pass the SMS biological criteria; this area has been addressed by placement of a permanent sediment cap. The remaining 43 samples were compared to the SQS chemical criteria to evaluate compliance.

Out of 423 chemical analytical results, from 43 samples, six samples exceeded the SQS for mercury only, which represents 98.6 percent of all sample analytical results being less than the SQS chemical criteria.

Table 7 – Confirmation Sampling Locations, Results, and Remedial Action for Samples Exceeding the Compliance Criteria

Sampling Locations		Compliance Criteria	Sampling Results	Remedial Action Taken
SMA 1	TSP-01-01	mercury – 0.41 mg/kg	0.68 mg/kg	none
SMA 2	TSP-02-06	mercury – 0.41 mg/kg	0.71 mg/kg	ENR
	TSP-02-08	mercury – 0.41 mg/kg	0.48 mg/kg	ENR
SMA 3	TSP-03-02	mercury – 0.41 mg/kg	0.85 mg/kg	ENR
	TSP-03-06	mercury – 0.41 mg/kg	1.04 mg/kg	ENR
	TSP-03-07	mercury – 0.41 mg/kg	0.66 mg/kg	ENR

All mercury exceedances were below the 90th percentile for mercury present in the West Waterway based on bioassays. A No Action determination was made for the West Waterway Operable Unit of the Harbor Island Superfund Site.

Water quality monitoring during in-water remedial action was conducted according to the Water Quality Certification. Visual turbidity monitoring was performed during demolition of over-water structures and intensive and routine water quality monitoring was performed during dredging and barge dewatering and filling/capping operations. Results of these monitoring events indicate that water quality remained within marine quality standards throughout the monitored events.

A Fish Coordination Plan was developed by Todd in consultation with EPA and affected Indian Tribes. There are two Treaty Indian Tribes that have reserved fishing rights in the lower Duwamish River including the area of the Todd sediment remediation. The Muckleshoot and Suquamish cooperatively fish in these waters. Because in-water demolition, dredging and capping activities would be occurring at the same time that Tribal fishing would be occurring, a Tribal Fishing Coordination Plan (Plan) was developed jointly with the affected Tribes and Todd. The objectives of the Plan were to:

1. Reduce the potential for conflicts between in-water construction operations and tribal fishing through effective communications and schedule planning.

2. Rapidly address any fishing equipment damaged as the result of construction operations within or adjacent to the site area.

3. Coordinate future construction activity (as practical) to reduce potential for further damage to fishing equipment.

According to the Plan, ongoing communications between the Todd contractors and the Tribes successfully minimized conflicts between in-water construction and tribal fishing activities despite a high level of fishing activity and record catches in the Waterway.

Remedial activities were conducted as planned and cleanup goals were obtained for the first phase of the remedial action. EPA conducted a pre-final inspection on March 7, 2005. The pre-final inspection concluded that construction had been completed in accordance with the remedial design plans and specifications and did not result in the development of a punch list for the first phase of remedial action.

Remedial construction activities for the Phase 2 are expected to start on July 5, 2005 and all remedial action construction activities for the TSSOU9 will be completed in spring of 2006. The second phase of remedial construction efforts will be focused along the west side of the OU, and includes pier demolition, dredging and disposal of contaminated sediments, and capping.

The major components of Phase 2 RA are the following:

- Dredging in SMA 6, SMA 8 (where the initial overburden dredging was conducted in 2004), and SMA 9.
- Demolition of Pier 4S.
- Construction of habitat bench in SMA 6.
- Capping below Piers 1, 2P, 3, and outer reaches of building ways.

<u>System Operation/Operation and Maintenance</u>

An Operation, Maintenance and Monitoring Plan (OMMP) has not been finalized for TSSOU9. However, the 2003 ESD specified that the following activities would constitute as basis for the development of an OMMP:

- erosion monitoring by survey, video or other means of the under-pier granular materials, with contingencies for maintenance of the cap materials and potential sampling for chemicals of concern (COCs) in areas adjacent to the piers if erosion of cap materials has occurred;

- monitoring of storm water source control actions through documentation of compliance with NPDES requirements, and monitoring of potential NPDES system overflows for both NPDES and sediment chemicals of concern (COCs);

- monitoring of dry dock grit management source control actions through documentation of compliance with NPDES requirements.

- EPA may require monitoring of the open water areas to be conducted as part of Five Year Reviews. If chemical monitoring for COCs is performed in open water areas along the outer areas of the TSSOU9, results will be compared to the confirmation numbers listed in above to determine whether recontamination has occurred at levels of concern.

West Waterway OU (West Waterway OU8)

Remedial Actions

The ROD for the West Waterway OU (9/11/2003) presents the basis for the determination that no CERCLA action is necessary at this OU to protect human health or the environment.

East Waterway OU (East Waterway OU10)

Remedial Actions

No ROD has been written for this OU. The Port of Seattle conducted a non-time critical removal action for highly contaminated sediments on the East Waterway that covered two dredge seasons from 2004-2005 (Figure 4). The removal action was implemented under the authority of an Action Memorandum (2003). The following actions were completed under the Action Memorandum:

1) Dredging 180,000 cy of contaminated sediment unsuitable for open-water disposal and 67,000 cy of sediment suitable for open-water disposal.

2) De-watering sediments not suitable for open-water disposal at an upland staging area and disposing of the de-watered sediments at an upland landfill.

The dredging did not reach SQS sediment standards after sediment removal so a six-inch layer of clean sand was placed over the surface to protect benthic organisms from residual contaminants. A supplemental remedial investigation and feasibility study is anticipated to start in 2006 for the entire East Waterway.

V. Progress Since the Last Review

The recommended actions from the first Five-Year Review (Five-Year Review, 9/28/00) consisted of completing construction and implementing ICs. Neither of these recommendations has been completed because the construction has not finished.

Soil and Groundwater OU (S&GWOU1)

The Port of Seattle (Port) Terminal 18 Redevelopment Project was completed in 2003. This project involved nearly the entire island because the rail lines and roads were relocated to increase the storage space for shipping containers. As a result of the project, virtually the entire island in now capped (paved or under-drained). The rain water is channeled to the storm drain system which reduces the recharge of the island groundwater. The capping removed the dermal pathway for contact with the contaminants of concern which was determined to be the greatest human health risk.

The remedial action to remove oil product from the soil and groundwater beneath the Todd Shipyard facility has been steadily pumping the weathered oil since 1999. Approximately 180,000 gallons of product has been recovered to date. This is the last major remedial action that is ongoing in the S&GWOU1. The recovery process will require several more years of operation before the concentrations of TPH (total petroleum hydrocarbon) are less than 10,000 ppm in the soil (the cleanup requirement for TPH in soil for this site).

Tank Farms OU (TFOU2)

All remedial actions as described for the Tank Farms OU were implemented and accomplished since the last five-year review. Excavation and removal of lead/arsenic contaminated soil above standards was completed. Excavation and removal of TPH contaminated soil above applicable standards was 90% completed. In situ remedial systems were constructed and operated that were/are successful in directly removing hydrocarbons from soil and groundwater, and facilitating biodegradation. Sheen emanating from the bulkhead area at the BP facility was controlled. Monitoring data was acquired that confirmed the degradation of contamination by the active remedial systems and by natural attenuation. Remediation was completed in C Yard at the Kinder Morgan facility and in Plant 2 at the BP facility.

Lockheed Shipyard Sediment OU (LSSOU7)

The following list summarizes activities that have taken place at the LSSOU since the previous 5 year review.

- A second ESD was issued on 2/22/2002. The primary purposes of this ESD was to:
    - define shipyard waste, including AGB;
    - require dredging to the SQS in the channel area; and
    - require sufficient dredging to accommodate a 5 foot cap, without loss of intertidal habitat, in the slope area.
- A third ESD was issued on 3/31/2003. The purposes of this ESD was to:
    - establish confirmation numbers characteristic of contamination present in the West Waterway for the purpose of defining contamination associated with Lockheed Shipyard as the source;
    - summarize the long-term monitoring, maintenance and operational parameters for Lockheed Shipyard Sediment Operable Unit (LSSOU); and
    - identify the disposal option for dredged sediment as upland disposal.
- A CD finalizing the settlement for responsible party performance of the remedy was entered by Federal Court on 7/23/2003.
- EPA approved the remedial design for the first phase of the remedy on 7/7/03.
- Phase 1 of the remedial action started on 7/7/03 and was completed on 3/10/04.
- Phase 2 of the remedial action started on 10/22/4 and was completed on 2/4/05.

The previous Five-Year Review for the LSSOU7 did not make any recommendations or declare any follow-up actions because the OU was still undergoing remedial design activities.

Todd Shipyard Sediment OU (TSSOU9)

The following list summarizes activities that have taken place at the TSSOU9 since the previous Five-Year Review.

- A second ESD was issued on April 7, 2003. The purpose of this ESD was to:

(1) further define the selected remedial action for the under-pier areas;

(2) establish confirmation numbers characteristic of contamination present in the West Waterway for the purpose of defining the Todd Shipyard Sediments Operable Unit (TSSOU9) boundary;

(3) adjust the TSSOU9 boundary based on the use of confirmation numbers;

(4) summarize the long-term monitoring, maintenance and operational requirements for TSSOU9;

(5) define "predominately abrasive grit blast (AGB); and

(6) identify the disposal option.

- A CD finalizing the settlement for responsible party performance of the remedy was entered by Federal Court on 21 July 2003.
- EPA approved the remedial design for the remedy on May 25, 2004.
- Phase 1 of the remedial action started on July 6, 2004 and was completed on February 25, 2005.
- Phase 2 of the remedial action is expected to start on July 5, 2005 and to be completed by February 15, 2006.

The previous Five-Year Review for the TSSOU9 did not make any recommendations or declare any follow-up actions because the OU was still undergoing remedial design activities.

East Waterway OU (East Waterway OU10)

Through an amended existing AOC with EPA, the Port proceeded with Supplemental Remedial Investigation 3 (SRI3). Results of SRI3 were used to identify 12 areas for potential early cleanup action (Figure 3). The area that contained the highest total chemical concentrations and had the greatest mass of contamination was identified as an area in the middle to south portion of East Waterway that had not undergone maintenance dredging. EPA and the Port under an AOC have conducted a non-time critical removal action for these highly contaminated sediments (Figure 4). The removal area was located off-shore between Terminals 25 and 30. It covered 20 acres and had a depth of approximately -38 MLLW. The removal action occurred over two dredging seasons, from January 2004-March 2004 and July 2004-March 2005. The dredging resulted in the removal of approximately 67,000 cubic yards (cy) of

material characterized as suitable for open-water disposal and 180,000 cy of material characterized as unsuitable for open-water disposal. Chemicals of concern that exceeded regulatory criteria included mercury, total PCBs, total DDTs, alpha-chlordane, aldrin, dieldrin, BEHP, and zinc concentrations. Toxicity testing of these sediments also indicated that sediments from the biologically active zone were toxic to benthic organisms. A supplemental RIFS will be conducted for the entire waterway in 2006.

VI. Five-Year Review Process

Administrative Components

The Harbor Island Five-Year Review Team was lead by Neil Thompson, EPA RPM for the upland portion (S&GWOU1) of the site. The team included the RPMs for each of the active operable units: Roger Nye, Ecology Project Manager for Tank Farms OU (TFOU2); Lynda Priddy, EPA RPM for shipyard sediments (LSSOU7 and TSSOU9); Karen Keeley, EPA RPM for West Waterway (West Waterway OU8); and Ravi Sanga, EPA RPM for East Waterway (East Waterway OU10). Each RPM has OU specific technical resources available. Each OU therefore has a specific team made up of EPA or Ecology leads and technical resources from EPA and/or consultants. The PRPs for each OU also have their technical teams to implement the selected remedies. All of the OU leads were notified of the Five-Year Review on March 9, 2005.

There were significant design and construction activities in five of the operable units; Soil and Groundwater OU1, Tank Farms OU2, Lockheed Shipyard Sediment OU7, Todd Shipyard Sediment OU9, and East Waterway OU10. EPA or the State has had active involvement in each of these OUs throughout the last five years. Therefore the review process has been ongoing and not specific to this Five-Year Review process. During the next five years, most of the remedial work on-site will be finished and many of the long-term systems will be in operations and maintenance mode.

Community Involvement

The Harbor Island site is within the Seattle industrial waterfront area. There are no residences located on the island and only a few businesses located south of Spokane Street that are not related directly to maritime activities. The major property owner on the island is the Port of Seattle.

A public notice announcing the public comment period for the Second Five-Year Review was published in the *Seattle Times* on June 13, 2005. There were no responses to the announcement.

Document Review

Because these OUs are still in the remedial action phase, documents are being reviewed as delivered. EPA, state and PRPs are all commenting and finalizing design and construction projects. Within each of the OUs there are periodic monitoring reports that guide project planning, but the island wide long-term comprehensive monitoring is still being designed. This monitoring will sample the groundwater, sediment, and groundwater-surface water interface to insure compliance with the site cleanup goals.

Data Review

Soil and Groundwater OU (S&GWOU1)

For the last five years, data for the S&GWOU1 is being reported from Todd Shipyards property for the petroleum product removal. A system of groundwater drawdown, bioventing, and oil skimming is being employed to remove TPH from the vadose zone. This system has been optimized and still is removing significant amounts of oil each month. Since the system startup in 1999, over 180,000 gallons of waste oil have been removed from the site soil and floating on the groundwater. Data reports are quarterly.

Other data review for the S&GWOU1 consists of annual cap inspections. Until all of the long-term monitoring gets fully integrated into a single system, each of the properties that had contamination hot spot removals and installed a cap system has to perform an annual cap inspection. After the Port's Terminal 18 Redevelopment Project, about half of the island is under Port jurisdiction. Part of the long-term site monitoring plan will be to integrate the groundwater monitoring, sediment monitoring, and cap inspections into a single program.

Tank Farms OU (TFOU2)

The groundwater is sampled and reported quarterly. The product extraction and treatment operating on the BP (previously ARCO) facility is monitored daily.

Lockheed Upland OU (Lockheed Upland OU3)

The surface cap is inspected annually and groundwater monitoring is done quarterly. Copper in the groundwater may be a cause for concern from this OU because of the monitoring well's proximity to the marine environment. Additional

groundwater sampling is planned in conjunction with the new sediment capped area adjacent to the bulkhead separating the upland from the marine water. Annual cap inspections revealed that the PRP was not properly maintaining the cap. Repair work is anticipated by early next summer.

Lockheed Shipyard Sediment OU (LSSOU7) and
Todd Shipyard Sediment OU (TSSOU9)

The contaminated sediment excavation and cap has been completed for the LSSOU7 but the excavation of contaminated sediment and installation of the cap in the TSSOU9 has not been completed. Monitoring of these two sediment caps has not begun. The monitoring will be both visual and by divers measuring depth of cap layer and sampling for cap recontamination. In addition, drainage from the Lockheed Upland must be controlled to prevent recontamination of the sediment cap.

East Waterway OU (East Waterway OU10)

The Port of Seattle will monitor the sand layer placed in the East Waterway annually until 2008, whereupon the EPA will evaluate the monitoring data and make a decision on future monitoring.

Site Inspection

The latest in ongoing construction oversight was a site inspection on August 31, 2005, of the Soil and Groundwater OU cap and interface of the Lockheed Upland OU with the new Lockheed Shipyard Sediment OU sediment cap. The following representatives were present:

Neil Thompson, EPA
Lynda Priddy, EPA
Kathy Bahnick, Port of Seattle
Carl Schaeffer, Port of Seattle
Jeffery Fellows, Lockheed
Jerry Portele, Lockheed

No Five-Year Review specific site inspection was done because of the level construction occurring on the site. Project managers are in frequent contact with the PRPs and their representatives.

Interviews

No interviews were conducted for this Second Five-Year Review. The newspaper notice did not produce any responses or requests for information. This site is within the ongoing Port of Seattle port improvement project which also has community outreach.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

Yes. All the remedial actions for this site are not yet completed; however, two OUs; Lockheed Upland (Lockheed 03) and West Waterway OU (West Waterway OU8) have been completed according to their respective RODs. Based on the review of individual OUs that are still under construction, the actions that have been completed are functioning as intended by the RODs and ESDs. The capping and sediment cleanups have already greatly minimized the migration of contaminants from the soil to groundwater, and ultimately to the marine surface water through the sediments. The engineered caps that are installed on both the upland and sediments prevent the direct contact to humans and marine organisms. However, as noted previously, cap maintenance and drainage controls need to be improved on the Lockheed Upland property. There are no supply wells on-site which eliminates exposure through the groundwater ingestion route.

The remedial actions for the Soil and Groundwater OU (S&GWOU1) are nearing completion. The capping actions that were part of the Port of Seattle's T-18 Redevelopment Project are completed. These actions completed capping on about one-half of the island as a part of road and railway improvements and paving associated with increasing the area for shipping container storage and sorting. Capping now covers about 90% of the land area of the island. Most of the island has storm sewers to divert water from infiltrating into the soils which still contain contaminants above unrestricted use. The City of Seattle has institutional controls concerning construction activities and well installation. These are in place but are not site specific. Development of site specific ICs is scheduled but has not yet been completed. A deed notice that Harbor Island is a Superfund site has not been filed. This is a state requirement.

Part of the cleanup plan calls for inspection of the capped areas on an annual basis. The inspection reports and compliance inspections by EPA indicate that the cap remains effective and maintenance is performed when cracks or holes develop. Some major repairs occurred after the Nisqually Earthquake in 2001.

The petroleum product extraction systems at Todd Shipyard (S&GWOU1) and at BP (TFOU2) are continuing to remove product and reducing the amount in the soil. The volume in the soil at both locations is reducing based on the monitoring well data. The extraction is expected to continue for years before the soil will meet the cleanup requirements.

The construction of the Lockheed Shipyard Sediment (LSSOU7) remedy was completed in February 2005. The remedy was built according to plans and

specifications. Four other OUs are still implementing remedial actions specified in their respective RODs.

There is no ROD for East Waterway OU (East Waterway OU10) and the final remedy for this operable unit has not been determined. The final surface contamination data, post dredging, was not below the SQS for all chemicals; however a 6 inch nominal sand layer was placed over the remaining sediments in order to prevent contamination exposure to the benthic population. Given that the final post removal surface was not below the WA State Sediment Management Standards for PCBs, The sand layer placement will protect exposure to the environment in the short term. An RI/FS will address gaps in sediment chemistry information. The final remedy for the East Waterway OU will address this removal area.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes. There have been no changes in the conditions of the site that would affect the initial exposure assumptions, toxicity data, cleanup levels, or RAOs of the selected remedies.

Changes in Standards and To Be Considereds

The only standard that has changed since the various RODs were written is for arsenic in groundwater (S&GWOU1). Arsenic is not a contaminant of concern for the groundwater at Harbor Island. The Safe Drinking Water Standards, MCLs, are not applicable since there is no potable aquifer. The other RODs are more recent and there are no changes in the regulations cited.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the Human Health Risk Assessments included both current exposures (workers and fish consumption) and future exposures (workers and fish consumers) have not changed since the various OU assessments. There are no residences on the island nor are any expected in the future. Fish consumption from the waterways is a concern for human health since contaminated sediments were identified. The remedial actions in the sediment OUs and the East Waterway OU are designed to control these contaminated contaminants and reduce human health and environmental risks.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. No new human health or environmental targets were identified during the Five-Year Review. Some of the remedial actions are still under construction but for those actions that have been completed, there is no other information that calls into question the protectiveness of the remedy. In the S&GWOU1, surface runoff from Lockheed Upland OU area may be impacting the new Lockheed Shipyard Sediment OU sediment cap. Currently there is no data to identify or quantify any contamination in surface runoff which is an issue for the protection of the Lockheed Shipyard sediment cap. Additional monitoring is being implemented along with construction plans to modify the surface drainage. Control measures were used to prevent any contaminants from entering the surface runoff. Some questions remain regarding the potential contamination of surface water that infiltrates the storage area. More monitoring wells have been installed and additional surface cleaning has been done. There is a plan to divert the surface runoff from discharging to the new sediment cap to allow future uses of the Lockheed Upland OU property.

A recent dive survey in the East Waterway OU10 indicated limited mixing of the sand layer with the sediment surface beneath. This could result in minimal contamination of the sand layer. However core samples that will be taken during annual re-contamination monitoring will confirm the integrity and protectiveness of the sand layer.

Technical Assessment Summary

Some of the remedial actions identified in the RODs have not been completed. Even though the selected remedies are still considered protective of human health and the environment, not all contamination is fully controlled because several remedies are still under construction.

A new drainage plan for the surface runoff from the Lockheed Upland OU (OU3) has been prepared and is part of the O&M actions, but has not been constructed yet. Storage of potentially contaminated soil is subject to best management practices (BMPs) and requires full containment.

Although many TPH Hot Spots have been removed, two continue to be actively treated by extraction and treatment. Product extraction systems are operating in the S&GWOU1 and TFOU2 to remove product from the soil as part of the soil cleanup to RAOs at these two OUs.

Sediment cap construction at the Todd Shipyard (TSSOU9) is nearly completed. This remedial action will have removed the highly contaminated sediments and covered the residual lower contaminated bottom sediments with a clean material that will provide a long-term cap that is compatible with the marine habitat.

After removal of contaminated sediments in the East Waterway OU, sampling identified areas that require removal of additional contaminated sediment. This dredging is planned for 2006 along with other maintenance dredging.

Some institutional controls are in place, but they are not site-specific. The RODs call for protection of the engineered soil and sediment caps. The development of the site-specific ICs needs to continue. They can be done in phases as the construction activities get competed. Not all of the ICs can be implemented until construction actions are complete.

VIII. Issues

Table 8 - Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Uncontrolled surface runoff (Lockheed Upland OU3	Y	Y
Contaminated sediments (East Waterway)	Y	Y
Long-Term Monitoring	N	Y
TPH contamination in Tank Farms OU	N	Y
TPH contamination in S&GWOU1	N	Y
Site Specific Institutional Controls (ICs)	N	Y

Although the NTCRA removed a large amount of contamination out of East Waterway OU10, the removal footprint was determined based on navigational needs of the Port. Areas immediately outside the removal footprint are contaminated above the WA State SMS CSL that could affect the protectiveness of the sand layer. In addition, further characterization is needed for areas in the waterway with limited sampling information.

IX. Recommendations and Follow-Up Actions

Several remedial actions are still under construction. The conclusion of these actions will deal with the issues identified above.

The remaining remedial actions in the Soil and Groundwater OU (S&GWOU1) are the continuing TPH soil contamination cleanup at Todd Shipyard and the long-term groundwater monitoring. An island wide Long-term Monitoring Program is being implemented and initial data will be collected in late

2005. Site specific ICs have yet to be implemented. ICs are in effect for construction and well installation through state ordinances, but site-specific ICs need to be developed and implemented.

Future remedial actions within the Tank Farms OU that are anticipated at this time include the following:

- Two additional areas of TPH contaminated soil above applicable standards will be removed given constraints on excavating imposed by existing structures. One of these areas is in the Shoreline Manifold area at the Shell facility (10,000 ppm standard). Extensive pipeline structures will have to be removed to access this contaminated soil. At the time of the CAP, upgrades to the pipeline structures in the manifold area were anticipated. These upgrades have not taken place, but could be impending given planned renovations to the shoreline area. The second area of TPH contaminated soil is in A Yard at the Kinder Morgan facility (20,000 ppm standard). The CAP states that the soil excavation will be accomplished after free product has been removed from this area, which hasn't been fully completed.

- An air-sparging remedial system will be constructed and operated to control and further remediate soil and groundwater in A Yard at the KM facility. The remediation system in Plant 1 at the BP facility will continue operating as long as there is significant hydrocarbon recovery and no sheen on surface water occurs when the system is not operating.

Groundwater monitoring will continue. The number of wells monitored and frequency of monitoring will be reduced as appropriate.

Remedial actions not determined at this time could be implemented in localized areas of the TFOU2 where minor free product and/or dissolved contaminant levels above standards persist.

Recommendations and follow-up actions for removal actions in the East Waterway OU10 include further characterization of the waterway including long-term monitoring of past dredging and sand cover removal action.

Although Lockheed Shipyard Uplands OU (OU3) was delisted from the NPL, some new surface drainage issues are being addressed for the Lockheed Shipyard Sediment OU (LSSOU7). The asphalt cap was not being properly maintained. These O&M actions will be taken by the PRPs and should protect water quality and the new sediment cap that has been placed over near-shore sediments.

The Todd Shipyards Sediment OU (TSSOU9) is currently under construction with the removal of contaminated sediments and a protective cap. This will be the remedy for the contaminated sediments at Todd Shipyard.

The East Waterway OU (OU10) underwent some navigational dredging but sediment contamination remains. A protective cap was placed over the remaining contaminated sediments. Monitoring of the sand cap and further remedial investigation is anticipated to begin in 2006.

Table 9 - Recommendations and Follow-Up Actions

Issue	Recommend/ Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N) Current/Future	
Long-Term Monitoring S&GWOU1	Construct monitoring wells and finalize sampling plan	PRP Group	EPA	12/31/06	N	Y
Surface Runoff Controls Lockheed Upland OU3	Construct Drainage Plan for old Lockheed Property	PRP Group	EPA	9/15/06	Y	Y
TPH contamination in TFOU2	Plan to Treat contaminated soil	PRPs	Ecology	6/30/15	N	Y
TPH contamination in S&GWOU1	Plan to Treat contaminated soil	PRPs	EPA	9/15/15	N	Y
Site Specific Institutional Controls	Implement the ICs	PRPs	EPA/ Ecology	Partial 12/31/08 Complete 12/31/15	N	Y

X. Protectiveness Statements

Soil and Groundwater OU

The remedy at this OU is expected to be protective of human health and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

Tank Farms OU

The remedy at this OU is expected to be protective of human health and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

Lockheed Upland OU

The ROD remedy for this OU has been completed and the OU delisted. The protective surface soil cap upgrade by diverting surface runoff will provide additional protection to the marine environment. The remedy at this OU is expected to be protective of human health and the environment when maintenance issues are addressed, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Lockheed Shipyard Sediment OU

The remedy at this OU is expected to be protective of human health and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

Todd Shipyard Sediment OU

The remedy at this OU is expected to be protective of human health and the environment upon completion, and in the interim exposure pathways that could result in unacceptable risks are being controlled.

West Waterway OU

This OU is considered protective of human health and the environment and a No Action ROD was written for this OU.

East Waterway OU

The ROD has not yet been completed for this OU. A protectiveness determination of the remedy at this OU cannot be made yet. The following additional removal actions are planned: dredging additional Hot Spots of contaminated sediment and place additional protective capping material to reduce risks to the marine habitat.

XI. Next Review

The next five-year review for the Harbor Island Superfund site is required by September 2010, five years from the date of this review.

Figure 1
Harbor Island Vicinity Map

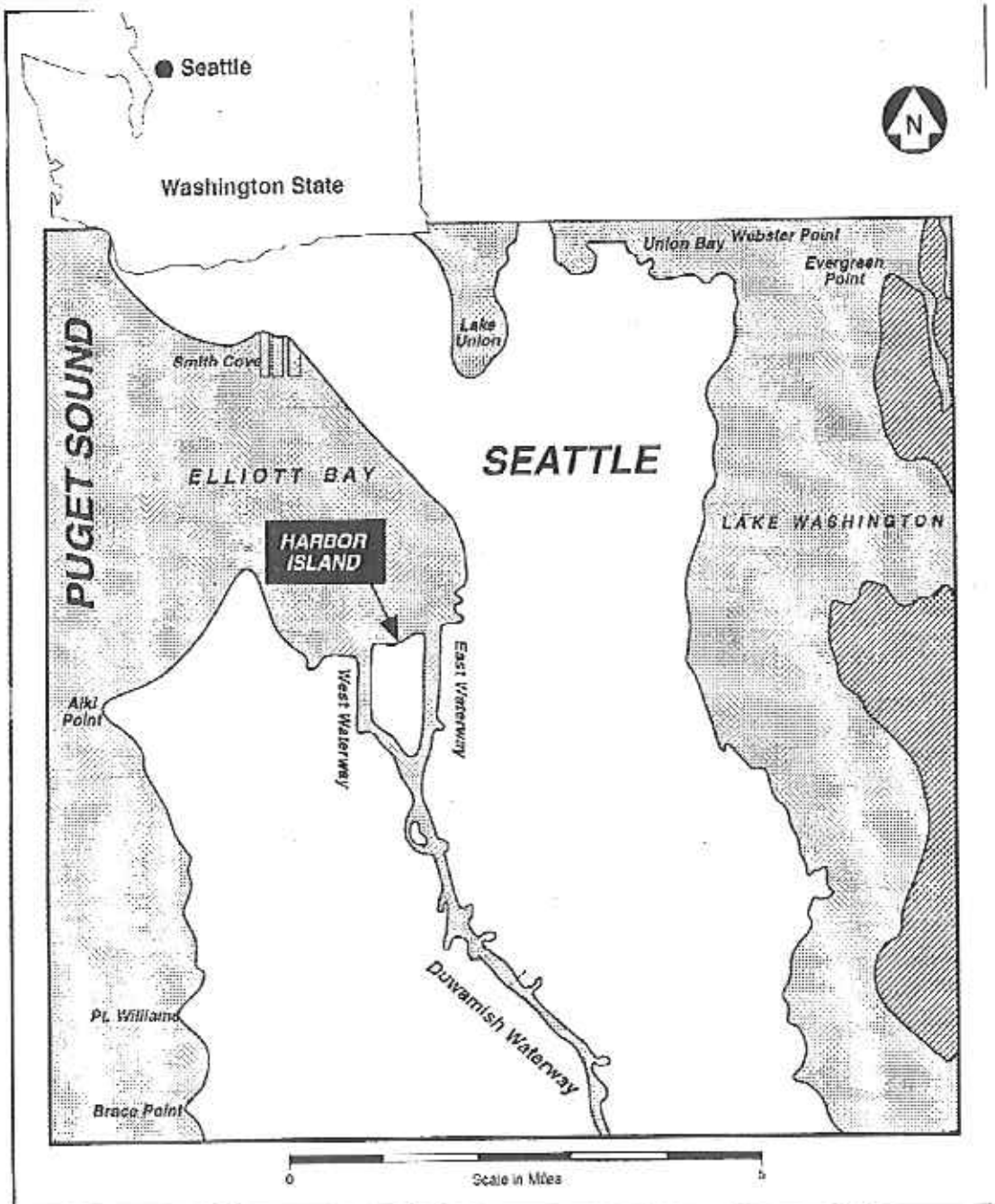

Figure 2
Harbor Island Operable Units

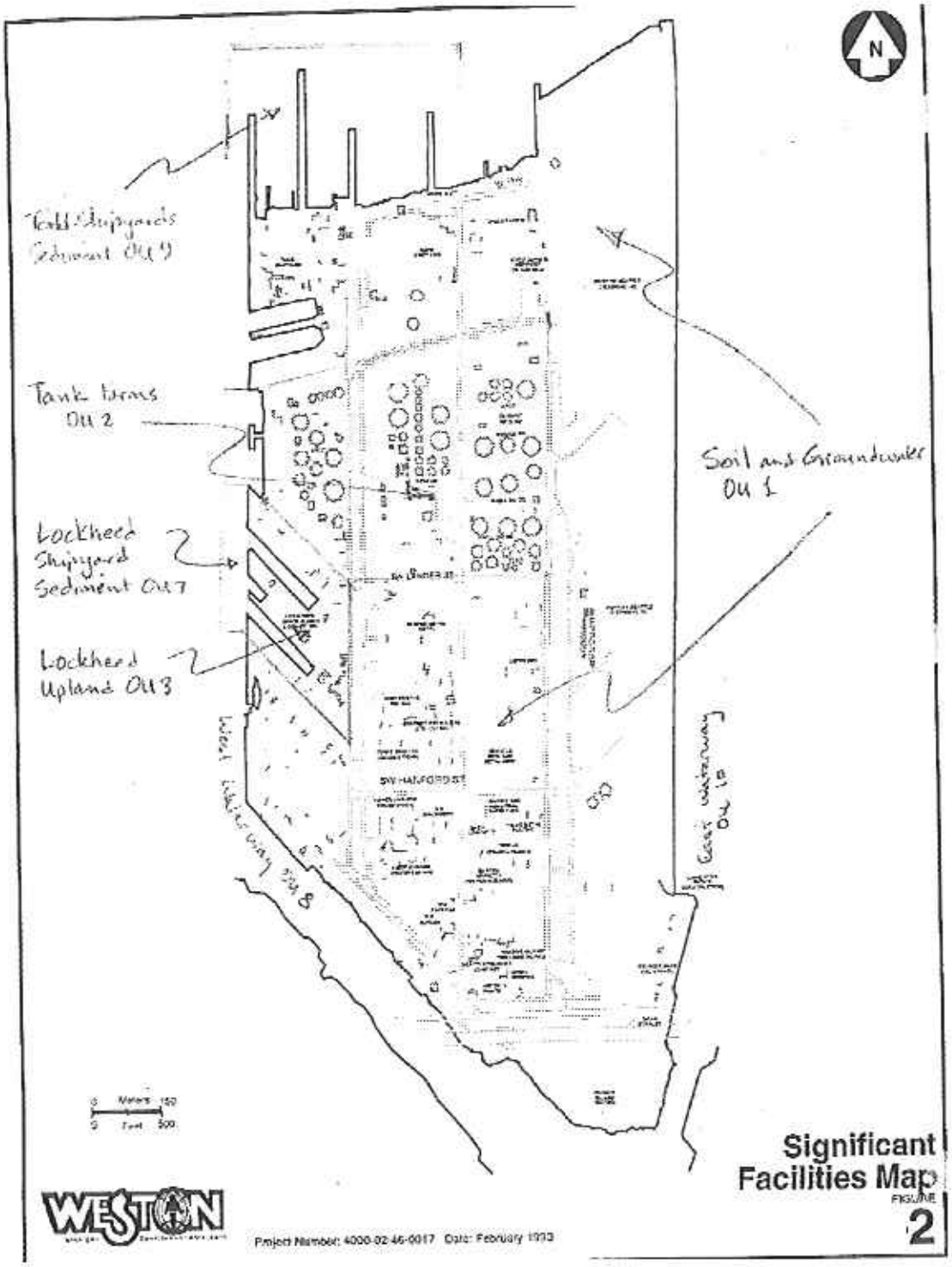

Figure 3
East Waterway Dredging Activities

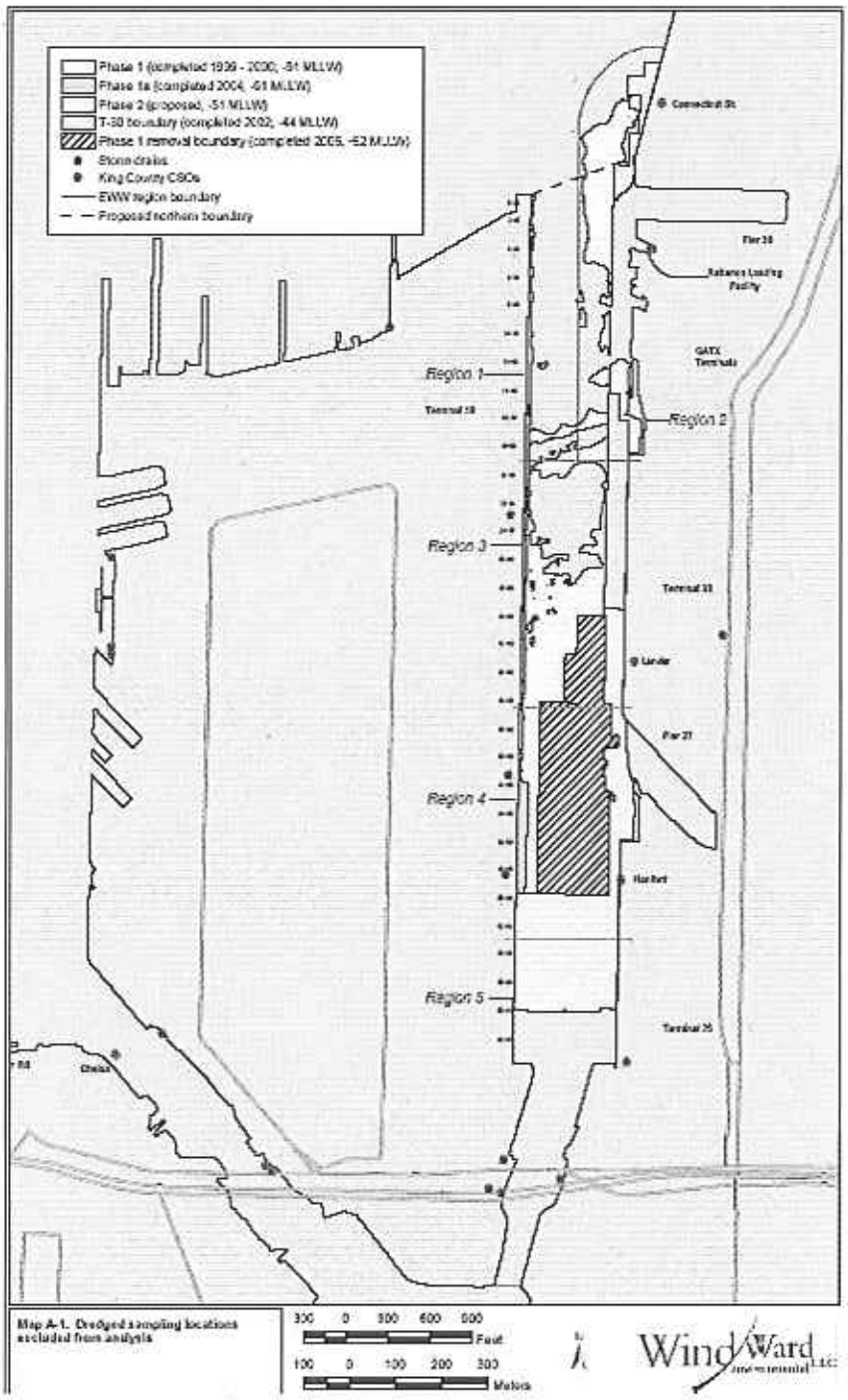

Figure 4
East Waterway Phase I Dredging