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November 9, 2010

TO-002-09-10-0010-DCN847

Brandon Perkins, Task Monitor
United States Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

**Reference: Contract No. EP-S7-06-03
Technical Direction Document No. 09-10-0010
Makah Warmhouse Beach Dump
Final Preliminary Assessment Report**

Dear Mr. Perkins:

Enclosed please find the Final Preliminary Assessment Report for Makah Warmhouse Beach Dump, located in near Neah Bay, Clallam County, Washington. TechLaw, Inc., appreciates the opportunity to provide technical services to U.S. EPA Region 10. If you have any questions or comments, please contact START-3 Project Manager, Malia Crane, at (678) 691-2000, or me at (206) 577-3051.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Steve Fuller', is written over a horizontal line.

Steve Fuller
START-3 Program Manager
TechLaw, Inc.

Enclosure

cc: Tiffany Ban, Central Files Administrator, TechLaw, Inc.
Paul Swift, START-3 Site Assessment Group Leader, TechLaw, Inc.
Malia Crane, START-3 Project Manager, TechLaw, Inc.

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**Preliminary Assessment Report, Final
Makah Reservation
Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington
TDD: 09-10-0010**

**TechLaw, Inc.
Contract EP-S07-06-03**

Region 10

START-3

Superfund Technical Assessment and Response Team

**Submitted To: Brandon Perkins, Task Monitor
United States Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101**

November 2010

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE BACKGROUND..... 2

 2.1 SITE LOCATION 2

 2.1.1 Site Description and Current Use 2

 2.1.2 Site Ownership History 3

 2.1.3 Site Operations and Waste Characteristics 3

 2.1.4 Potential Sources..... 4

 2.2 PREVIOUS INVESTIGATIONS 4

 2.2.1 1993 EPA Landfill Closure Plan..... 4

 2.2.1 1995 Open Dump Inventory 4

 2.2.3. 1995 Waste Delineation and Characterization Report..... 4

 2.2.4 1999 Draft Makah Reservation Waste Management Plan..... 4

 2.2.5 2001 Biological Assessment..... 4

 2.2.6 2001 Draft Makah Strategic Project Implementation Plan (SPIP) 5

 2.2.7 2001 Hydrogeological Investigation..... 5

 2.2.8 2002 Draft Solid Waste Management Plan (SWMP) 5

 2.2.9 2002 Preliminary Engineering Report/ Environmental Report 5

 2.2.10 2003 Draft Warmhouse Beach Dump Closure Plan 5

 2.2.11 2004 Site Investigation, Semi-Annual Sampling Event 6

 2.2.12 2006 Semi-Annual Sampling Event..... 6

 2.2.13 2007 Makah Seafood Study, Phase I 6

 2.2.14 December 2007 Semi-Annual Sampling Event 6

 2.2.15 Open Dump Closure Project (Date Unknown, post-2008) 7

 2.2.16 May 2009 Semi-Annual Sampling Event 7

 2.2.17 2009 Petition for Preliminary Assessment..... 8

 2.2.18 2010 EPA Removal Assessment..... 8

3.0 MIGRATION/EXPOSURE PATHWAYS..... 11

 3.1 GROUNDWATER MIGRATION PATHWAY..... 11

 3.1.1 Geologic Setting..... 11

 3.1.2 Aquifer Setting..... 11

 3.1.3 Drinking Water Targets 12

 3.2 SURFACE WATER MIGRATION PATHWAY 12

 3.2.1 Overland Route 12

 3.2.2 Drinking Water Targets 13

 3.2.3 Human Food Chain Targets..... 13

 3.2.1.1 Sport Catch..... 13

 3.2.1.2 Commercial Harvest..... 13

 3.2.1.3 Tribal Harvest..... 14

 3.2.4 Environmental Targets..... 14

 3.3 SOIL EXPOSURE PATHWAY 15

 3.4 AIR MIGRATION PATHWAY 15

 3.4.1 Human Targets..... 16

 3.4.2 Environmental Targets..... 16

4.0 SUMMARY AND CONCLUSIONS..... 17
5.0 REFERENCES..... 20

LIST OF APPENDICES

APPENDIX

A FIGURES

- A-1 General Site Location
- A-2 Sample Locations
- A-3 4-Mile Radius Map
- A-4 15-Mile TDL Map

B TABLES

- B-1 Organic Analytical Results Summary – Surface Soil Samples
- B-2 Organic Analytical Results Summary – Surface Soil SPLP Samples
- B-3 Inorganic Analytical Results Summary – Surface Soil Samples
- B-4 Inorganic Analytical Results Summary – Surface Soil SPLP Samples
- B-5 Dioxin Analytical Results Summary – Surface Soil and Sediment Samples
- B-6 Organic Analytical Results Summary – Surface Soil PBDE Samples
- B-7 Organic Analytical Results Summary – Surface Water Samples - West Creek
- B-8 Inorganic Analytical Results Summary – Surface Water Samples - West Creek
- B-9 Inorganic Analytical Results Summary – Filtered Surface Water Samples - West Creek
- B-10 Organic Analytical Results Summary – Sediment Samples- West Creek
- B-11 Inorganic Analytical Results Summary – Sediment Samples - West Creek
- B-12 Organic Analytical Results Summary – Sediment PBDE Samples - West Creek
- B-13 Organic Analytical Results Summary – Surface Water Samples - East Creek
- B-14 Inorganic Analytical Results Summary – Surface Water Samples - East Creek
- B-15 Inorganic Analytical Results Summary – Filtered Surface Water Samples - East Creek
- B-16 Organic Analytical Results Summary – Sediment Samples- East Creek
- B-17 Inorganic Analytical Results Summary – Sediment Samples - East Creek
- B-18 Organic Analytical Results Summary – Sediment PBDE Samples - East Creek
- B-19 Summary of Waste in Warmhouse Beach Dump
- B-20 Groundwater Drinking Water Population within a 4-Mile Radius
- B-21 Sport Catch Data – Area 4A
- B-22 Sport Catch Data – Area 4B
- B-23 Commercial Bottom/Groundfish Catch Data
- B-24 Commercial Salmon Catch Data – Area 4A
- B-25 Treaty Harvest Data – Areas 4A and 4B
- B-26 Population within a 4-Mile Radius
- B-27 Wetlands within a 4-Mile Radius

C PHOTOGRAPHIC DOCUMENTATION

D FIELD LOGBOOK

LIST OF ACRONYMS

<u>Acronym</u>	<u>Definition</u>
°F	degrees Fahrenheit
Army	United States Army
BA	Biological Assessment
bgs	below ground surface
BIA	Bureau of Indian Affairs
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern; chain of custody
CRDL	contract required detection limit
CRQL	contract required quantitation limit
DHHS	United States Department of Health and Human Services
DoD	United States Department of Defense
Ecology	Washington State Department of Ecology
E&E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HRS	Hazardous Ranking System
HIS	Indian Health Service
MCL	Maximum Contaminant Level
MEL	Manchester Environmental Laboratory
msl	mean sea level
MSW	municipal solid waste
MTCA	Model Toxics Control Act
Navy	United States Navy
No.	Number
NOAA	National Oceanic and Atmospheric Administration
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PEL	probable effect level
PPE	probable point of entry
RBC	risk-based concentration
Ridolfi	Ridolfi Engineering, Inc.
SARA	Superfund Amendments and Reauthorization Act
SPIP	Strategic Project Implementation Plan
SPLP	Synthetic Precipitation Leaching Procedure
SQL	sample quantitation limit
START-3	Superfund Technical Assessment and Response Team-3
SVOCs	semivolatile organic compounds
SWMP	Solid Waste Management Plan
TAL	Total Analyte List
TDD	Technical Direction Document
TDL	target distance limit.
TEL	threshold effect level
the dump	Warmhouse Beach Dump
TPH	total petroleum hydrocarbon
TPH-Dx	total petroleum hydrocarbon – diesel range
TPH-Gx	total petroleum hydrocarbon – gasoline range
TechLaw	TechLaw, Inc.
USAF	United States Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Services
USGS	U.S. Geological Survey

LIST OF ACRONYMS (continued)

<u>Acronym</u>	<u>Definition</u>
VOCs	volatile organic compounds
WBD	Warmhouse Beach Dump
WDFW	Washington State Department of Fish and Wildlife

1.0 INTRODUCTION

Pursuant to U.S. Environmental Protection Agency (EPA) Region 10 Superfund Technical Assessment and Response Team-3 (START-3) Contract No. EP-S7-06-03 and Technical Direction Document (TDD) No. 09-10-0010, TechLaw, Incorporated (TechLaw) conducted a Preliminary Assessment (PA) at the Makah Reservation – Warmhouse Beach Open Dump site (WBD, the dump), located near Neah Bay, Clallam County, Washington. The PA activities performed were conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

The objectives of this PA are to:

- Determine the potential threat to public health and the environment posed by the WBD;
- Determine the potential for a release of hazardous substances into the environment; and
- Determine the potential for placement of the WBD on the National Priorities List.

Completion of the PA included a site reconnaissance, reviewing existing site information, collecting receptor information within the range of site influence, and determining regional characteristics.

This document includes the site background information (Section 2), a discussion of migration/exposure pathways and potential receptors (targets; Section 3), a conclusion (Section 4) and a list of pertinent references (Section 5).

2.0 SITE BACKGROUND

The following subsections discuss the site background, description, ownership history, and operations. Information presented in this subsection is based on a review of site background information using EPA Region 10 files.

2.1 Site Location

Site Name:	Makah Reservation – Warmhouse Beach Open Dump
CERCLIS ID:	WAN001002857
Location:	Neah Bay, Washington
Latitude:	48° 23' 20" North
Longitude:	-124° 39' 24" West
Legal Description:	Northwest Quadrant of Section 4, Township 33 North, Range 15 West (Willamette Meridian)
Site Owners:	Makah Tribal Council P.O. Box 115 Neah Bay, WA 98357 360-645-2201
Site Contacts:	Michael Lawrence Tribal Council Chairman 360-645-3235 Steve Pendleton Environmental Program Manager 360-645-3289

2.1.1 Site Description and Current Use

The Warmhouse Beach Open Dump is located 2 to 3 miles northwest of Neah Bay in Clallam County, Washington (see Figure A-1, located in Appendix A), and is situated on the edge of a small valley overlooking the Strait of Juan de Fuca. The dump is accessible off an unpaved gravel road from the road leading to Koitlah Point. The oval-shaped dump occupies 7 acres at the top of a ridge or "saddle," between the drainage area between two unnamed creeks. Drainage occurs to the east and west into unnamed creeks (hereby referred to as the East Creek and the West Creek) that discharge into the Strait Juan de Fuca. The dump is bordered by forests and is located approximately 800 feet inland from the Warmhouse Beach shoreline at an elevation of 260 feet above mean sea level (msl) (Ridolfi 2003; Ridolfi 2001b; Ridolfi 2006).

The majority of waste is located in a deep ravine. Waste was initially dumped in a deep ravine that runs east and west along the south edge of the dump. The ravine is 20 to 40 feet deep relative to the elevation of the access road that enters WBD. A bedrock ridge just to the north of the ravine runs parallel to the ravine. The top of the ridge is about 70 feet above the top of the ravine. The north side of the ridge slopes steeply to the north toward Warmhouse Beach and the Strait of Juan de Fuca (Ridolfi 2006).

The dump is currently used by the Makah Tribe and serves approximately 1,500 people in 492 residences. Primary dump contents include municipal solid waste (MSW), construction materials (including roofing), and animal carcasses, although lubricants and other petroleum-based products have been observed. As of 2003, it was estimated that WBD contained 55,000 to 65,000 cubic yards of waste (Ridolfi 2003; White Shield 1995; Ridolfi 2002b).

The surface area of the dump is 5.22 acres (227,500 square feet – 650 feet wide by 350 feet long; Ridolfi 2008). The waste depth is at least 40 feet deep and in the ravine at the toe of the waste, the waste extends below ground surface (bgs) at least 22 feet (Ridolfi 2003; White Shield 1995). Debris, including drums and tires, are scattered along the access road and in the ravine west of the access road (Ridolfi 2003, Ridolfi 2002b).

The dump is in a remote area; access to the dump is unrestricted. Warmhouse Beach can be accessed by a steep trail that begins at the northwest corner of the dump. The beach is used for camping, surfing, and other recreational activities (Ridolfi, 2006).

2.1.2 Site Ownership History

As part of the 1855 Treaty of Neah Bay (ratified March 8, 1985), the Makah Reservation was established, and the Makah Tribe reserved ownership of the tract of land on which the present dump site is located. The U.S. Government leased various areas from the Makah for national defense purposes between that time until 1988, when the Makah AFS was closed. Available records do not indicate that the dump site was ever owned or leased by any entity other than the Makah Tribe.

2.1.3 Site Operations and Waste Characteristics

The United States Air Force (USAF) and the United States Navy (Navy) began using WBD in the 1940s. Other dumps at Koitlah Point, Cape Flattery, and at the breakwater also were used; however, Department of Defense (DoD) records indicate WBD was more actively used after the Koitlah Point Dump closed in the 1960s. Since the 1960s, the United States Army (Army), USAF, Bureau of Indian Affairs (BIA), and Indian Health Service (IHS) have used the dump. The Makah Solid Waste Management Department has been recommending closure since 1963 (Ridolfi 2003; Ridolfi 2001a).

The Makah Air Force Station operated on the Makah Reservation from World War II until 1988. The dump was used to dispose of household and hazardous wastes. A DoD Site Assessment Report stated “hazardous waste is known to have been disposed of by DoD in the landfill.” Polychlorinated biphenyls (PCBs) and asbestos were reportedly disposed at the dump (Ridolfi 2003; Ridolfi 2001a). According to the 1995 White Shield Waste Delineation and Characterization Report, batteries, used motor oil, hypodermic needles, tires, appliances, roofing and construction materials, car bodies, household waste, and glass were also disposed. Table B-19, located in Appendix B, provides a summary of waste in WBD (White Shield 1995).

Waste materials were originally dumped into the ravine from the access road on the ravine’s south side. As the ravine filled with waste material, a road embankment was constructed on top of the waste and across the ravine. This road embankment increased the dump’s accessibility and allowed additional filling of the ravine to the east and west. Subsequently, the access

road was extended to the top of the ridge. Since then, waste materials have been dumped from the top of the ridge down toward the ravine to the south. A layer of waste covers the steep hillside that faces south toward the ravine. Waste also has been dumped from the top of the ridge down toward the north and northeast. The wastes are now partially burned (Ridolfi 2001a; Ridolfi 2006).

2.1.4 Potential Sources

Potential sources include the WBD (i.e., landfill). As of 2008, WBD was estimated at 5.22 acres of waste material, extending from the surface to 22 feet bgs (Ridolfi 2003; Ridolfi 2008; White Shield 1995). It is unknown if any liners or containment features are in place at the dump; but considering the age and history these features are not likely in place.

2.2 Previous Investigations

The following subsections discuss previous site investigations.

2.2.1 1993 EPA Landfill Closure Plan

In 1993, EPA began developing engineering alternatives to close WBD. After a site visit, three alternatives were proposed: minimal soil cover, consolidation and capping, and excavation and haul to a conforming landfill. Consolidation and capping was selected as the method that would protect human health and the environment (Ridolfi 2003; SAIC 1993).

2.2.1 1995 Open Dump Inventory

In 1995, the U.S. Department of Health and Human Services (DHHS) and HIS inventoried WBD pursuant to the Indian Lands Open Dump Clean-up Act of 1994. Based on this assessment, the dump was listed on the HIS Sanitary Deficiency System as No. WA05344-0301 and was ranked as a high potential threat to human health and the environment (Ridolfi 2003; DHHS and HIS 1995).

2.2.3. 1995 Waste Delineation and Characterization Report

In 1995, White Shield completed a Waste Delineation and Characterization Report to survey WBD and determine the waste streams and subsoil materials present. A topographic survey was completed and nine test pits were excavated. From this investigation, it was determined the dump occupies approximately 3 acres of mixed waste that varies in depth from the surface to over 22 feet bgs. No samples were collected for laboratory analysis (Ridolfi 2003; White Shield 1995).

2.2.4 1999 Draft Makah Reservation Waste Management Plan

In 1999, a draft plan for solid waste management that included an evaluation of waste streams, a review of current and future regional disposal opportunities, and proposed alternatives to close WBD. Closure in place and excavation and export were evaluated (Ridolfi 2003; B&C 1999).

2.2.5 2001 Biological Assessment

In spring 2001, Makah wildlife biologists prepared a Biological Assessment (BA) for Industrial Development on the Makah Reservation. Although the BA did not specifically address WBD, the dump was identified as a source of adverse effects to Marbled Murrelets (*Brachyrampus marmoratus marmoratus*) (Ridolfi 2003; McCoy 2001).

2.2.6 2001 Draft Makah Strategic Project Implementation Plan (SPIP)

In 2001, Ridolfi Engineering, Inc. (Ridolfi) prepared a Draft SPIP for DoD to address environmental mitigations on Makah Reservation. The SPIP summarizes the historical uses of the Makah Reservation by DoD, discusses the environmental impacts, and outlines a clean-up approach. Consolidation and closure in place were proposed for WBD (Ridolfi 2003; Ridolfi 2001a). The SPIP subsequently was updated in August 2006 (Ridolfi 2006).

2.2.7 2001 Hydrogeological Investigation

In 2001, the Makah Environmental Restoration Team conducted a hydrogeological investigation to support plans for closing WBD. Four monitoring wells were installed along the perimeter of the dump. The investigation determined a layer of waste and soil overlies a hard gray siltstone. Water was encountered in one well; however, the well did not yield 0.1 gallons per minute of potable groundwater and therefore, did not meet the regulatory definition of an aquifer (Ridolfi 2003; Ridolfi 2001b). Additional details regarding the well installation were not available in the file material. However, it has been reported that one of the monitoring wells (MW4) was covered with waste debris shortly after installation and subsequently has not been sampled during routine sampling events (Ridolfi 2008).

Groundwater, surface water, subsurface soil, and sediment samples were collected during the hydrogeological investigation and analyzed for polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCB), total petroleum hydrocarbons (TPH), TPH as Diesel Range Organics (TPH-Dx), TPH as Gasoline Range Organics (TPH-Gx), and Total Analyte List (TAL) metals. Barium, chromium, lead, selenium, vanadium, and zinc were detected at concentrations exceeding the EPA “drinking water standards.” Surface water and sediment samples contained cadmium, chromium, copper, lead, and zinc at concentrations “considerably higher” than the Criteria for Maximum Concentrations (Ridolfi 2003; Ridolfi 2001b).

2.2.8 2002 Draft Solid Waste Management Plan (SWMP)

Ridolfi prepared a SWMP to address existing solid waste, provides alternative solid waste options, and discusses increasing reuse and recycling (Ridolfi 2003; Ridolfi 2002a).

2.2.9 2002 Preliminary Engineering Report/ Environmental Report

Ridolfi prepared five alternatives to using WBD for solid waste disposal were evaluated. In addition, three locations for a transfer station were evaluated (Ridolfi 2003; Ridolfi 2002c). The Environmental Report evaluated the five alternatives from an environmental perspective and analyzing the environmental impacts associated with the three proposed transfer station locations (Ridolfi 2003; Ridolfi 2002d).

2.2.10 2003 Draft Warmhouse Beach Dump Closure Plan

In 2003, Ridolfi developed a Draft Closure Plan for Warmhouse Beach. The plan further developed previous studies that evaluated various closure options. The two selected remedies for comparison the plan were a “Slope Option” and a “Ravine Option.” The Slope Option consolidated approximately 22,000 cubic yards of waste and contaminated soil currently located along the access road, the hillside, and the east and west areas of the dump. The Ravine Option relocates the waste along the access road and hillside on top of the existing waste in the ravine, where approximately 28,000 cubic yards of waste and contaminated soil would be excavated and placed in the ravine, adding an additional 20 feet of depth to the waste.

2.2.11 2004 Site Investigation, Semi-Annual Sampling Event

In October 2004, Ridolfi collected four groundwater samples to verify that contaminants were not migrating from the dump. Two surface water and sediment samples were also collected from the East Creek and West Creek. Arsenic and lead were detected in at least one groundwater sample at a concentration exceeding the EPA Maximum Contaminant Levels (MCLs). Arsenic was the only constituent detected above “screening levels” (original document was not available in file material; referenced document does not specify which screening levels were used) in surface water samples collected. Lead, manganese, nickel, and zinc were detected at a concentration exceeding the “screening levels” in at least one sediment sample (Ridolfi 2009a).

2.2.12 2006 Semi-Annual Sampling Event

In March 2006, Ridolfi and the Makah Environmental Restoration Team collected three groundwater, two surface water, and two sediment samples. Groundwater samples were collected from existing monitoring wells and surface water and sediment samples were collected from the East Creek and West Creek. Arsenic and lead were detected in one groundwater sample at concentrations exceeding “screening levels” (original document was not available in file material; referenced document does not specify which screening levels were used). Concentrations of arsenic, copper, and lead exceeding “screening levels” in the surface water samples collected. The higher concentrations were detected in the West Creek sample, collected near the waste. Chromium, copper, and nickel were detected at concentrations exceeding the screening levels in sediment samples collected. In addition, several metals that can be indicators of landfill leachate (calcium, iron, manganese, and sodium) were detected at concentrations several times greater than the background concentrations (Ridolfi 2009a).

2.2.13 2007 Makah Seafood Study, Phase I

In 2007, Ridolfi conducted the first phase of a three-year seafood study. Fifty-seven seafood samples were collected from 10 locations. Samples were analyzed for PAHs, PCBs, chlorinated pesticides, various metals, percent lipids, and moisture content. One chiton sample and three blue mussel samples were collected from Warmhouse Beach. Several seafood samples were also collected from the Strait Juan de Fuca, including pink salmon, black cod, lingcod, Dungeness crab, black rockfish, kelp greenling, china rockfish, cabezon rockfish, and blue rockfish. The samples were compared to EPA Region 3 Risk-Based Concentrations (RBC) for fish tissue. Arsenic was detected at concentrations exceeding the RBC in the chiton and all three blue mussel samples collected from Warmhouse Beach. Cadmium concentrations exceeded its RBC in the chiton sample and three blue mussel samples collected at Warmhouse Beach. Arsenic also was detected in several seafood samples collected from the Strait Juan de Fuca. It was concluded that the small data set collected during Phase I limited the ability to identify trends on contaminant concentrations. The Seafood Study recommended the following for Phase II of the study: collection of background samples from Freshwater Bay for comparison purposes, further research into cadmium levels detected in the blue mussel samples and use of more-sensitive analytical procedures to achieve lower reporting limits for PCBs, further analysis of arsenic and mercury detected in samples, and continue training of field crew (Ridolfi 2007).

2.2.14 December 2007 Semi-Annual Sampling Event

In 2007, Ridolfi collected three collocated surface water and sediment samples: one from the East Creek, one from the West Creek, and one background sample from Classet Creek. Three additional sediment samples were collected from the West Creek. Groundwater samples were

collected from the three existing monitoring wells. Arsenic was detected in a concentration that exceeded the Makah Indian Tribe Water Quality Standards for Surface Waters in a surface water sample. Sediment samples were compared to threshold effect level (TEL) or probable effect level (PEL) for freshwater ecosystems. In addition, sediment and surface water samples were compared to background concentrations from samples collected in Classet Creek. Groundwater samples were compared MCLs, EPA Secondary Drinking Water Regulations, Washington Department of Ecology (Ecology) Model Toxics Control Act (MTCA) Methods A and B. Total PCB concentrations exceeded sediment screening levels on both East Creek and West Creek. Several metals were detected at concentrations exceeding in sediment and the groundwater samples collected (Ridolfi 2008).

It was concluded that metal concentrations in surface water samples collected from both creeks have remained relatively constant over time, with more metals detected at upstream locations compared to downstream locations. Diesel- and motor-oil range hydrocarbons, PAHs, PCBs and metals have been detected in sediment collected from East Creek and West Creek and have remained at relatively constant concentrations over time. Concentrations were higher upstream compared to downstream. PCBs are a contaminant of concern in sediment, particularly in West Creek. Most metals concentrations were comparable or higher in West Creek compared to East Creek, and were most often detected at higher concentrations upstream than downstream. Metals concentrations have remained relatively constant over time. Most metals concentrations in groundwater have decreased in concentrations over time.

2.2.15 Open Dump Closure Project (Date Unknown, post-2008)

The Makah Tribe prepared an Open Dump Closure Project Report to discuss constructing a transfer station and close WBD. The objectives specifically identified included: close WBD and design, construct, and operate a solid waste transfer station and resource recovery facility (Makah; in progress).

2.2.16 May 2009 Semi-Annual Sampling Event

In 2009, Ridolfi conducted a round of monitoring and sampling at WBD. Surface water and sediment samples were collected from three locations. Surface water samples were analyzed for TAL metals, chloride, and nitrogen as nitrate. Sediment samples were analyzed for PCBs, total organic carbon, and grain size. Collocated surface water and sediment samples were collected from the East Creek, West Creek, and Kydikabbit Creek. Four additional sediment samples were collected from the West Creek (Ridolfi 2009b).

Barium and manganese were detected at concentrations that were “significantly higher” than the background concentrations in surface water samples collected from Kydikabbit Creek. Arsenic was detected in surface water at concentrations that exceeded the conservative water quality standards for the protection of human health. Total PCBs exceeded the TEL sediment samples collected from West Creek; one sediment sample exceeded the PEL. Arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, vanadium and zinc all exceeded at least the TEL or PEL in sediment samples collected from West Creek. Barium, copper, lead, manganese, mercury, nickel, vanadium and zinc were detected at a concentration the exceeded either the PEL or TEL in sediment samples collected from the East Creek. Several of the background sediment concentrations also exceeded the sediment screening levels (Ridolfi 2009b).

2.2.17 2009 Petition for Preliminary Assessment

On October 22, 2009, the Makah Tribal Council submitted a written request to EPA to complete a Preliminary Assessment (PA) and Removal Assessment (RA) at WBD (Lawrence 2009).

2.2.18 2010 EPA Removal Assessment

On January 25, 2010, EPA and START-3 mobilized from Port Orchard, Washington. The principle goals of the RA were to collect surface water and sediment samples from West Creek and East Creek to determine if contaminants of concern (COC) are present at concentrations that present risks to human health or the environment and whether they are migrating off-site; and collect surface soil samples from the waste pile to determine the presence of COCs; and determine the potential for contaminants to migrate off site during precipitation events.

Five equally spaced locations along West Creek were identified for sediment (0-4 inches bgs) and surface water sample collection. Four equally spaced locations along East Creek were identified for sediment (0-4" bgs) and surface water sample collection. Background sediment and surface water samples were collected from a creek along the road into WBD and are not expected to be influenced by the dump. Four surface soil samples were collected randomly from various locations on the waste pile. Sample locations are shown on Figure A-2, located in Appendix A (TechLaw 2010a).

Sediment samples were analyzed for TAL metals, volatile organic compounds (VOCs), semivolatile organics compounds (SVOCs), pesticides, PCBs, explosives, polybrominated diphenyl ethers (PBDEs), TPHs, and perchlorate. The four sediment samples closest to the dump also were analyzed for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran compounds (dioxins/furans). Surface water samples were analyzed for total and dissolved TAL metals, VOCs, SVOCs, pesticides, PCBs, explosives, TPHs, and perchlorate. Surface soil samples were analyzed for TAL metals, VOCs, SVOCs, pesticides, PCBs, explosives, PBDEs, TPHs, perchlorate, and dioxins/furans. Surface soil samples also were extracted using the Synthetic Precipitation Leaching Procedure (SPLP), EPA Method 1312, at the EPA Manchester Environmental Laboratory (MEL). The SPLP extracts were analyzed for TAL metals, VOCs, and SVOCs. The SPLP method is designed to simulate leaching under acid rainwater conditions and is used to evaluate the potential for leaching metals from soil into groundwater and surface water. The background samples were not analyzed for dioxin/furans. As a result, elevated concentrations could not be established; therefore, dioxin/furan results are presented in Appendix B and discussed briefly in the corresponding sections below. Analytical results are presented in Tables B-1 through B-18, located in Appendix B.

For the purposes of this PA, significant/elevated concentrations are defined, using Table 2-3 of the EPA Hazardous Ranking System (HRS) model criteria for observed release as follows:

- Equal to or greater than the sample's contract required quantitation limit (CRQL), or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the background sample's CRQL/contract required detection limit (CRDL) or SQL when the background concentration is below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limit.

Source Samples - Waste Pile (i.e., the dump/landfill)

No VOCs were detected at elevated concentrations or exceed the action levels in soil samples collected from the waste pile. The following seventeen SVOCs were detected at elevated concentrations: 2-methylnaphthalene; acenaphthene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; bis(2-ethylhexyl)phthalate; chrysene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; pyrene; TPH-Dx; and TPH-G. In addition, alpha-chlordane, gamma-chlordane, and heptachlor were detected at elevated concentrations in one soil sample. Organic analytical results for these soil samples are located in Table B-1. Organic SPLP analytical results for soil samples are located in Table B-2.

Antimony, barium, cadmium, copper, lead, manganese, silver, and zinc were detected at elevated concentrations in soil samples. TAL metal analytical results for these waste pile samples are located in Table B-3. SPLP inorganic analytical results for soil samples are located in Table B-4.

All 17 of the dioxin and furan compounds analyzed for were detected in soil samples collected from the waste pile. Concentrations generally were comparable to or higher than those detected in the West Creek sediments, with the exception of concentrations measured in sample WB-15-SS. Dioxin/furan concentrations detected in this sample generally were between two to four orders of magnitude higher than those measured in the other soil and creek sediment samples. No background soil samples were collected for comparison, so further evaluation was not performed. Dioxin/furan analytical results for these soil samples are located in Table B-5.

Of the 210 dioxin and furan (polychlorinated dibenzo-p-dioxins [PCDD] and polychlorinated dibenzofurans [PCDF]) congeners, 17 are generally the focus of regulatory action due to their toxicities. These compounds are unwanted by-products of incineration, uncontrolled burning and certain industrial processes. Industrial sources of dioxin to the environment include incinerators, metal smelters, cement kilns, the manufacture of chlorinated organics, and coal burning power plants. Dioxin is also produced by non-industrial sources, like residential wood burning, backyard burning of household trash, oil heating, and emissions from diesel vehicles (Dow 2010).

Seven PBDEs were detected at elevated concentrations in samples collected from the waste pile. Soil PBDE analytical results for these soil samples are located in Table B-6.

West Creek

Two organic constituents were detected at elevated concentrations in surface water samples collected from West Creek: 1,2-dichloroethane and perchlorate. Organic analytical results for these surface water samples are located in B-7. Perchlorate also was detected at elevated concentrations in several sediment samples. Benzo(a)pyrene was detected at an elevated concentration in one sediment sample. In addition, isopropyl benzene and toluene were detected at elevated concentrations in one sediment sample collected from West Creek. Organic analytical results for sediment samples are located in Table B-10.

Several TAL metals were detected at elevated concentrations in the filtered and unfiltered surface water samples, including arsenic, barium, copper, manganese, nickel, selenium, and zinc.

Chromium, lead, and vanadium were all detected at elevated concentrations in unfiltered surface water samples collected from West Creek. TAL metal and filtered TAL metal analytical results for these surface water samples are located in Tables B-8 and B-9. Eleven TAL metals, including barium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, silver, thallium, and zinc were detected at elevated concentrations in sediment samples. Inorganic analytical results for these sediment samples are located in Table B-11.

Several PBDEs were detected at elevated concentrations in sediment samples collected from West Creek. PBDE analytical results for these sediment samples are located in Table B-12.

Sixteen of the 17 dioxin/furan compounds analyzed for in the West Creek sediment samples were detected; the only congener not detected was 1,2,3,7,8,9-HxCDF. Dioxin/furan concentrations detected in these samples generally an order of magnitude higher than those measured in the East Creek sediment samples. Dioxin/furan analytical results for these sediment samples are located in Table B-5.

East Creek

Perchlorate is the only organic constituent detected at an elevated concentration in surface water samples collected from East Creek. Organic analytical results for these surface water samples are located in Table B-13. Two VOCs, 2-butanone and acetone were detected in one sediment sample at elevated concentrations. One SVOC, anthracene, was detected in one sediment sample at an elevated concentration. Organic analytical results for these sediment samples are located in Table B-16.

Several TAL metals were detected at elevated concentrations in the filtered and unfiltered surface water samples, including arsenic, barium, manganese, nickel, selenium, and zinc. Cadmium and lead were also detected at elevated concentrations in unfiltered surface water samples, but not the filtered samples collected from East Creek. TAL metal and filtered TAL metal analytical results for these surface water samples are located in Tables B-14 and B-15. Zinc was the only TAL metal detected at an elevated concentration in sediment samples. Inorganic analytical results for these sediment samples are located in Table B-17.

Two PBDEs were detected at elevated concentrations in sediment samples collected from East Creek. PBDE analytical results for these sediment samples are located in Table B-18.

Fourteen of the 17 dioxin/furan compounds analyzed for in the East Creek sediment samples were detected; the only congeners not detected were 2,3,7,8-TCDD; 1,2,3,7,8,9-HxCDF; and 1,2,3,4,7,8,9-HpCDF. Dioxin/furan analytical results for these sediment samples are located in Table B-5.

3.0 MIGRATION/EXPOSURE PATHWAYS

The following subsections describe the migration/exposure pathways and potential targets within the dump's range of influence (Figures A-3 and A-4, located in Appendix A).

3.1 Groundwater Migration Pathway

The target distance limit (TDL) for the groundwater migration pathway is a four-mile radius that extends from the sources at the site. Figure A-3 depicts the groundwater 4-mile TDL.

3.1.1 Geologic Setting

WBD is located on top of siltstone of the Hoko River Formation, a geological rock formation composed primarily of siltstone and pebble-cobble conglomerates, with thin, fine to medium grained sandstone beds. It is estimated that this formation potentially extends to at least 2,000 feet below the dump (Ridolfi 2003; B&C 1999).

Soils at WBD are primarily sandy silts with a high percentage of organics from the adjacent forests. These soils overlay a hard gray siltstone. Silty soils developed on the Hoko Formation are often found as slope-wash over cliff and cut faces, and are generally less than four to five feet thick. There are small areas along the upper portion of the dump where the conglomerate has weathered to sandy gravel; however, in most areas where the conglomerate is present, the surface is cemented, and there is no soil layer. The siltstone is exposed in areas along the access road (Ridolfi 2003; B&C 1999).

3.1.2 Aquifer Setting

Groundwater on the Makah Reservation originates as precipitation falling on the uplands and lowlands. Due to low permeability of the impervious bedrock and soils, it is estimated that 80% of the precipitation runs into streams. The remaining 20% of precipitation is removed through evapotranspiration. As a result, the groundwater resources are limited in the Neah Bay area (Ridolfi 2003; B&C 1999).

During the 1995 Waste Delineation and Characterization investigation, water was encountered in only two of nine test pits excavated in the ravine (Ridolfi 2003; White Shield 1995). In addition, during the 2001 Hydrogeological Investigation, water was encountered in only one of four monitoring wells installed. The yield was not sufficient to qualify as an aquifer (Ridolfi 2003; Ridolfi 2001b). However, water levels in the monitoring wells have been measured during inclement weather events and water has been present in all four wells. It is assumed that due to increased precipitation, more water is flowing along the interface between the waste and underlying rock formation (Ridolfi 2003).

The dump is 2 to 3 miles from the Waatch River valley, which is the nearest area delineated by the U.S. Geological Survey (USGS) as potentially having an aquifer (Ridolfi 2006). Therefore, because an aquifer is not present, the groundwater migration pathway for site-related contaminants does not exist.

3.1.3 Drinking Water Targets

Two domestic wells are located within the 4-mile TDL (Figure A-3, located in Appendix A). One well is located 1 to 2 miles from the dump and the other well is located between 2 and 3 miles of the dump (Ecology 2010). The populations served by the domestic wells were estimated using the country average of persons (2.31 persons) residing per household for Clallam County, Washington (Fedstats 2010). Table B-20, located in Appendix B, provides a summary of the groundwater wells located within the 4-mile TDL and populations served. In addition, a total of seven production wells are located within the 4-mile TDL; one well within 1 to 2 miles of the dump and six wells within 2 to 3 miles of the dump. However, according to Noel Phillip Well Construction Coordinator for the Washington State Department of Ecology (Ecology), the production wells are owned by the Water Treatment Plant and do not provide potable water (TechLaw 2010b). Therefore, the production wells are not included in Table B-20.

The Waatch River is the source of domestic water for the town of Neah Bay (the only town on the Makah Reservation). Village Creek was originally the water source for the town and is available as a supplemental water supply if needed. Several industrial and residential water-supply wells have been drilled in and around Neah Bay. At least three public water-supply wells were drilled for the town by the U.S. Department of Health; however, these wells were abandoned due to inferior water quality and insufficient yield (Ridolfi 2006; B&C 1999).

3.2 Surface Water Migration Pathway

The surface water migration pathway TDL begins at the probable point of entry (PPE) of surface water runoff from the dump to the nearest perennial surface water body and extends downstream for 15 miles. Figure A-4, located in Appendix A, depicts the 15-mile surface water TDL.

Average precipitation in the Neah Bay area is just over 100 inches per year (WorldClimate 2010). The climate on the Olympic Peninsula is primarily influenced by wind direction, ocean surface temperatures, terrain, and intensity of high and low pressure centers over the North Pacific Ocean. These conditions produce a marine climate. Heaviest precipitation begins in the fall, reaching a peak in December and decreasing in the spring. Summers are relatively dry; however, weather at anytime of the year is extremely unpredictable in the Olympics. Winter temperatures range from 40 degrees Fahrenheit (°F) to 30°F. Snowfall is rare in the lower elevations. Summer temperatures range from 80 °F to 50°F (USFS 2010). The 2-year, 24-hour rainfall event for the area is 4 inches (NOAA 1973). The dump appears to lie outside the 100-year floodplain (FEMA 2010).

3.2.1 Overland Route

WBD is located at the top of a ridge causing surface water from the dump to drain to the east and west into unnamed creeks (East Creek and West Creek), resulting in two PPEs (see Figure A-4, located in Appendix A). Runoff originates on the south side of ridge, flows across the waste on the ridge's south hillside, and flows through the waste deposit in the ravine. From there, surface water flows to East and West Creek. The watershed generally drains to the north, into the Strait of Juan de Fuca and away from the known aquifers in the Waatch River valley and the Sooes River valley (Ridolfi 2006).

The west drainage flows southwest approximately 250 feet where it confluences with the West Creek, at PPE 1. The West Creek discharges to Warmhouse Beach, 1,000 feet from the dump,

and into the Strait of Juan de Fuca. The east drainage flows southeast approximately 325 feet into East Creek, at PPE 2. The East Creek flows into Kydikabbit Creek, which outfalls west of Kydikabbit Point approximately 500 feet northeast of the dump, and ultimately discharges into the Strait of Juan de Fuca (Ridolfi 2006). The 15-mile TDLs for both PPEs are completed in the Strait of Juan de Fuca, where the TDL is applied as an arc because the direction of flow is not considered for an ocean (EPA 1990).

3.2.2 Drinking Water Targets

There are no drinking water intakes along the 15-mile TDL.

3.2.3 Human Food Chain Targets

Warmhouse Beach is an important natural and cultural resource of the Makah Tribe. Warmhouse Beach was used as a traditional summer fishing camp for many generations; however, deterioration of kelp beds and shellfish habitats has hindered these activities (Ridolfi 2003). Drainage from the dump has potentially impacted downgradient and adjacent beach areas. In addition, a historical fishing village in the area that is of archaeological value may have been impacted by the waste disposal practices (Ridolfi 2006).

In November 2007, Ridolfi collected eight blue mussel and one chiton tissue samples from Warmhouse Beach during the Phase I Seafood Study. Samples contained concentrations of arsenic and cadmium that exceeded the EPA Region 3 risk-based concentrations (RBCs) for fish tissue. Seafood samples collected from the Strait Juan de Fuca also contained arsenic at concentrations exceeding the RBCs. A background or reference sample was collected from Strawberry Rock during the Phase I Seafood Study (Ridolfi 2007).

3.2.1.1 Sport Catch

Sport fishing is known to occur within the 15-mile TDL. The most current sport catch data is from the 2009 license year (WDFW 2010b & 2010c). Fish catch data is reported by catch areas. The TDL is located in catch areas 4a and 4b. Area 4a extends from Cape Alava north to the Bonilla-Tatoosh line and west in to the Pacific Ocean. Area 4b extends from the Bonilla-Tatoosh line east to the Sekiu River (WDFW 2008). START estimates that 100% of catch area 4b is within the TDL. The percentage of catch area 4a located in the TDL is unknown due to the fact that this area extends west into the Pacific Ocean infinitely. Boats seldom fish more than 40 miles offshore commercially, and are usually within 10-15 miles of shore recreationally (WDFW 2010c). Based on this information, and for the purpose of this Preliminary Assessment, 100% of catch area 4b is assumed to lie within the 15-mile TDL.

Finally, sport catch data is presented as the number of fish caught. To calculate the total pounds of fish caught for each statistical area, START multiplies the number of fish caught in each catch area by the average weight of each fish species. Sport catch harvest data by fish species is presented in Tables B-21 and B-22.

3.2.1.2 Commercial Harvest

Non-Tribal and tribal commercial groundfish harvest occurs within the 15-mile TDL. The catch numbers for tribal and non-tribal groundfish harvest are reported together. Unlike sport fishing, commercial fishing harvest is reported as pounds caught. (WDFW 2010b) The percentage of catch located in the TDL is unknown due to the fact that catch numbers are reported by port and not area. A port of landing does not always match up with area of catch because commercial

vessels can travel great distances from port (WDFW 2010b). The pounds of groundfish harvest caught per species are presented in Table B-23.

Commercial salmon fishing is known to occur within the 15-mile TDL. The most current commercial catch data is from the 2009 license year (WDFW 2010b). Fish catch data is reported by catch areas. Commercial salmon fishing is restricted to Area 4a. Area 4a extends from Cape Alava north to the Bonilla-Tatoosh line and west in to the Pacific Ocean (WDFW 2008). The percentage of catch area 4a located in the TDL is unknown due to the fact that this area extends west into the Pacific Ocean infinitely. Boats seldom fish more than 40 miles offshore commercially, and are usually within 10-15 miles of shore recreationally (WDFW 2010c). The pounds of commercial salmon caught per species are presented in Table B-24.

3.2.1.3 Tribal Harvest

Tribal harvest is documented to occur on Warmhouse Beach immediately downstream from the site. Members of the Makah Tribe have been known to harvest blue mussels, sea urchins, and goose neck barnacles (USEPA 2010b). The amount of organisms harvested annually is unknown. For the purposes of this PA, it is assumed that between 0 and 100 pounds of fish and shellfish are caught for human consumption by Tribal fishers along Warmhouse beach.

Tribal harvest is known to occur within the 15-mile TDL. The most current tribal catch data is from the 2009 harvest year (USEPA 2010a). Fish catch data is reported together for areas 4a and 4b.

Finally, tribal harvest data is reported as the number of fish caught, except for halibut which is reported as pounds caught. To calculate the total pounds of fish caught, START multiplies the number of fish caught in each catch area by the average weight of each fish species. Tribal harvest data by fish species is presented in Table B-25.

3.2.4 Environmental Targets

The Makah Reservation encompasses 42 square miles considered to be a temperate rain forest. The Flattery Rocks National Wildlife Refuge and Olympic Coast National Marine Sanctuary are located along the western shore of the Makah Reservation and are within the 15-mile TDL.

Flattery Rocks National Wildlife Refuge is a group of 870 islands, rocks, and reefs extending for more than 100 miles from Flattery Rocks south to Copalis Beach. These islands are closed to the public to protect seabird nesting sites; 150,000 pelagic birds nest annually on the islands, including Leach's storm petrel, fork-tailed storm petrel, Rhinoceros auklet, tufted puffin, common Murre, glaucous-winged gull, western gull, Brandt's cormorant, pelagic cormorant, Cassin's auklet, black oystercatcher, pigeon guillemot, and double-crested cormorant. Sea lions haul out on the islands and bald eagles and peregrine falcons roost in winter. The portion of Flattery Rocks National Wildlife Refuge that lies within the 15-mile TDL is also part of the Olympic Coast National Marine Sanctuary and the Washington Islands Wilderness (USFWS 2010a).

Olympic Coast National Marine Sanctuary spans 3,310 square miles of marine waters off the Olympic Peninsula coastline and extends 25 to 50 miles seaward, covering much of the

continental shelf and several major submarine canyons (NOAA 2010). The Olympic Coast National Marine Sanctuary lies within, and extends past, the 15-mile TDL.

There are several Federal and State threatened and endangered species habituating within the 15-mile TDL (E&E 2010). Federal-listed threatened species with sensitive habitats include the Marbled Murrelet (*Brachyramphus marmoratus marmoratus*), and Steller Sea Lion (*Eumetopias jubatus*). Warmhouse Beach is a prime habitat for Marbled Murrelet; however, murrelet nesting in the area is inhibited because crows and seagulls use the dump site (WDFW 2008). The State-listed endangered species with sensitive habitats include the Sea otter (*Enhydra lutris*). Habitats for these three species are located within the Strait of Juan de Fuca and Pacific Ocean.

Only marine wetlands are located along the 15-mile TDL and therefore are not evaluated as part of this PA (USFWS 2010b).

3.3 Soil Exposure Pathway

The soil exposure pathway is evaluated based on the threat to resident and nearby populations from soil contamination within the upper 2 feet of the surface (EPA 1990).

The dump is currently used by the Makah Tribe for MSW, construction materials, and animal carcasses (Ridolfi 2003; White Shield 1995; Ridolfi 2002b). The dump is surrounded mostly by forest and is accessible via an unpaved gravel road from the road leading to Koitlah Point. The dump occupies 7 acres, with the active dump estimated at 5.22 acres. The dump is in a remote area; access to the dump is unrestricted (Ridolfi 2003; Ridolfi 2001b). Warmhouse Beach can be accessed by a steep trail that begins at the northwest corner of the dump (Ridolfi 2006). The beach is used for camping, surfing, and other recreational activities (Ridolfi, 2006).

There are no residences, schools, or daycare facilities located on the dump or within 1 mile of the dump. The closest population is 1 to 2 miles from the dump (MCDC 2010). Table B-26, located in Appendix B, provides a breakdown of the nearby population located within 1-mile of WBD.

The source is the dump. It was estimated in 2003, that 55,000 to 65,000 cubic yards of waste are present at WBD (Ridolfi 2003; White Shield 1995; Ridolfi 2002b). The dump occupies approximately 5.22 acres of mixed waste that varies in depth from the surface to over 22 feet bgs (Ridolfi 2003; Ridolfi 2008; White Shield 1995).

Four surface soil samples were collected randomly from various locations on the waste pile (see Figure A-2, located in Appendix A). All four samples contain elevated concentrations of at least one contaminant (see Tables in Appendix B) (TechLaw 2010a).

3.4 Air Migration Pathway

The air migration pathway is evaluated based on the threat to on-site and nearby populations within a 4-mile radius TDL from releases to air. No air samples have been collected on the property and there have been no reports of releases to air from the property. However, a landfill (or dump) can be a source of air contamination, specifically from methane and other contaminants present in the landfill.

3.4.1 Human Targets

There are 1,078 residents within the 4-mile TDL. The population from 1- to 2-miles is 34 persons; from 2- to 3-miles is 806 persons, and from 3- to 4-miles is 328 persons (MCDC 2010). Table B-26, located in Appendix B, provides a breakdown of the nearby population. The nearest schools are located approximately 2-3 miles from WBD in Neah Bay (MapQuest 2010).

3.4.2 Environmental Targets

There are a total of 158 acres of wetlands along the 4-mile TDL (USFWS 2010b). Table B-27 breaks down the wetlands by radial distance to WBD.

Within the 4-mile TDL, Federal-listed Threatened Species include the Marbled Murrelet within 2 to 4 miles and the Stellar sea lion within 3 to 4 miles (E&E 2010).

Nearby sensitive environments include the Olympic Coast National Marine Sanctuary.

4.0 SUMMARY AND CONCLUSIONS

WBD is located 2 to 3 miles northwest of Neah Bay in Clallam County, Washington and is situated on the edge of a small valley overlooking the Strait of Juan de Fuca. The dump is accessible off an unpaved gravel road from the road leading to Koitlah Point. The oval-shaped dump occupies 7 acres at the top of a ridge or “saddle,” between the drainage between two unnamed creeks.

The USAF and the Navy began using WBD in the 1940s. The Makah Air Force Station operated on the Makah Reservation from World War II until 1988. The dump was used to dispose of household and hazardous wastes. A DoD Site Assessment Report stated “hazardous waste is known to have been disposed of by DoD in the landfill.” Batteries, used motor oil, hypodermic needles, tires, appliances, roofing and construction materials, car bodies, household waste, and glass were disposed of at the dump.

Majority of waste is located in a deep ravine. Waste was initially dumped in a deep ravine that runs east and west along the south edge of the dump. As the ravine filled with waste material, a road embankment was constructed on top of the waste and across the ravine. Since then, waste materials have been dumped from the top of the ridge down toward the ravine to the south. A layer of waste covers the steep hillside that faces south toward the ravine. Waste has also been dumped from the top of the ridge down toward the north and northeast.

The dump is currently used by the Makah Tribe for MSW, construction materials (including roofing), and animal carcasses. Lubricants and other petroleum-based products have been observed. WBD serves approximately 1,500 people in 492 residences. As of 2003, it was estimated that WBD contained 55,000 to 65,000 cubic yards of waste. Debris, including drums and tires, are scattered along the access road and in the ravine west of the access road.

Potential sources include the WBD (i.e., landfill). As of 2008, WBD was estimated at 5.22 acres of waste material, extending from the surface to 22 feet bgs. It is unknown if any liners or containment features are in place at the dump.

In January 2010, EPA and START-3 completed a Removal Assessment at WBD. Five surface water and sediment samples were collected along West Creek, four sediment and surface water samples were collected from East Creek, and four surface soil samples were collected randomly from various locations on the dump (waste pile).

Two organic constituents were detected in surface water samples and four organic constituents were detected in sediment samples collected from West Creek. Several TAL metals were detected at elevated concentrations in the filtered and unfiltered surface water samples, including, but not limited to, arsenic, barium, copper, manganese, nickel, selenium, and zinc. Chromium, lead, and vanadium were all detected at elevated concentrations in unfiltered surface water samples collected from West Creek. Eleven TAL metals were detected at elevated

concentrations in sediment samples. Several PBDEs were detected at elevated concentrations in sediment samples collected from West Creek.

One organic constituent was detected at an elevated concentration in surface water samples collected from East Creek. Two VOCs, 2-butanone and acetate, and one SVOC, anthracene, were detected in at least one sediment sample at elevated concentrations. Six TAL metals were detected at elevated concentrations in the filtered and unfiltered surface water samples. Cadmium and lead were detected at elevated concentrations in unfiltered surface water samples. Zinc was the only TAL metal detected at an elevated concentration in sediment samples. Two PBDEs were detected at elevated concentrations in sediment samples collected from East Creek.

No VOCs were detected at elevated concentrations or exceed the action levels in soil samples collected from the waste pile. Seventeen SVOCs were detected at elevated concentrations. In addition, alpha-chlordane, gamma-chlordane and heptachlor were detected at elevated concentrations in one soil sample. Several TAL metals were detected at elevated concentrations in soil samples. Seven PBDEs were detected at elevated concentrations in samples collected from the waste pile.

Two domestic wells are located within the 4-mile TDL. In addition, a total of seven production wells are located within the 4-mile TDL; one well within 1 to 2 miles of the dump and six wells within 2 to 3 miles of the dump. However, the production wells are owned by the Water Treatment Plant and do not provide potable water. The Waatch River is the source of domestic water for the town of Neah Bay. At least three public water-supply wells were drilled for the town by the U.S. Department of Health, but these wells were abandoned due to inferior water quality and insufficient yield. The dump is 2 to 3 miles from the Waatch River valley, which is the nearest area delineated by USGS as potentially having an aquifer. Because an aquifer is not present, the groundwater migration pathway for site-related contaminants does not exist.

Surface water from The dump drains to the east and west into unnamed creeks (East Creek and West Creek), resulting in two PPEs. Runoff originates on the south side of ridge, flows across the waste on the ridge's south hillside, and flows through the waste deposit in the ravine. The west drainage flows southwest approximately 250 feet where it confluences with the West Creek, at PPE 1. The West Creek discharges to Warmhouse Beach, 1,000 feet from the dump, and into the Strait of Juan de Fuca. The east drainage flows southeast approximately 325 feet into East Creek, at PPE 2. The East Creek flows into Kydikabbit Creek, which outfalls west of Kydikabbit Point approximately 500 feet northeast of the dump, and ultimately discharges into the Strait of Juan de Fuca. The 15-mile TDLs for both PPEs are completed in the Strait of Juan de Fuca, where the TDL is applied as an arc because the direction of flow is not considered for an ocean.

There are no drinking water intakes along the 15-mile TDL. Sport and recreational fishing occurs on the Strait Juan de Fuca. Strait Juan de Fuca contains numbers species of fish, including Chinook salmon, Coho salmon, halibut, lingcod, and black rockfish. Commercial fishing occurs in the Strait Juan de Fuca. The Olympic Coast National Marine Sanctuary are located along the western shore of the Makah Reservation. The Olympic Coast National Marine Sanctuary lies within, and extends past, the 15-mile TDL.

There are several Federal and State threatened and endangered species assumed to be habituating within the 15-mile TDL. Federal-listed threatened species include the Marbled Murrelet and Steller Sea Lion. The State-listed endangered species include the Sea Otter.

In November 2007, eight blue mussel and one chiton tissue samples from Warmhouse Beach during the Phase I Seafood Study. Samples contained concentrations of arsenic and cadmium that exceeded the EPA Region 3 risk-based concentrations (RBCs) for fish tissue. Seafood samples collected from the Strait Juan de Fuca also contained arsenic at concentrations exceeding the RBCs.

The dump is in a remote area; access to the dump is unrestricted. Warmhouse Beach can be accessed by a steep trail that begins at the northwest corner of the dump. The beach is used for camping, surfing, and other recreational activities. The closest population is 1 to 2 miles from the dump.

No air samples have been collected on the property and there have been no reports of releases to air from the property. An unregulated landfill can be a source of air contamination, commonly from methane. There are 1,078 residents within the 4-mile TDL. The nearest schools are located approximately 2 to 3 miles from WBD in Neah Bay. There are a total of 158 acres of wetlands along the 4-mile TDL. Within the 4-mile TDL, Federal-listed Threatened Species include the Marbled Murrelet within 2 to 4 miles and the Stellar Sea Lion within 3 to 4 miles. Nearby sensitive environments include the Olympic Coast National Marine Sanctuary.

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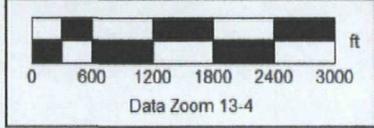
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APPENDIX A
FIGURES



Created By: JLS
 Date: 06/14/2010
 Source: Delorme Xmap 6



Legend

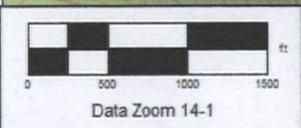
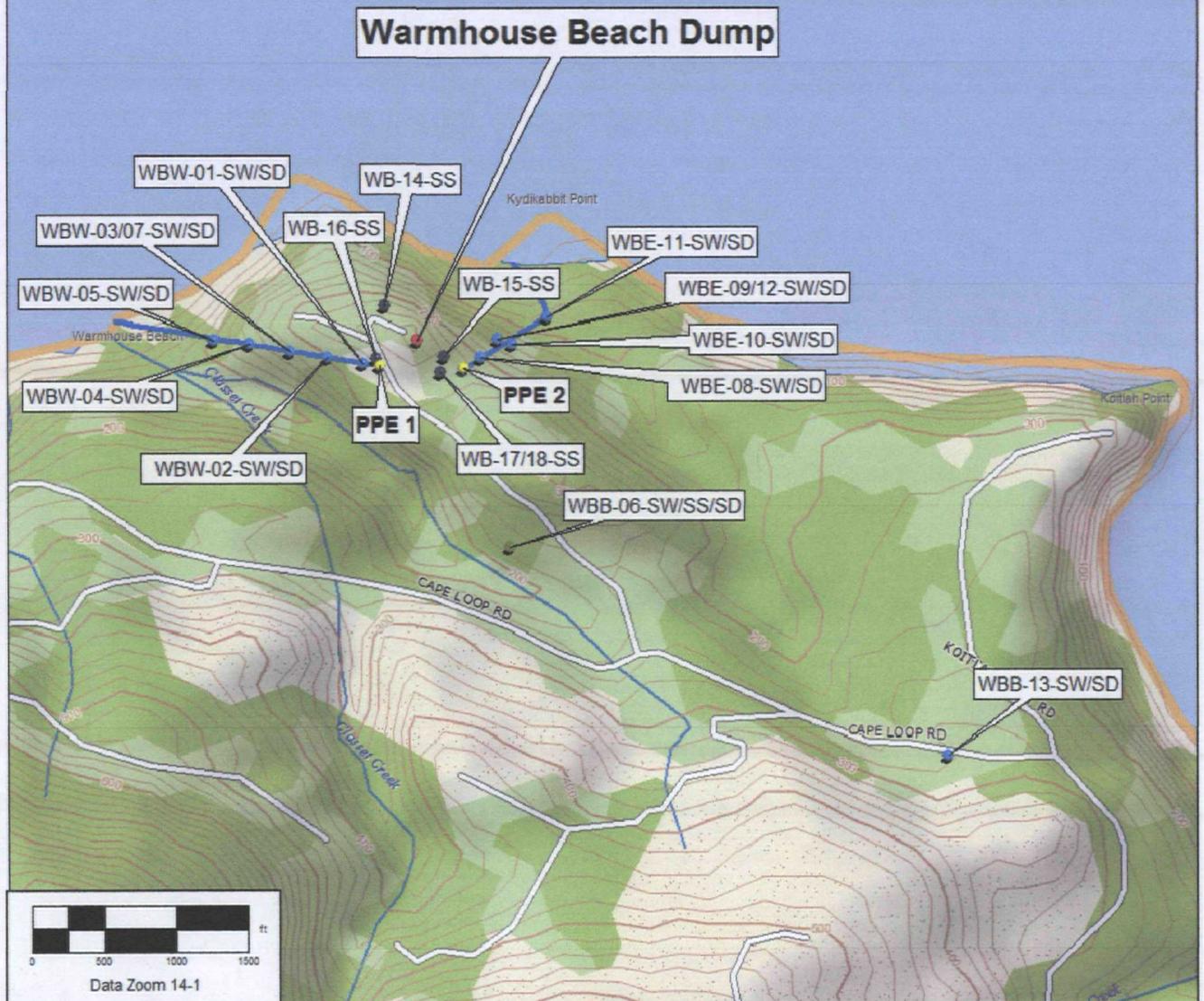
 Site Location



Neah Bay
 Clallam County, Washington

Figure A-1
General Site Location
Makah Reservation
Warmhouse Beach Dump

Neah Bay
 Clallam County, Washington



Created By: JLS
 Date: 06/14/2010
 Source: Delorme Xmap 6



Legend

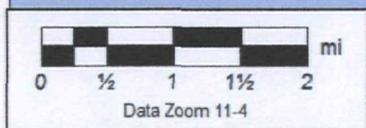
- Site Location
- PPE
- SW & SD Sample
- SS Sample
- SW, SS, & SD Sample



Neah Bay
 Clallam County, Washington

Figure A-2
Sample Locations
Makah Reservation
Warmhouse Beach Dump

Neah Bay
 Clallam County, Washington



Created By: JLS
 Date: 06/14/2010
 Source: Delorme Xmap 6



Legend

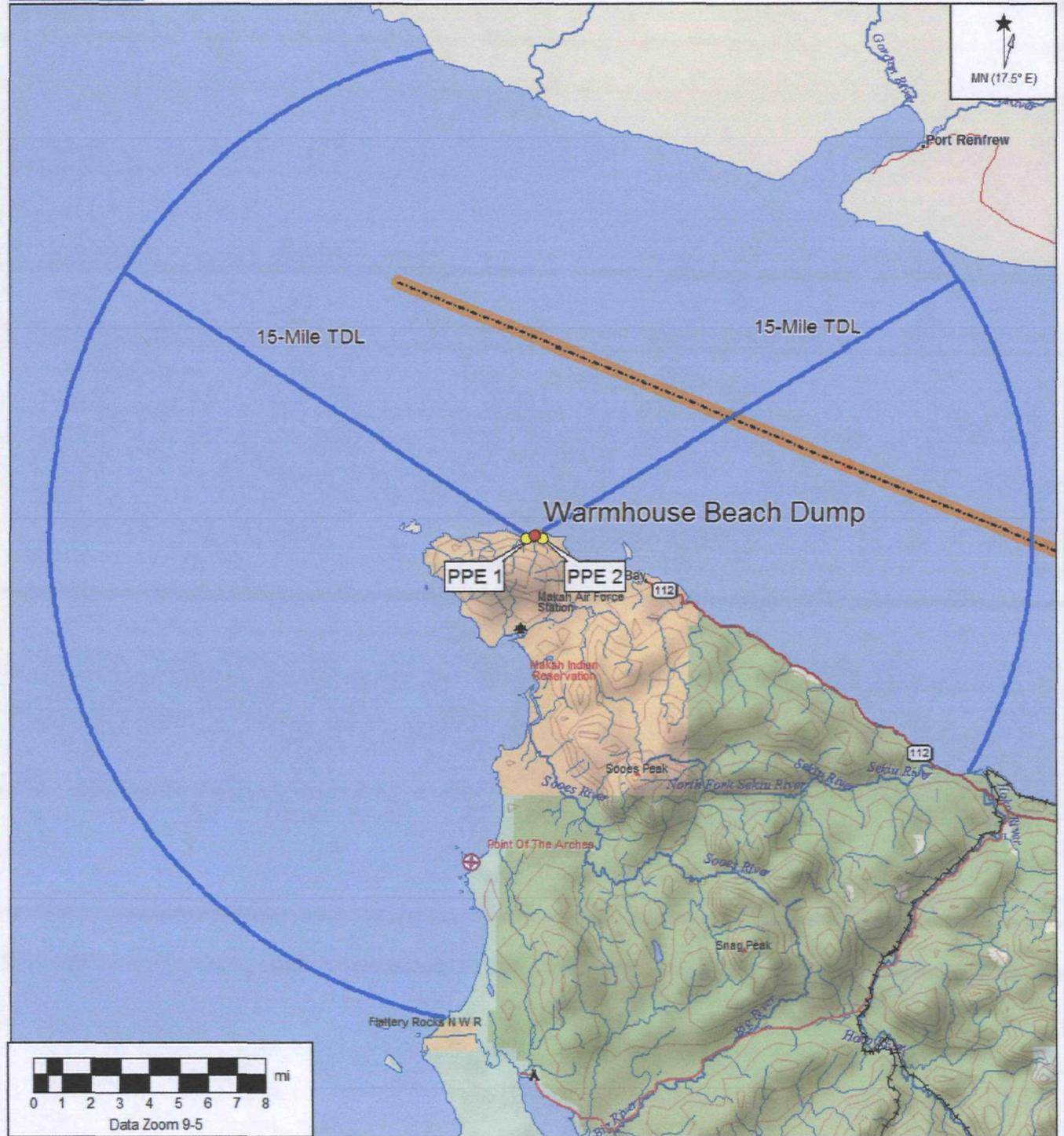
- Site Location



Neah Bay
 Clallam County, Washington

Figure A-3
4-Mile Radius Map
Makah Reservation
Warehouse Beach Dump

Neah Bay
Clallam County, Washington



Created By: JLS
 Date: 06/14/2010
 Source: Delorme Xmap 6



Legend

- Site Location
- PPE



Neah Bay
 Clallam County, Washington

Figure A-4
15-Mile TDL Map
Makah Reservation
Warmhouse Beach Dump

Neah Bay
 Clallam County, Washington

APPENDIX B
TABLES

Table B-1
Organic Analytical Results Summary - Surface Soil Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC658	JC651	JC652	JC653	JC655	JC656
Location ID	WBB-06-SS	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WB-18-SS
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	Waste Pile				
<i>Volatile Organic Compounds (µg/kg)</i>						
1,1-Dichloroethene	2.7 JQ	0.76 JQ	1.1 JQ	1.2 JQ	6.8 U	9.6 U
1,4-Dioxane	420 R	110 R	160 R	140 R	140 R	190 R
2-Butanone	27 JQ	11 U	24	14 U	25	27
Benzene	21 U	5.3 U	4 JQ	6.9 U	6.8 U	9.6 U
Cyclohexane	21 U	5.3 U	7.8 U	6.9 U	6.2 JQ	9.6 U
Ethylbenzene	21 U	5.3 U	0.85 JQ	6.9 U	0.84 JQ	0.98 JQ
m,p-Xylene	21 U	5.3 U	0.99 JQ	6.9 U	2.2 JQ	2.9 JQ
Methylcyclohexane	21 U	5.3 U	7.8 U	6.9 U	11	9.6 U
o-Xylene	21 U	5.3 U	7.8 U	6.9 U	1.1 JQ	1.4 JQ
Styrene	21 U	5.3 U	7.8 U	0.82 JQ	6.8 U	9.6 U
Toluene	21 U	5.3 U	5.1 JQ	6.9 U	2.3 JQ	3.3 JQ
<i>Semivolatile Organic Compounds (µg/kg)</i>						
2-Methylnaphthalene	9.1 U	3.9 U	3.8 JQ	4.3 U	<u>14</u>	8.2
4-Methylphenol	470 U	200 U	260 U	440 U	120 JQ	76 JQ
Acenaphthene	9.1 U	1.2 U	5.2	4.3 U	<u>14</u>	<u>12</u>
Acenaphthylene	9.1 U	3.9 U	5 U	4.3 U	4.6 U	2.6 JQ
Acetophenone	470 U	3.3 JQ	47 JQ	99 JQ	480 U	230 U
Anthracene	9.1 U	3.3 JQ	2.8 JQ	2.5 JQ	<u>21</u>	<u>17</u>
Benzo(a)anthracene	9.1 U	<u>28</u>	5.8	5.9	<u>58</u>	<u>55</u>
Benzo(a)Pyrene	9.1 U	<u>27</u>	<u>33</u>	<u>11</u>	<u>59</u>	<u>45</u>
Benzo(b)fluoranthene	9.1 U	<u>29</u>	<u>9.9</u>	<u>11</u>	<u>60</u>	<u>32</u>
Benzo(g,h,i)perylene	9.1 U	7.4	5 U	6.2	<u>18</u>	<u>16</u>

CLP Sample ID	JC658	JC651	JC652	JC653	JC655	JC656
Location ID	WBB-06-SS	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WB-18-SS
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	Waste Pile				
Benzo(k)fluoranthene	9.1 U	<u>11</u>	4.5 JQ	3.5 JQ	<u>22</u>	<u>20</u>
Bis(2-ethylhexyl)phthalate	470 U	63 JQ	260 U	110 JQ	<u>2,200</u>	410
Butylbenzylphthalate	470 U	200 U	260 U	440 U	130 JQ	61 JQ
Chrysene	9.1 U	<u>18</u>	<u>16</u>	<u>15</u>	<u>86</u>	<u>52</u>
Dibenzo(a,h)anthracene	9.1 U	4.5	5 U	4.3 U	4.6 U	4.4 U
Di-n-butylphthalate	470 U	200 U	58 JQ	440 U	480 U	230 U
Fluoranthene	9.1 U	<u>38</u>	<u>24</u>	<u>16</u>	<u>140</u>	<u>130</u>
Fluorene	9.1 U	3.9 JQ	5 U	4.3 U	<u>15</u>	<u>18</u>
Indeno(1,23-cd)pyrene	9.1 U	<u>15</u>	5 U	4.9	<u>24</u>	<u>22</u>
Naphthalene	9.1 U	2.8 JQ	7	4.3 U	<u>10</u>	8.2
Pentachlorophenol	18 U	7.8 U	10 U	4.4 JQ	15	13
Phenanthrene	9.1 U	9	<u>17</u>	4 JQ	<u>76</u>	<u>65</u>
Pyrene	9.1 U	<u>37</u>	<u>22</u>	<u>17</u>	<u>130</u>	<u>91</u>
<i>Pesticide and PCB (µg/kg)</i>						
4,4'-DDD	9.4 U	4.2 U	0.37 JQ	4.4 U	4.8 U	4.2 U
4,4'-DDT	9.4 U	4.2 JK	5.2 U	4.4 U	4.8 U	4.2 U
Aldrin	4.7 U	0.53 JQ	2.6 U	2.2 U	2.4 U	0.091 JQ
alpha-BHC	4.7 U	2 U	2.6 U	0.72 JQ	2.9	1.4 JQ
alpha-Chlordane	4.7 U	<u>35</u>	2.6 U	2.2 U	2.4 U	2.1 U
Aroclor - 1016	92 U	38 U	17 JQ	42 U	12 JQ	42 U
Aroclor - 1254	92 U	38 U	49 U	12 JQ	28 JQ	41 JQ
delta-BHC	0.29 JQ	2 U	2.6 U	2.2 U	2.4 U	2.1 U
Endosulfan I	4.7 U	2 U	2.4 JQ	2.2 U	0.45 JQ	0.25 JQ
Endosulfan II	9.4 U	4.2 U	0.43 JQ	4.4 U	0.76 JQ	4.2 U
Endosulfan sulfate	9.4 U	0.16 JQ	5.2 U	4.4 U	4.8 U	0.061 JQ
Endrin	9.1 U	2.1 JQ	5.2 U	4.4 U	0.42 JQ	4.2 U
Endrin ketone	0.076 JQ	0.037 JQ	5.2 U	4.4 U	4.8 U	4.2 U
gamma-Chlordane	4.7 U	<u>39</u>	1.8 JQ	2.2 U	2.4 U	2.1 U
Heptachlor	4.7 U	<u>9.8</u>	2.6 U	2.2 U	2.4 U	2.1 U

CLP Sample ID	JC658	JC651	JC652	JC653	JC655	JC656
Location ID	WBB-06-SS	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WB-18-SS
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	Waste Pile				
Total Petroleum Hydrocarbons (mg/kg)						
Unleaded Gasoline Composite	10 U	4.7 U	6.4 U	6.6 U	9.2	7.4
TPH-GC/Diesel Range Organics	9 U	73	3.8 U	24 U	26 U	19 U
TPH-GC/Motor Oil Range	18 U	48	270	520	1,300	490

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

K = Unknown bias

Location ID = START-3 sample identification number

mg/kg = Milligrams per kilogram

Q= Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.

R = Sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

SS = Surface soil

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/kg = Micrograms per kilogram

WB= Warmhouse Beach Open Dump

WBB = Warmhouse Beach Background

Table B-2
Organic Analytical Results Summary - Surface Soil SPLP Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC6A1/6	JC6A2/7	JC6A3/8	JC6A4/BO
Location ID	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS
Sample Date	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Waste Pile			
Volatile Organic Compounds (µg/L)				
2-Butanone	5 U	5 U	5 U	2.5 JQ
Benzene	0.5 U	0.31 JQ	0.5 U	0.17 JQ
Ethylbenzene	0.11 JQ	0.5 U	0.5 U	0.14 JQ
m,p-Xylene	0.33 JQ	0.5 U	0.5 U	0.4 JQ
o-Xylene	0.37 JQ	0.5 U	0.5 U	0.21 JQ
Toluene	0.079 JQ	0.065 JQ	0.5 U	0.44 JQ
Trichlorofluoromethane	0.5 U	0.5 U	0.5 U	0.11 JQ
Semivolatile Organic Compounds (µg/L)				
Benzaldehyde	5 UJK	5 UJK	5 UJK	5 UJK
Bis(2-ethylhexyl)phthalate	1.1 JQ	2.1 JQ	0.81 JQ	0.59 JQ
Fluorene	0.1 U	0.1 UJK	0.1 U	0.13

Key:

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

K = Unknown bias

Location ID = START-3 sample identification number

Q = Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.

SPLP = Synthetic Precipitation Leaching Procedure

SS = Surface soil

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WB = Warmhouse Beach Open Dump

Table B-3
Inorganic Analytical Results Summary - Surface Soil Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC658	MJC651	MJC652	MJC653	MJC655	MJC656
Location ID	WBB-06-SS	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WB-18-SS
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	Waste Pile				
<i>Inorganic Compounds (mg/kg)</i>						
Antimony	15.1 UJ	6.8 UJ	<u>33.7 J</u>	1.2 J	0.99 J	1 J
Arsenic	8	9.6	6.9	7.2	8.3	6.1
Barium	30.9 J	81.1	<u>178</u>	70.1	<u>112</u>	81.4
Beryllium	0.42 J	0.4 J	0.22 U	0.42 J	0.34 U	0.27 U
Cadmium	1.3 U	0.26 J	<u>10.8</u>	0.54 J	0.75	0.62
Chromium	31.9 J	36.4 J	35 J	44.5 J	35.7 J	27.5 J
Cobalt	6.1 J	13.1	10.8	15.3	13.4	10.4
Copper	30.2	69.7	<u>520</u>	83	<u>182</u>	<u>140</u>
Lead	10.6 J	23.5 J	<u>127 J</u>	<u>58.9 J</u>	<u>137 J</u>	<u>104 J</u>
Manganese	274 J	<u>954 J</u>	540 J	575 J	481 J	346 J
Mercury	0.26	0.12 U	0.095 J	0.27	0.15	0.12 J
Nickel	14.1	35.8	40.7	31	32.7	24
Silver	0.27 J	0.17 J	<u>2</u>	0.074 J	0.11 J	0.12 J
Thallium	3.4 J	4.5	3.3	4.5	4.3	3.1
Vanadium	78.3 J	73 J	35.5 J	83.8 J	74.2 J	52.3 J
Zinc	39.2 J	80.7 J	<u>923 J</u>	<u>165 J</u>	<u>375 J</u>	<u>262 J</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SS = Surface soil

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

mg/kg = Milligrams per kilogram

WB= Warmhouse Beach Open Dump

WBB = Warmhouse Beach Background

Table B-4
Inorganic Analytical Results Summary - Surface Soil SPLP Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC651	MJC652	MJC653	MJC655
Location ID	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS
Sample Date	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Waste Pile			
<i>Inorganic Compounds (µg/L)</i>				
Antimony	1.2	20.3	2.7	10.2
Arsenic	0.63 U	0.63 U	0.63 U	0.9
Barium	17 J	29 J	20 J	38 J
Chromium	1.3 U	1.3 U	1.4	1.3 U
Copper	2.7	15.3	8.44	4.7
Lead	1.3	1.7	3.5	3.7
Nickel	1.2	1.7	1.2	1.8
Zinc	22 J	22 J	33 J	23 J

Key:

CLP Sample ID = Contract Laboratory Program sample identification

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SPLP = Synthetic Precipitation Leaching Procedure

SS = Surface soil

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WB= Warmhouse Beach Open Dump

Table B-5
Dioxin Analytical Results Summary - Surface Soil and Sediment Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC651	JC652	JC653	JC655	MJC667	MJC668	MJC660	MJC662
Location ID	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WBW-01-SD	WBW-02-SD	WBE-08-SD	WBE-09-SD
Sample Date	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/26/2010	1/26/2010	1/27/2010	1/27/2010
Location	Waste Pile				West Creek		East Creek	
<i>Dioxin / Furan (ng/kg)</i>								
2378-TCDD	0.345 JQ	150	0.318 U	2.56	2.24	4.04	0.249 U	0.404 U
2378-TCDF	1.79	386 JL	1.6	19	8.32	20.1	1.95	2.18
12378-PeCDF	1.6 JQ	574 U	1.11 JQ	16.9	5.61	11.5	1.08 U	0.752 JQ
12378-PeCDD	1.1 JQ	763	1.33 JQ	12.3	4.3 JQ	8.1	0.556 JQ	0.850 U
23478-PeCDF	2.51 JQ	1,180	1.37	29.9	7.29	16.8	1.03 JQ	1.19 JQ
123478-HxCDF	1.92 JQ	1050 U	2.20 JQ	32.8	4.3 JQ	11.6	0.767 JQ	0.61 JQ
123678-HxCDF	2.29 JQ	790	2.34 JQ	30.3	7.38	11.2	0.553 JQ	0.467 JQ
123478-HxCDD	0.8 JQ	963	1.18 JQ	9.07	2.75 JQ	4.89	0.358 JQ	0.268 JQ
123678-HxCDD	2.18 JQ	2,160 JL	4.6	30.5	8.62	16	0.597 JQ	0.58 JQ
123789-HxCDD	1.45 JQ	1,530	2.45 JQ	16.5	5.28	9.53	0.403 JQ	0.481 JQ
234678-HxCDF	3.01 JQ	1,450	3.36 JQ	35.4	5.7	11.1	0.784 JQ	0.599 JQ
123789-HxCDF	0.733 JQ	191	0.84	8.41	1.56 U	2.75 U	0.211 U	0.137 U
1234678-HpCDF	11.9	4,990 JL	21.3	183	24	41.5	2.13 JQ	2.06 JQ
1234678-HpCDD	31.7	10,700 JL	82.7	702	183	296	6.05	5.28
1234789-HpCDF	0.98 U	167	7.89	18.6 U	2.00 U	3.47 JQ	0.306 U	0.279 U
OCDD	230	17,100 JL	800	7,480 JH	1,900	2,990	43.9	33.6
OCDF	15.4	1,100	54.4	340 JH	31.8	48	2.64 JQ	2.35 JQ

Key:

- CLP Sample ID = Contract Laboratory Program sample
- ID = Identification
- H = High bias
- J = The analyte was positively identified. The associated numerical result is an estimate.
- L = Low bias
- Location ID = START-3 sample identification number
- ng/kg = Nanograms per kilogram
- Q = Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.
- SS = Surface soil
- U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
- WB = Warmhouse Beach Open Dump

Table B-6
Organic Analytical Results Summary - Surface Soil PBDE Samples
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC658	MJC651	MJC652	MJC653	MJC655	MJC656
Location ID	WBB-06-SS	WB-14-SS	WB-15-SS	WB-16-SS	WB-17-SS	WB-18-SS
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	Waste Pile				
PBDE (µg/kg)						
BDE# 28	1.4 U	1 U	0.36 J	0.27 J	0.64 J	0.73 J
BDE# 47	1.4 U	<u>3.5</u>	<u>20</u>	<u>14</u>	<u>29</u>	<u>35</u>
BDE# 99	1.4 U	<u>6.4</u>	<u>37</u>	<u>37</u>	<u>58</u>	<u>66</u>
BDE#100	1.4 U	<u>1.4</u>	<u>7.8</u>	<u>7.2</u>	<u>11</u>	<u>13</u>
BDE#153	1.4 U	0.95 J	<u>5.1</u>	<u>4.7</u>	<u>6.8</u>	<u>7.4</u>
BDE#154	1.4 U	0.85 J	<u>4.5</u>	<u>4</u>	<u>5.6</u>	<u>6</u>
BDE#183	1.4 U	1 U	<u>2.3</u>	0.6 J	1.1	1.1
BDE#209	14 U	6.4 J	12 J	<u>18 J</u>	<u>17 J</u>	<u>24 J</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

PBDE = polybrominated diphenyl ethers

SS = Surface soil

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/kg = Micrograms per kilogram

WB= Warmhouse Beach Open Dump

WBB = Warmhouse Beach Background

Table B-7
Organic Analytical Results Summary - Surface Water Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC621	JC628	JC629	JC630	JC631	JC632	JC633
Location ID	WBB-06-SW	WBW-01-SW	WBW-02-SW	WBW-03-SW	WBW-04-SW	WBW-05-SW	WBW-07-SW
Sample Date	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
Location	Background	West Creek					
<i>Volatile Organic Compounds (µg/L)</i>							
1,2-Dichloroethane	0.5 U	<u>1.1</u>	0.19 JQ	0.5 U	0.5 U	0.5 U	0.083 JQ
<i>Semivolatile Organic Compounds (µg/L)</i>							
3,3'-Dichlorobenzidine	5 UJK	5 UJK	5 UJK	5 UJK	5 UJK	5 R	5 UJK
4-Chloroaniline	5 UJK	5 UJK	5 UJK	5 UJK	5 UJK	5 R	5 UJK
Hexachlorocyclopentadiene	5 UJK	5 UJK	5 UJK	5 UJK	5 UJK	5 R	5 UJK
Perchlorate	0.1 U	<u>52.9</u>	<u>44.1</u>	<u>42.1</u>	<u>26.6</u>	<u>24.7</u>	<u>41</u>
<i>Pesticide and PCB (µg/L)</i>							
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.0053 JQ

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

K = Unknown bias

Location ID = START-3

Q = Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.

R = Sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-8
Inorganic Analytical Results Summary - Surface Water Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC621	MJC628	MJC629	MJC630	MJC631	MJC632	MJC633
Location ID	WBB-06-SW	WBW-01-SW	WBW-02-SW	WBW-03-SW	WBW-04-SW	WBW-05-SW	WBW-07-SW
Sample Date	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
Location	Background	West Creek					
<i>Inorganic Compounds (µg/L)</i>							
Arsenic	1 U	<u>1.5</u>	<u>1.3</u>	<u>1.4</u>	<u>1.1</u>	<u>1.1</u>	<u>1.4</u>
Barium	2.1 J	<u>51.7</u>	<u>49.7</u>	<u>55.1</u>	<u>68.9</u>	<u>67.6</u>	<u>56.3</u>
Cadmium	1 U	0.088 J	1 U	0.069 J	1 U	1 U	0.084 J
Chromium	0.22 U	<u>0.62 J</u>	<u>1 J</u>	<u>0.91 J</u>	0.39 U	<u>1.2 J</u>	<u>0.85 J</u>
Cobalt	1 U	0.63 J	0.38 J	0.87 J	0.33 J	0.8 J	0.83 J
Copper	0.23 J	<u>2.6</u>	<u>1.5 J</u>	<u>2.2</u>	<u>1 J</u>	<u>2 J</u>	<u>1.9 J</u>
Lead	1 U	<u>1.2</u>	0.31 J	0.69 J	1 U	0.57 J	0.62 J
Manganese	2.4 J	<u>178 J</u>	<u>34.6 J</u>	<u>98.6 J</u>	<u>19.8 J</u>	<u>62.9 J</u>	<u>89.4 J</u>
Nickel	0.18 J	<u>4.8</u>	<u>4.4</u>	<u>4.4</u>	<u>4.9</u>	<u>5.2</u>	<u>4.6</u>
Selenium	5 U	<u>5.4</u>	<u>5.2</u>	4.7 J	4.3 J	4.1 J	<u>5.2</u>
Vanadium	0.28 J	<u>0.89 J</u>	0.34 J	<u>1.6 J</u>	0.5 J	<u>1.9 J</u>	<u>1.5 J</u>
Zinc	2 UJ	<u>50.8 J</u>	<u>28.2 J</u>	<u>31.1 J</u>	<u>14.1 J</u>	<u>22.8 J</u>	<u>30.4 J</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-9
Inorganic Analytical Results Summary - Filtered Surface Water Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC638	MJC645	MJC646	MJC647	MJC648	MJC649	MJC650
Location ID	WBB-06-SW	WBW-01-SW	WBW-02-SW	WBW-03-SW	WBW-04-SW	WBW-05-SW	WBW-07-SW
Sample Date	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
Location	Background	West Creek					
<i>Inorganic Compounds (µg/L)</i>							
Arsenic	0.08 J	<u>1.3</u>	<u>1.2</u>	<u>1.1</u>	<u>1</u>	<u>0.98 J</u>	<u>1.2</u>
Barium	14.5	<u>47.7</u>	<u>50.2</u>	<u>50.9</u>	<u>64.7</u>	<u>63.7</u>	<u>50</u>
Cobalt	1 U	0.34 J	0.25 J	0.21 J	0.19 J	0.18 J	0.2 J
Copper	0.93 J	1.6 J	1.4 J	<u>3.4</u>	1.3 J	1.1 J	<u>4.8</u>
Manganese	2.6	<u>114</u>	<u>14.7</u>	2.1	2.4	1.2	2.2
Nickel	0.8 J	<u>4.3</u>	<u>4</u>	<u>3.3</u>	<u>4.4</u>	<u>3.5</u>	<u>3.4</u>
Selenium	0.41 U	<u>5.2</u>	<u>5</u>	<u>4.8 J</u>	<u>4.4 J</u>	<u>4.2 J</u>	<u>4.7 J</u>
Silver	1 R	1 R	1 R	1 R	1 R	1 R	1 R
Vanadium	0.32 J	5 U	0.1 J	0.081 J	0.14 J	0.2 J	0.1 J
Zinc	4	<u>35.4</u>	<u>21.4</u>	<u>14</u>	<u>12.6</u>	9.3	<u>16.2</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3

R = Sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-10
Organic Analytical Results Summary - Sediment Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC657	JC667	JC668	JC669	JC670	JC671	JC672
Location ID	WBB-06-SD	WBW-01-SD	WBW-02-SD	WBW-03-SD	WBW-04-SD	WBW-05-SD	WBW-07-SD
Sample Date	1/26/2010	1/26/2010	01/26/10	01/26/10	01/26/10	01/26/10	01/26/10
Location	Background	West Creek					
Volatile Organic Compounds (µg/kg)							
1,4-Dioxane	370 R	1,100 R	860 R	190 R	220 R	350 R	220 R
Isopropylbenzene	19 U	850	43 U	9.7 U	11 U	18 U	11 U
Styrene	19 U	8.4 JQ	43 U	9.7 U	11 U	18 U	11 U
Toluene	2.3 JQ	8.3 JQ	43 U	1.3 JQ	11 U	2.5 JQ	11 U
Semivolatile Organic Compounds (µg/kg)							
Benzo(a)pyrene	6.7 U	27	16 UJK	6	5.6 UJK	5.9 UJK	7.7 U
Perchlorate	2.1 U	5.6 U	5.2 U	13.6	5.61	2.6 U	13.9
Pesticide and PCB (µg/kg)							
4,4'-DDD	6.5 U	2 JQ	1.1 JQ	5.6 U	5.6 U	5.9 U	0.099 JQ
Aldrin	3.3 U	10 U	8.3 U	2.9 U	2.9 U	0.068 JQ	0.059 JQ
alpha-BHC	3.3 U	0.27 JQ	8.3 U	2.9 U	0.038 JQ	0.13 JQ	0.087 JQ
alpha-Chlordane	3.3 U	10 U	0.55 JQ	2.9 U	2.9 U	0.089 JQ	3.9 U
Aroclor - 1254	67 U	56 JQ	30 JQ	58 U	55 U	58 U	75 U
delta-BHC	3.3 U	0.4 JQ	8.3 U	2.9 U	2.9 U	3 U	3.9 U
Endosulfan I	3.3 U	0.62 JQ	8.3 U	2.9 U	2.9 U	3 U	3.9 U
Endosulfan II	6.5 U	20 U	1.1 JQ	5.6 U	5.6 U	0.14 JQ	7.5 U
Endosulfan sulfate	6.5 U	20 U	16.6 U	0.14 JQ	0.051 JQ	5.9 U	7.5 U
Endrin ketone	6.5 U	0.8 JQ	16.6 U	5.6 U	5.6 U	5.9 U	7.5 U
gamma-BHC(Lindane)	3.3 U	0.26 JQ	8.3 U	2.9 U	2.9 U	3 U	3.9 U
gamma-Chlordane	3.3 U	0.22 JQ	0.2 JQ	2.9 U	2.9 U	3 U	3.9 U
Heptachlor	3.3 U	10 U	8.3 U	2.9 U	0.072 JQ	3 U	0.1 JQ

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

K = Unknown bias

Location ID = START-3 sample identification number

Q = Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.

R = Sample results were rejected due to serious deficiencies in the ability to

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/kg = Micrograms per kilogram

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-11
Inorganic Analytical Results Summary - Sediment Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC657	MJC667	MJC668	MJC669	MJC670	MJC671	MJC672
Location ID	WBB-06-SD	WBW-01-SD	WBW-02-SD	WBW-03-SD	WBW-04-SD	WBW-05-SD	WBW-07-SD
Sample Date	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
Location	Background	West Creek					
<i>Inorganic Compounds (mg/kg)</i>							
Antimony	13 UJ	8.1 J	3.9 J	9.3 UJ	10.2 UJ	13.8 UJ	9.4 UJ
Arsenic	4.7	13.4	11.3	6.1	8.9	4.6	4.2
Barium	77.8	<u>701</u>	<u>316</u>	105	83.4	91.2	98
Beryllium	0.62 J	0.68 J	0.79 J	0.61 J	0.61 J	0.35 J	0.49 J
Cadmium	1.1 U	<u>6</u>	<u>2.7</u>	0.25 J	0.85 U	1.2 U	0.18 J
Chromium	46 J	32.6 J	34.1 J	60.9 J	64 J	30.1 J	60.4 J
Cobalt	8 J	<u>68.7</u>	<u>47.2</u>	16.5	17.6	10 J	16.4
Copper	36.7	<u>111</u>	78	36.2	62.4	35.6	53
Lead	8.1 J	<u>50.5 J</u>	<u>38 J</u>	8.2 J	9.2 J	8.2 J	8 J
Manganese	188 J	<u>26,500 J</u>	<u>10,000 J</u>	508 J	304 J	<u>752 J</u>	550 J
Mercury	0.13 J	<u>0.48 J</u>	0.5 U	0.1 J	0.17 U	0.14 J	0.16 U
Nickel	23.9	<u>129</u>	<u>88</u>	47.3	43.1	32.6	40.9
Selenium	1.5 J	19.8 U	17.6 U	5.4 U	5.9 U	1.1 J	5.5 U
Silver	0.34 J	<u>1.6 J</u>	0.74 J	1.6 U	0.14 J	0.17 J	1.6 U
Thallium	1.8 J	<u>6.3 J</u>	3.9 J	5.2	4.9	1.5 J	4.8
Vanadium	86.1 J	62.3 J	65.9 J	102 J	121 J	55.1 J	93.4 J
Zinc	62.6 J	<u>2,610 J</u>	<u>1,200 J</u>	153 J	80.3 J	160 J	141 J

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

mg/kg = Milligrams per kilogram

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-12
Organic Analytical Results Summary - Sediment PBDE Samples - West Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC657	MJC667	MJC668	MJC669	MJC670	MJC671	MJC672
Location ID	WBB-06-SD	WBW-01-SD	WBW-02-SD	WBW-03-SD	WBW-04-SD	WBW-05-SD	WBW-07-SD
Sample Date	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010	1/26/2010
Location	Background	West Creek					
PBDE (µg/kg)							
BDE# 28	1.1 U	<u>1.1</u> J	1 J	1.1 U	1.1 U	1.3 U	1.2 U
BDE# 47	1.1 U	<u>48</u>	<u>36</u>	0.19 J	1.1 U	<u>1.4</u>	0.31 J
BDE# 99	1.1 U	<u>160</u>	<u>100</u>	0.38 J	1.1 U	<u>2.3</u>	0.31 J
BDE#100	1.1 U	<u>33</u>	<u>22</u>	1.1 U	1.1 U	0.67 J	1.2 U
BDE#153	1.1 U	<u>18</u>	<u>12</u>	1.1 U	1.1 U	1.3 U	1.2 U
BDE#154	1.1 U	<u>16</u>	<u>11</u>	1.1 U	1.1 U	1.3 U	1.2 U
BDE#183	1.1 U	<u>2.6</u> J	<u>1.7</u> J	1.1 U	1.1 U	1.3 U	1.2 U
BDE#209	11 U	<u>18</u> J	<u>15</u> J	11 U	11 U	13 U	12 U

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

PBDE = polybrominated diphenyl ethers

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/kg = Micrograms per kilogram

WBB = Warmhouse Beach Background

WBW = Warmhouse Beach Open Dump - West Creek

Table B-13
Organic Analytical Results Summary - Surface Water Samples - East Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC622	JC623	JC624	JC625	JC626	JC627
Location ID	WBB-13-SW	WBE-08-SW	WBE-09-SW	WBE-10-SW	WBE-11-SW	WBE-12-SW
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	East Creek				
<i>Semivolatile Organic Compounds (µg/L)</i>						
Acenaphthene	0.1 U	0.1 U	0.1 U	0.1 U	0.084 JQ	0.1 U
Perchlorate	0.1 U	<u>2.93</u>	<u>2.06</u>	<u>1.96</u>	<u>1.92</u>	<u>2.04</u>
Pyrene	0.1 UJK	0.07 JQ	0.1 U	0.1 U	0.1 UJK	0.1 U

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte

K = Unknown bias

Location ID = START-3 sample identification number

Q= Detected concentration is below the method reporting limit/Contract required quantitation limit,

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBE= Warmhouse Beach Open Dump - East Creek

Table B-14
Inorganic Analytical Results Summary - Surface Water Samples - East Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC622	MJC623	MJC624	MJC625	MJC626	MJC627
Location ID	WBB-13-SW	WBE-08-SW	WBE-09-SW	WBE-10-SW	WBE-11-SW	WBE-12-SW
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	East Creek				
<i>Inorganic Compounds (µg/L)</i>						
Arsenic	0.28 J	<u>1.4</u>	<u>1.1</u>	<u>1</u>	<u>1</u>	<u>1.1</u>
Barium	14.8	<u>87</u>	<u>50.7</u>	<u>45.9</u>	<u>45.9</u>	<u>48</u>
Cadmium	1 U	<u>1.1</u>	0.13 J	0.11 J	0.081 J	0.14 J
Chromium	1.6 J	0.48 U	0.41 U	0.28 U	0.31 U	0.38 U
Cobalt	0.47 J	1.2	0.29 J	0.22 J	0.2 J	0.26 J
Copper	1.9 J	4.6	2.2	1.8 J	1.7 J	2.2
Lead	0.53 J	<u>2.5</u>	1.1	0.82 J	0.61 J	0.95 J
Manganese	29.3 J	<u>519 J</u>	29.1 J	20.7 J	15.4 J	25.9 J
Nickel	1.3	<u>14.6</u>	<u>4.1</u>	3.5	3.4	<u>3.9</u>
Selenium	0.4 U	<u>5.2</u>	<u>4.4 J</u>	<u>4 J</u>	<u>4.1 J</u>	<u>4.4 J</u>
Vanadium	2.9 J	1.3 J	0.92 J	0.68 J	0.59 J	0.78 J
Zinc	4.3 J	<u>282 J</u>	<u>71.7 J</u>	<u>63 J</u>	<u>55.7 J</u>	<u>68.8 J</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBE = Warmhouse Beach Open Dump - East Creek

Table B-15
Inorganic Analytical Results Summary - Filtered Surface Water Samples - East Creek
Makah Reservation Warmhouse Beach Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC639	MJC640	MJC641	MJC642	MJC643	MJC644
Location ID	WBB-13-SW	WBE-08-SW	WBE-09-SW	WBE-10-SW	WBE-11-SW	WBE-12-SW
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	East Creek				
<i>Inorganic Compounds (µg/L)</i>						
Arsenic	0.12 J	<u>1.4</u>	<u>1.1</u>	<u>1</u>	<u>1.1</u>	<u>0.99 J</u>
Barium	9.5 J	<u>64.2</u>	<u>49.6</u>	<u>46.2</u>	<u>44.7</u>	<u>46.2</u>
Cadmium	1 U	0.18 J	0.097 J	0.083 J	0.074 J	0.084 J
Cobalt	1 U	0.18 J	0.11 J	0.12 J	0.097 J	0.11 J
Copper	3.4	1.9 J	1.4 J	1.4 J	1.3 J	1.3 J
Manganese	5.8	<u>21.6</u>	3.9	1.5	1.1	3.6
Nickel	0.51 J	<u>4.8</u>	<u>3.3</u>	<u>3.1</u>	<u>2.9</u>	<u>3.1</u>
Selenium	0.31 U	<u>5.8</u>	<u>4.4 J</u>	<u>4.1 J</u>	<u>4.3 J</u>	<u>4 J</u>
Silver	1 R	1 R	1 R	1 R	1 R	1 R
Vanadium	0.59 J	0.14 J	0.22 J	0.22 J	0.21 J	0.19 J
Zinc	3.7	<u>90.3</u>	<u>58</u>	<u>47.9</u>	<u>43.5</u>	<u>53</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

R = Sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

SW = Surface Water

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/L = Micrograms per liter

WBB = Warmhouse Beach Background

WBE = Warmhouse Beach Open Dump - East Creek

Table B-16
Organic Analytical Results Summary - Sediment Samples- East Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	JC659	JC660	JC662	JC663	JC665	JC666
Location ID	WBB-13-SD	WBE-08-SD	WBE-09-SD	WBE-10-SD	WBE-11-SD	WBE-12-SD
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	01/27/10
Location	Background	East Creek				
Volatile Organic Compounds (µg/kg)						
1,1-Dichloroethene	2.9 JQ	1 JQ	6.8 U	1 JQ	12 U	15 U
1,4-Dioxane	390 R	200 R	140 R	160 R	240 R	310 R
2-Butanone	39 U	33	14 U	21	37	<u>60</u>
Acetone	170 U	<u>340</u>	37 U	59 U	<u>220</u>	130 U
Isopropylbenzene	2.7 JQ	9.8 U	6.8 U	7.9 U	12 U	15 U
Toluene	20 U	1.1 JQ	0.89 JQ	0.91 JQ	1.3 JQ	1.8 JQ
Semivolatile Organic Compounds (µg/kg)						
Acenaphthylene	9.6 U	6.1 U	5 U	3.9 U	6.3 JK	5.4 UJK
Anthracene	9.6 U	6.1 U	5 U	3.9 U	<u>18</u> JK	5.4 UJK
Benzo(a)Pyrene	9.6 U	6.1 U	6.5	3.9 U	6.1 U	5.4 U
Fluorene	9.6 U	6.1 U	5 U	3.9 U	7.5 JK	5.4 UJK
Pesticide and PCB (µg/kg)						
4,4'-DDD	9.6 U	0.07 JQ	4.9 U	3.8 U	6.2 U	0.048 JQ
Aldrin	5 U	3.1 U	0.051 JQ	0.05 JQ	3.1 U	0.053 JQ
alpha-BHC	5 U	3.1 U	2.5 U	1.9 U	3.1 U	0.035 JQ
alpha-Chlordane	5 U	3.1 U	2.5 U	1.9 U	0.057 JQ	2.7 U
delta-BHC	0.2 JQ	3.1 U	2.5 U	0.07 JQ	0.2 JQ	2.7 U
Endosulfan I	0.18 JQ	3.1 U	2.5 U	1.9 U	0.13 JQ	2.7 U
Endosulfan sulfate	0.13 JQ	6.1 U	4.9 U	3.8 U	6.2 U	0.096 JQ
Endrin	9.6 U	6.1 U	4.9 U	3.8 U	0.13 JQ	5.3 U
Endrin ketone	9.6 U	6.1 U	4.9 U	0.04 JQ	6.2 U	5.3 U
gamma-BHC(Lindane)	5 U	3.1 U	2.5 U	0.15 JQ	1.3 JQ	2.7 U
gamma-Chlordane	5 U	3.1 U	2.5 U	0.02 JQ	3.1 U	2.7 U
Heptachlor	5 U	3.1 U	0.046 JQ	0.03 JQ	3.1 U	2.7 U

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

Q = Detected concentration is below the method reporting limit/Contract required quantitation limit, but is above the method detection limit.

R = Sample results were rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detect

µg/kg = Micrograms per kilogram

WBB = Warmhouse Beach Background

WBE = Warmhouse Beach Open Dump - East Creek

Table B-17
Inorganic Analytical Results Summary - Sediment Samples - East Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC659	MJC660	MJC662	MJC663	MJC665	MJC666
Location ID	WBB-13-SD	WBE-08-SD	WBE-09-SD	WBE-10-SD	WBE-11-SD	WBE-12-SD
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	East Creek				
<i>Inorganic Compounds (mg/kg)</i>						
Arsenic	5.1	4.1	2.3	2.3	4.8	2.5
Barium	113	45.3	50.2	38.2	71.1	65.5
Beryllium	0.64 J	0.26 U	0.24 U	0.22 U	1.5 U	0.94 U
Cadmium	1.3 U	0.2 J	0.68 J	0.46 J	0.94 J	1.2
Chromium	47.4 J	34.8 J	19.4 J	18 J	28.7 J	19.7 J
Cobalt	14.3	6 J	7.6 J	7.4	10.3 J	8.6 J
Copper	35.7	23	18.3	13.2	28.3	22.2
Lead	8.8 J	14.5 J	12.1 J	8.4 J	20.9 J	16.5 J
Manganese	837 J	377 J	927 J	771 J	1,270 J	1,060 J
Mercury	0.15 J	0.12 J	0.088 J	0.14 U	0.14 J	0.19 U
Nickel	32.7	18.9	23.8	21.9	28.5	29.6
Silver	0.19 J	1.8 U	0.093 J	1.3 U	0.14 J	0.13 J
Thallium	2.1 J	2.1 J	1.3 J	1.7 J	1.6 J	1 J
Vanadium	78.2 J	68.8 J	36.6 J	38.7 J	53.2 J	37.8 J
Zinc	81.8 J	179 J	<u>345 J</u>	<u>343 J</u>	<u>425 J</u>	<u>477 J</u>

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample identification number

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

mg/kg = Milligrams per kilogram

WBB = Warmhouse Beach Background

WBE = Warmhouse Beach Open Dump - East Creek

Table B-18
Organic Analytical Results Summary - Sediment PBDE Samples - East Creek
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

CLP Sample ID	MJC659	MJC660	MJC662	MJC663	MJC665	MJC666
Location ID	WBB-13-SD	WBE-08-SD	WBE-09-SD	WBE-10-SD	WBE-11-SD	WBE-12-SD
Sample Date	1/26/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010	1/27/2010
Location	Background	East Creek				
PBDE (µg/kg)						
BDE# 47	1.2 U	0.59 J	0.74 J	0.59 J	<u>2.9</u>	0.9 J
BDE# 99	1.2 U	0.48 J	0.71 J	0.68 J	<u>2.1</u>	0.78 J
BDE#100	1.2 U	1.2 U	1.1 U	1.1 U	0.46 J	0.24 J

Key:

Bold and Underlined = Concentration elevated when compared to background

CLP Sample ID = Contract Laboratory Program sample

ID = Identification

J = The analyte was positively identified. The associated numerical result is an estimate.

Location ID = START-3 sample identification number

PBDE = polybrominated diphenyl ethers

SD = Sediment

U = The material was analyzed for but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

µg/kg = Micrograms per kilogram

WBB = Warmhouse Beach Background

WBE= Warmhouse Beach Open Dump - East Creek

Table B-19
Summary of Waste in Warmhouse Beach Open Dump
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

Potentially Hazardous Materials	Estimated Percent by Volume
Batteries	Less than 0.1%
Used Motor Oil (or unknown material)	Less than 0.1%
Hypodermic Needles	Less than 0.001%
Tires	7 to 10%
Appliances (may contain ammonia)	(included in metals)
Roofing; Construction Materials	Less than 1%
Other Waste	
Organic Material and Household Waste	20 to 30%
Metal (car bodies, appliances, framework)	20 to 30%
Glass	20 to 30%

Source: White Shield 1995

Table B-20
Groundwater Drinking Water Population within a 4-Mile Radius
Makah Reservation - Warmhouse Beach Dump
Neah Bay, Clallam County, Washington

Distance Ring (miles)	Number of Wells	Well Population⁽¹⁾	Total Distance Ring Well Population
0 to 0.25	Domestic: 0	0	0
0.25 to 0.5	Domestic: 0	0	0
0.5 to 1	Domestic: 0	0	0
1 to 2	Domestic: 1	2.31	2.31
2 to 3	Domestic: 1	2.31	2.31
3 to 4	Domestic: 0	0	0
Total	2	2.31	4.62

Key:

(1) Population for domestic wells is based on the average number of people per household (2.31 for Clallam County)

Sources: Ecology 2010; Fedstats 2010

Table B-21
Sport Catch Data - Area 4A

2009 Neah Bay Recreational Groundfish Catch
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

Species	Number Harvested
Blackrock	24,864
Bluerock	354
Bocaccio	93
Cabezon	1,004
Canary	64
China	1,519
Copper	397
Flatfish	41
General Cod	35
General Rockfish	8
Halibut	1,642
Kelp Greenling	1,122
Ling Cod	3,586
Miscellaneous	99
Pacific Cod	7
Perch	3
Quillback	534
Sharks and Skates	7
Tiger	46
Tuna	0
Vermillion	107
Yelloweye	39
Yellowtail	1,343

Key:

General cod includes any cods other than Pacific cod

General rockfish includes any rockfish that could not be identified by the sampler (eg. Came in filleted)

Miscellaneous include any species of fish not listed in the ID list (eg. Hake, sablefish, silvergray rockfish, greenstripe rockfish, red irish lord, etc)

Flatfish include all species of flounder and sole

Sharks/Skates include all species of shark and skate

Source: WDFW Ocean Sampling Program

Table B-22
Sport Catch Data - Area 4B

2009 Neah Bay Recreational Catch
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

Species	Number Harvested
Salmonidae	
Chinook salmon <i>(Oncorhynchus tshawytscha)</i>	1060
Coho salmon <i>(Oncorhynchus kisutch)</i>	7101
Bottom/Other Fish	
Black Rockfish	27,894
Blue Rockfish	240
Bocaccio	13
Cabezon	696
Canary Rockfish	67
China	1,066
Copper Rockfish	1,023
Flatfish	412
General Cod	13
General Rockfish	0
Pacific Halibut	318
Kelp Greenling	2,201
Lingcod	2,929
Miscellaneous	208
Pacific Cod	6
Perch	3
Quillback Rockfish	766
Shark and Skates	5
Tiger Rockfish	76
Tuna	0
Vermillion Rockfish	41
Yelloweye Rockfish	17
Yellowtail Rockfish	898

Key:

General cod includes any cods other than Pacific cod

General rockfish includes any rockfish that could not be identified by the sampler (eg. Came in filleted)

Miscellaneous include any species of fish not listed in the ID list (eg. Hake, sablefish, slivergray rockfish,

greenstripe rockfish, red irish lord, etc.)

Flatfish include all species of flounder and sole

Sharks/Skates include all species of shark and skate

Source: WDFW Ocean Sampling Program

Table B-23
Commercial Groundfish Catch Data
Makah Reservation - Warmhouse Beach Dump
Neah Bay, Clallam County, Washington

Species	Pounds Harvested
Sablefish	954,806
Pacific Cod	420,858
Dover sole	302,959
English sole	216,916
Petrale sole	175,827
Unidentified skate	130,367
Dogfish	98,835
Lingcod	94,511
Rex sole	69,062
Unidentified sanddab	29,827
Arrowtooth Flounder	18,335
Unidentified flatfish	5,929
Rock sole	1,725
Starry flounder	1,143
Sand sole	531
Total	2,521,631

Source: WDFW 2010a; WDFW 2010b.

Table B-24
Commercial Salmon Catch Area 4A
Makah Reservation - Warmhouse Beach Dump
Neah Bay, Clallam County, Washington

Species	Number Harvested
Chinook salmon (<i>Oncorhynchus tshawytscha</i>)	1,201
Coho Salmon (<i>Oncorhynchus kisutch</i>)	584
TOTAL SALMON	1,785

Key:

Commercial troll fishery is restricted to the area west of the Bonilla-Tatoosh line in WA catch area 4.

Source: WDFW 2010a; WDFW 2010c

Table B-25
Treaty Harvest Data Area 4-A and 4-B
Makah Reservation - Warmhouse Beach Dump
Neah Bay, Clallam County, Washington

Species	Number Harvested	Average Pounds per Fish	Pounds Harvested
Salmonidae			
Chinook salmon (<i>Oncorhynchus tshawytscha</i>)	12,733	22	280,126
Coho salmon (<i>Oncorhynchus kisutch</i>)	59,987	11	659,957
Bottom/Other Fish			
Halibut	-	-	168,321
Total			1,108,404

Source: WDFW 2010a; WDFW 2010c

Table B-26
Population within a 4-Mile Radius
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

Distance Ring (miles)	Resident Population
0 to 0.25	0
0.25 to 0.5	0
0.5 to 1	0
1 to 2	34
2 to 3	806
3 to 4	238
Total	1,078

Source: Missouri Census Data Center, 2010.

Table B-27
Wetlands Area within a 4-Mile Radius
Makah Reservation - Warmhouse Beach Open Dump
Neah Bay, Clallam County, Washington

Distance Ring	Wetland acreage
0 to 1/4 mile	0
1/4 to 1/2 mile	0
1/2 to 1 mile	0
1 to 2 miles	0
2 to 3 miles	310.22
3 to 4 miles	71.96
TOTAL	382.18

Source: Ecology, 2010

APPENDIX C
PHOTOGRAPHIC DOCUMENTATION



PHOTOGRAPH #1

Description: Northeast boundary of open dump. East creek headwaters are located in back left corner.

Taken by: Amy Dahl, TechLaw Inc.
Witness: Bryan Berna, TechLaw Inc.

Direction: North
Date: January 25, 2010



PHOTOGRAPH #2

Description: Open dump; upper level has metal debris exposed on the hillside.

Taken by: Amy Dahl, TechLaw Inc.
Witness: Bryan Berna, TechLaw Inc.

Direction: North
Date: January 25, 2010



PHOTOGRAPH #3

Description: Site entry road and a warning sign.

Taken by: Amy Dahl, TechLaw Inc.
Witness: Bryan Berna, TechLaw Inc.

Direction: Northwest
Date: January 25, 2010



PHOTOGRAPH #4

Description: Site entry road; west creek headwaters are to the left.

Taken by: Amy Dahl, TechLaw Inc.
Witness: Bryan Berna, TechLaw Inc.

Direction: Northwest
Date: January 25, 2010



PHOTOGRAPH #5

Description: View of surface water and sediment samples WBE-09-SW/SD and their duplicates WBE-12-SW/SD, located 300' downstream of east creek headwaters.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Amy Dahl, TechLaw Inc.

Direction: Northeast
Date: January 27, 2010



PHOTOGRAPH #6

Description: View of surface water and sediment samples WBE-11-SW/SD, located 50' south of the junction between the east and west creek.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Amy Dahl, TechLaw Inc.

Direction: South
Date: January 27, 2010



PHOTOGRAPH #7

Description: View of surface water and sediment samples WBW-03-SW/SD and their duplicates WBW-07-SW/SD, located 550' downstream from west creek headwaters.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: West
Date: January 26, 2010



PHOTOGRAPH #8

Description: View of surface water and sediment samples WBW-01-SW/SD, located 105' downstream from west creek headwaters.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: West
Date: January 26, 2010

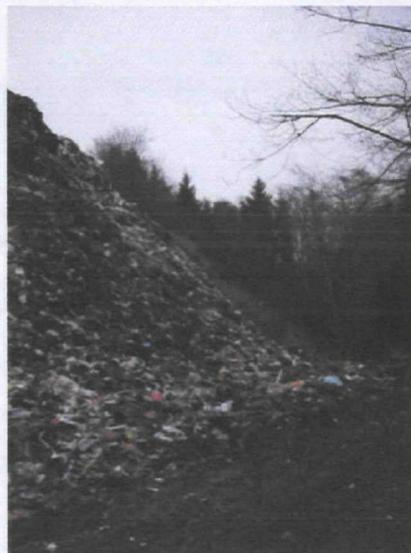


PHOTOGRAPH #9

Description: View of surface water and sediment samples WBE-10-SW/SD, located 440' downstream from east creek headwaters.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: Northeast
Date: January 27, 2010

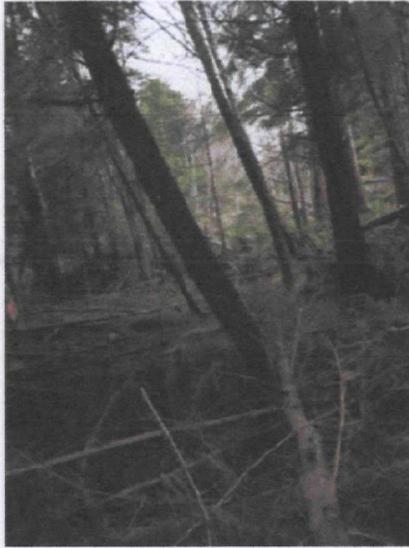


PHOTOGRAPH #10

Description: View of surface soil sample WB-17-SS and its duplicate WB-18-SS.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: Northeast
Date: January 27, 2010



PHOTOGRAPH #11

Description: View of surface soil sample WBB-06-SS, located 12' up the bank of the small stream used for the background surface water sample.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: South
Date: January 26, 2010



PHOTOGRAPH #12

Description: View of surface soil sample WB-14-SS, from a pushed soils pile.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Mike Hase, TechLaw Inc.

Direction: Northwest
Date: January 27, 2010



PHOTOGRAPH #13

Description: View of surface soil sample WB-15-SS, located on the southeast edge of upper dump area.

Taken by: Bryan Berna, TechLaw Inc.

Direction: West

Witness: Amy Dahl, TechLaw Inc.

Date: January 27, 2010



PHOTOGRAPH #14

Description: View of surface soil sample WB-16-SS, located 50' from the edge of the pushed dump.

Taken by: Bryan Berna, TechLaw Inc.

Direction: Northwest

Witness: Mike Hase, TechLaw Inc.

Date: January 27, 2010



PHOTOGRAPH #15

Description: View of surface water and sediment samples WBW-04-SW/SD, located 800' downstream from west creek headwater.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Amy Dahl, TechLaw Inc.

Direction: North
Date: January 26, 2010



PHOTOGRAPH #16

Description: View of surface water and sediment samples WBW-05-SW/SD, located 18' upstream of waterfall that drops roughly 125' to beach access.

Taken by: Bryan Berna, TechLaw Inc.
Witness: Amy Dahl, TechLaw Inc.

Direction: North
Date: January 26, 2010

**APPENDIX D
LOGBOOKS**

CONTENTS

PAGE	REFERENCE	DATE
	Disclaimer; this logbook contains info. regarding Warmhouse Beach open dump located in Neah Bay, WA. This information is considered confidential. Should this logbook be found, it is requested by the USEPA that it be returned to sender.	
	Technician ATTN: Bryan Bennett	
	7411 Beach Dr E	
	P.O. WA 98366	
	EPA Kathy Parker	
	1200 6 th Ave Ste 900	
	Sea, WA 98101	
	* All samples are collected per standard operating procedures found in the SSSP / SQAP B Bennett 1/25/10	

Location Warmhouse Date 1/25/10Project / Client NEAH BAY, WAPotential site workonce open dump

~~1 Sub Closed in 60's~~
 50) Kottah Point Pump
 300) ROAD NAMED SAME
 Rotati will send DATA
 of potential sampling at
 water's edge FOR PBs
 Steve

WADI ISLAND w/ Break water
 Future NECLAP 2005-2007
 PB hits zone unknown. Access
 issues with undercut bank
 and limited beach during
 high tide.

1500/onsite w/ KP MTH,
 AD & PB to scout West
 creek and acquire GPS
 points and relative
 distances of dump
 & creek length.
 off site @ 11728

(PB)

6

Location Warmhouse B. Date 1/26/10

Project / Client _____

NEAR BAY, WA WA

1115 sample # WBW-03-SD & duplicate sample WBW-07-SD, collected by AD. separates are clay w/ iron staining. small gravel sits on top. clay 2-4" deep. 03, 07 collected 550' down stream of head water.

drop off. SD 03, 07
SW 03, 07
550'

1050' photo # 100-268 no GPS
one to tree canopy. BEAKING for lunch @ 12:10 - 12:30

1255 sample # WBW-02-SW collected by Ms. Amy Dahl from west creek 320' downstream of head water.

1050' sample # WBW-02-SW contains MS MSD photo # 100-269 looking North
No GPS due to tree cover.

Location Warmhouse Beach Date 1/26/10

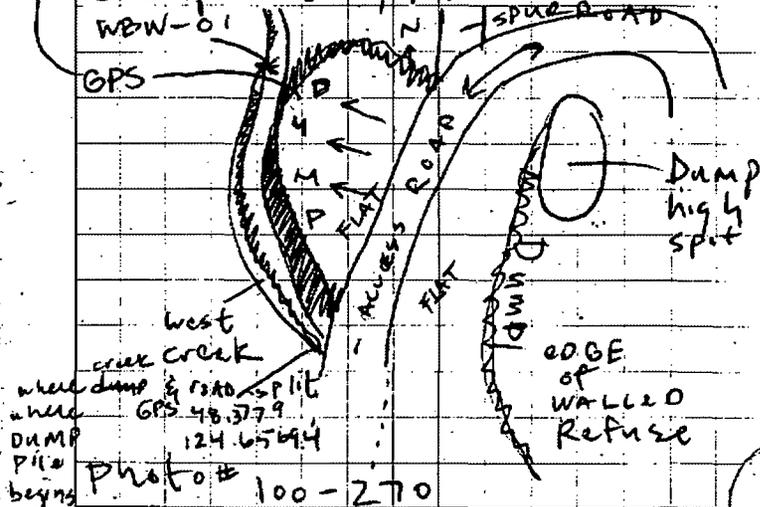
Project / Client _____

NEAR BAY, WA

1305 sample # WBW-02-SD collected from same location
Also MS MSD

1410 sample # WBW-01-SW collected from 105' down stream of head water
the sample is 25' near (horizontally) W from GPS N48.38829
W124.65789.

this reading was captured from the NW corner of pushed dump edge, ^{off of access} ROAD.
WBW-01



8

Location Warmhouse Beach Date 1/26/10

Project / Client _____

NEAH BAY, WA

1430 WBW-01-SD collected. —
 1 foot downstream, soils —
 where silty mud w/ organics. —
 collected by Amy Dahl. —

1600 WBB-06-SW collected from
 a ~~claret~~ creek approximately
 350' downstream from road
 surface soils & vegetation
 is similar to west creek. GPS

W
 W

→ taken at
 ROAD CREEK runs
 to west

photo 100-271

1638 WBB-06-SD collected
 4' downstream sediments
 are light brown with gravel
 over top, silty clay
 beneath. similar to SW 05
 Beyond BEWA sample of
 SW SD-06.

1655 WBB-06-SS collected
 12' up the bank of the
 small stream used for back

9

Location Warm House Date 1/26/10

Project / Client _____

NEAH BAY, WA

ground surface water.
 soils are loamy heavy
 dark Browns w/ clay
 collected by B.B.
 GPS not available due
 to tree cover. All
 three background
 samples are taped from
 the road @ 405' A correction
 to the estimated distance
 previously noted

N. 48.38526 (27' acc)
 W. 124.65265

GPS at roads edge (west)
 SS, SD, SW-06 405' west
 of this location.

1715 off site

(BB)

Project / Client

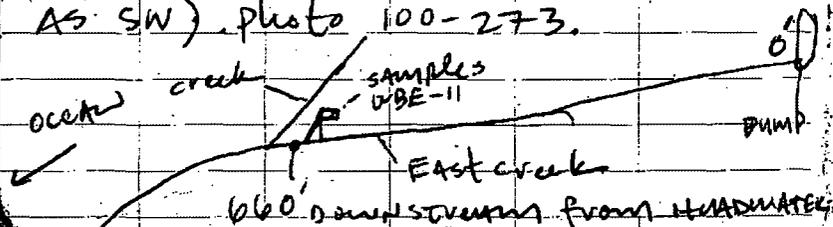
NEAR Bay, WA

0775) onsite. AD, MH, BRYAN
BEANA (log book). Positioning
sampling kits @ locations
on WARMHOUSE BEACH EAST (WBE)
Creek.

1000) sample WBE-11-SW collected
by A.D. 50' south of junction
between creek &
east creek. Joiner creek Flow to STD.
GPS 48.38906 " "
124.65340 } 24

70' above sea level. DUMP
ACCESS ROAD; level of head
WATERS of EAST creek is
@ 200' ABOVE S.L.

1020) sample WBE-11-SD collected
by A.D. 3' downstream of SW.
soils are loamy w/ organics
& fine sand. GPS ABOVE (same
AS SW). photo 100-273.



Project / Client

NEAR Bay, WA

1031) AD collects WBE-10-SW
@ 440' downstream of
head water GPS 48.38861
elevation 117' 124.65428

1050) AD collects WBE-10-SD
seeds are fine gravel w/
little silt. photo 274
looking down hill toward
junction of creeks. Sample
within 5' of SW,

1120) AD collects WBE-09-SW
DUP - WBE-12-SW
48.38868 elevation 178'
124.65463 ABOVE SEA LEVEL

1200) AD collects WBE-09-SD
Duplicate - WBE-012-SD
seeds
SANDS are small gravel, silt
sand. DARK BROWN & tan (rock)
300' downstream of head water
heading back to access road @
12:45. Photo 100-275

Project / Client _____

NEAR BAY, NEAR BAY, WA

1335 sample collected @ location
WBE-08-SW by Amy Dantz
120' DOWN stream of head
WATERS AT monitoring well.
GPS N. not marked due to
W. canyon curvature
elevation N/A or in.

~~See~~ This is the first sample
located on DOWN stream of
Dump. on East creek.

1355 sample WBE-08-SD
collected by A.D. SEDS are
light brown, clay, small pebbles
dryer than previous, twigs
root (organics). GPS is same
as SW. Photo same as GW.

1498 2ND Background collected
340' EAST of culvert on
creek. Same location that

Rodafi uses for monitoring.
WBB-013-SW. collected
by Bryan Berna

Project / Client _____

NEAR BAY, WA

1500 WBB-13-SD collected
by Bryan Berna.

SEDS are dark brown
MUD consistency, clay w/
ORGANIC debris fine pebbles
on top 1/8' GPS 48 38182

→ W122.62329
From this point on ROAD GO

South west 45' into woods
creek runs NEARLY parallel
At this pt. **1530** AMY & KP
are ~~not~~ determining location
for SPLP / soil samples.
4 selected 2 on or near
top of open dump. 2 on lower
level each potentially impacting
the respective E and W creeks.

1605 WBB-14-SS collected
by Amy Dantz. sample is
from a pushed soils pile.

GPS N 48.38923 elevation 293'
W W124.65746

soils are dark brown w/ rock
chip soils have been moved to

Location Warmhouse Beach Date 1/27/09

Project / Client

NEAR BAY, WA

this location to come-up
trash. photo # 100- Looking
NW towards ocean.

11630 sample WB-15-SS collected
by Bryan Brown. location
is the SE EDGE of upper pump
AREA. N 48.38841 elevation 245'
W 124.65598 Above SL.
soils are heavily influenced
by trash, small bits of
glass, metals, plastics < 5mm

11645 WB-16-SS AD sample
GPS N 48.38836 246'
W 124.65768 ABSL
50' from edge of pushed dump

11650 WB-17-SS sample BB
WB-18-SS (duplicate)
N 48.38815
W 124.65607 244 ABSL

Location Warmhouse BeachDate 1/27/09

Project / Client

NEAR BAY, WA

Monitoring well GPS
N 48 38809
124 65565

pH WATERS using WATERM
pH INDICATION PAPER
Type CF Cat No. 2613991
PH-0-14

Sample #	(pH)	ASTM D1595 pH meter	
		cap. 4.5	7 buffer slope 96.7
	PH	pH	
01	7	6.89	
02	7	7.06	
03	7	7.24	
04	7	7.08	
05	7	7.27	
06	7	6.65	
07	7	7.33	
08	7	7.14	
09	7	7.48	
10	7	7.62	
11	7	7.62	
12	7	7.65	
13	7	6.62	