Report
Remedial Investigation/Feasibility Study
Westman Marine Site
Blaine, Washington

August 12, 2020

Prepared for

Port of Bellingham
Bellingham, Washington

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Blaine, Washington

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

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LIST OF ABBREVIATIONS AND ACRONYMS

AO	Agreed Order No. DE-9001
ARAR	applicable or relevant and appropriate requirement
ARI	Analytical Resources, Inc.
ASTM	ASTM International
bgs	below ground surface
BMC	Blaine Municipal Code
CAP	cleanup action plan
CFR	Code of Federal Regulations
CLARC	Cleanup Levels and Risk Calculations
cm	centimeters
CSL	cleanup screening level
CSM	conceptual Site model
COPC	constituent of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DCA	disproportionate cost analysis
Development Plan	Blaine Wharf District Master Plan
DMMP	Dredged Material Management Program
DNR	Washington State Department of Natural Resources
EC	electrical conductivity
Ecology	Washington State Department of Ecology
EMNR	enhanced monitored natural recovery
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FS	feasibility study
ft	foot/feet
ft^2	square feet
HCID	hydrocarbon identification
HPAH	high molecular weight polycyclic aromatic hydrocarbon
IHS	indicator hazardous substance
LAET	lowest apparent effects threshold value
LPAH	low molecular weight polycyclic aromatic hydrocarbon
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mhhw	mean higher high water
mllw	mean lower low water
MNR	monitored natural recovery
MTCA	Washington State Model Toxics Control Act
ND	not detected
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
OC	organic carbon
ORP	oxidation-reduction potential
PAH	polycyclic aromatic hydrocarbon

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

PCB	polychlorinated biphenyl
ppt	parts per trillion
PBT	persistent bioaccumulative toxin
PCL	proposed cleanup level
PID	photoionization detector
Port	Port of Bellingham
PQL	practical quantitation limit
PSDDA	Puget Sound Dredged Disposal Analysis
PSL	preliminary screening level
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
RSS	Research Support Services, Inc.
SCO	sediment cleanup objective
SCUM II	Sediment Cleanup User's Manual II
SEPA	State Environmental Policy Act
SIM	selected ion monitoring
Site	Westman Marine Site
SL	screening level
SMA	sediment management area
SMS	Sediment Management Standards
SUF	site utilization factor
SVOC	semivolatile organic compound
TBT	tributyltin
TEF	toxicity equivalency factor
TEQ	toxicity equivalency
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-D	diesel-range total petroleum hydrocarbons
TPH-G	gasoline-range total petroleum hydrocarbons
TPH-O	oil-range total petroleum hydrocarbons
TVS	total volatile solids
USACE	US Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
Westman Marine	Westman Marine Inc.
yd^3	cubic yards

1.0 INTRODUCTION

Landau Associates, Inc. (LAI) prepared this report for the Westman Marine Site (Site) under the terms of Agreed Order (AO) No. DE-9001 (Ecology 2013). This report presents the results of the remedial investigation (RI) and the feasibility study (FS), which evaluates methods for Site cleanup. The Site is located in Blaine Washington (Figure 1) and encompasses property that is owned by the Port of Bellingham (Port) and the Washington State Department of Natural Resources (DNR). The Site is located within the Blaine Harbor Industrial Area, and has been used to conduct maintenance and repair of marine vessels to support the local marine industry.

A surface sediment investigation conducted in Blaine Harbor by the Port in 2001 indicated contamination was present in marine sediment, and that it may have been associated with the maintenance and repair of marine vessels at the Site. Subsequent visits to the Site by Washington State Department of Ecology (Ecology) and Port representatives raised additional concerns that boatyard activities could be affecting environmental conditions. In December 2011, Ecology identified the Port as a potentially liable party under the Washington State Model Toxics Control Act (MTCA; Chapter 173-340 of the Washington Administrative Code [WAC]). In April 2013, the Port entered into AO DE-9001 with Ecology, which required the Port to conduct a remedial investigation at the Site and to prepare RI and FS reports.

The RI report was prepared for submittal to Ecology in accordance with the provisions of the AO and the approved RI Work Plan and associated addenda (LAI 2013b, 2014c, e). The RI report was approved by Ecology in 2015. This RI/FS report incorporates the approved RI. The RI/FS was developed to meet the general requirements for completing an RI/FS as defined by the MTCA Cleanup Regulation (WAC 173-340-350). The RI portion of this report summarizes the project background, describes the field activities and the environmental setting of the Site, identifies chemicals of potential concern (COPCs) and the contamination source(s) at the Site, explains the development of the Site screening levels (SLs), presents the results of investigation activities, develops a conceptual Site model (CSM) for the Site, and presents preliminary cleanup standards for indicator hazardous substances (IHSs). The FS defines Site cleanup and management units based on the results of the RI, summarizes remedial action objectives, evaluates remedial action alternatives, presents a disproportionate costs analysis for the various remedial alternatives, and proposes the preferred remedial alternative for consideration by Ecology.

1.1 Site Description and Land-Development Background

The Site is registered by Ecology as FSID 66519819, and is located at 218 McMillan Avenue in Blaine, Washington within Blaine Harbor, which is at the north end of Drayton Harbor. The Site is within the northwest quarter of Section 1, Township 40 North, Range 1 West, Willamette Meridian. Westman Marine Inc. (Westman Marine) leased approximately 1.5 acres of upland Port property at 218 McMillan Avenue for use as a boatyard from 1989 until January 2011. Walsh Marine has operated the Site as a boatyard from 2011 to the present. Westman Marine, Walsh Marine, and other former tenants have conducted maintenance and repair of marine vessels at the Site, an activity generally referred to in this report as “boatyard activities.” These boatyard activities have resulted in the potential release of hazardous substances to Site media, including soil, groundwater, and marine sediment.

The Site boundary is defined by the extent of contamination caused by the release of hazardous substances from Site activities, and is not limited to lease area or property boundaries. This includes areas where hazardous substances have been deposited, stored, disposed of, placed, or otherwise have come to be located. The preliminary Site boundary, established prior to the RI, is shown on Figure 2. The term “Site” will refer generally to the area within this boundary. The development and refinement of this boundary based on findings of the RI is addressed in Section 7.0 of this report. For clarity, the Site has been further divided into an Upland Area and an In-Water Area based on impacts to these two areas, which have different cleanup criteria under MTCA and Sediment Management Standards (SMS; Chapter 173-204 WAC) regulations.

With the exception of Figure 1, the figures in this report are oriented to the northwest at the top of the page, which will be used as project north for the Site. Descriptions of direction in this report will be in reference to project north.

1.2 Objective of the Remedial Investigation and Feasibility Study

The objective of the RI is to collect and evaluate sufficient information regarding contamination at the Site to enable the selection of a preferred cleanup action (WAC 173-340-350) in the feasibility study. Three primary data gaps were identified during the development of the RI Work Plan, which are addressed in this RI report:

- Nature and extent of contamination in upland soil
- Nature and extent of contamination in groundwater
- Nature and extent of contamination in marine sediment.

The objective of the FS is to assemble and evaluate cleanup action alternatives, and identify a preferred cleanup action to achieve cleanup standards for all affected media.

1.3 Report Organization

This RI report is organized as indicated below.

- Section 2.0 presents the Project Description, including a summary of Site history and a description of environmental investigations conducted prior to the signing of the Agreed Order.
- Section 3.0 describes the remedial activities conducted by the Port as an Interim Action to remove contaminated soil discovered during construction of a new building at the Site.

- Section 4.0 describes the Remedial Investigation Field Activities conducted by the Port to characterize the nature and extent of contamination in soil, groundwater, and marine sediment, as required under the Agreed Order.
- Section 5.0 describes the Environmental Setting of the Site, including its physical features, geology, hydrogeology, natural resources, and land use.
- Section 6.0 presents Site Screening Levels for affected media.
- Section 7.0 describes the Nature and Extent of Contamination in both the upland and in-water areas of the Site.
- Section 8.0 discusses Contaminant Fate and Transport, including contaminant sources and the fate and transport for identified exposure processes.
- Section 9.0 describes the Development of Cleanup Standards, including the conceptual Site model, and establishes indicator hazardous substances.
- Section 10.0 presents a brief summary of the Remedial Investigation Conclusions.
- Section 11 presents the Feasibility Study, including a Site cleanup screening of technology, development of cleanup alternatives, a disproportionate cost analysis of the cleanup alternatives, and an evaluation to select the alternative that provides permanent, effective, efficient remediation to the maximum extent practicable.
- Section 12 discusses the Summary and Conclusions, including a description of the preferred alternative.

2.0 PROJECT DESCRIPTION

This section summarizes the historical development and operations at the Site, as well as previous observations and environmental investigations.

2.1 Historical Site Development and Operations

The history of Site development and historical operations presented in this section are based on a review of environmental reports related to previous Site investigations and aerial photographs taken between 1949 and 2011, and summarized in the RI Work Plan (LAI 2013b).

2.1.1 Blaine Harbor Development

Blaine Harbor is located within the northern portion of Drayton Harbor at the entrance to Semiahmoo Bay. Aerial photographs of the Site area are provided in Appendix A that show conditions in the 1940s, 1950s, and 2010. Blaine Harbor was originally created in the late 1930s by dredging 2 acres of tideflats and using the dredged material to create uplands. The development of Blaine Harbor was facilitated by a resolution between the City of Blaine and the Port District in 1944. The resolution authorized the Port to lease the property from the City for 99 years. The Port became owner of the property comprising the Westman lease in February 1984. In the late 1940s, 4 additional acres of tideflats were dredged, additional uplands were created, and bulkheads, floats, ramps, and a breakwater were constructed. The upland area of the Site generally consists of dredged fill material with timber bulkheads along the shoreline. The timber bulkheads are constructed of two rows of timber pilings driven into the sediment. Based on permitting drawings dated 1936, the bulkheads may be braced by anchored pilings, though as-built documentation is not available to confirm bracing details. In some areas, riprap was used instead of, or in conjunction with, the bulkheads to establish the shoreline. In the mid-1950s, an additional 15-acre area of tideflats was dredged and an extension of the breakwater was completed (TEC 2001).

In 2001, the Port completed an expansion project at Blaine Harbor that included dredging approximately 15 acres of tideflats, enlarging the moorage basin, and creating more than 300 additional slips. As is discussed later in this report, a large amount of wood debris is found throughout much of the upland fill present at the Site, apparently placed during construction of the uplands.

The harbor and industrial areas have been upgraded over the years to meet the demand for services. Despite the upgrades, most of the infrastructure supporting the harbor is from the original construction in the 1940s and the footprint of the upland industrial area has remained largely unchanged since 1949. Business activity has historically been focused in the area along the western end of Blaine Harbor (the Blaine Harbor Industrial Area), which comprises all of the upland area shown on Figure 2. A portion of the southwestern end of the uplands includes State-owned lands that are managed by the Port under a Port Management Agreement with DNR. The Inner Harbor Line shown on Figure 2 defines the boundary between property owned by the Port (east of the Inner

Harbor Line), and property that is owned by the State and managed by the Port under contract to DNR (west of the Inner Harbor Line).

2.1.2 Site Historical Operations

The Site has been used for commercial marine operations since approximately 1949. The following summarizes historical operations and entities at the Site:

- From 1949 to 1955, Andrew Berg leased a portion of the Site and operated a cannery and boatbuilding operation.
- From 1955 to 1966, a portion of the Site was leased by Carl Berg for boatbuilding and boatyard operations. The marine railway and sidetracks were constructed at the Site between 1957 and 1961. A portion of the marine railway and sidetracks are still in use today.
- In 1955, Carl Berg subleased portions of the Site to Pacific Coast Seafoods and Kaylor & Dahl for seafood processing.
- Between 1962 and 1964, three underground storage tanks (USTs) were reportedly installed northwest of the Site, in an area leased by Boundary Fish. The approximate historical locations of the USTs, the fuel pumps they supplied, and the fueling office associated with the marine fuel sales operation are shown on Figure 3, outside the preliminary Site boundary. The USTs were reportedly closed in place in 2001 (EDR 2011) and the dock was removed prior to 2001. Between 1961 and 1969, a dock was constructed and the area where the current travel lift exists was dredged.
- From 1966 to 1989, Boundary Fish leased a portion of the Site and subleased to the following tenants (property usage in parentheses):
  - George Olsen (marine railway, boatyard), 1966-1967
  - Wrang Shipyard (boatyard), 1967-1970
  - Berg Shipyard (boatyard), 1970-1972
  - Jack Davis Marine (boatyard), 1972-1976 and
  - Westman Industrial (boatyard), 1976-1989.
- Lease documents in the Port's files indicate that the marine railway and sidetracks were maintained operable through the duration of Westman Industrial's lease.
- In 1989, Westman Marine began leasing approximately 1.5 acres of property from the Port for boatyard operations, occupying the same upland area as Westman Industrial.
- Between 2011 and the present, Walsh Marine has operated at the Site.
- In 2012, Boundary Fish reportedly removed three USTs (those installed between 1962 and 1964 as noted above) from its property and conducted soil and groundwater sampling following removal to evaluate whether a UST-related release occurred. It was reported that the tanks had been empty and unused for at least 23 years (Stratum Group 2013). No petroleum hydrocarbons were detected in the soil or groundwater samples collected after the removal action, which is consistent with observations made during the interim action discussed in Section 3.

Westman Marine and other tenants used the Site to perform marine vessel repair and maintenance including scraping or sandblasting hull surfaces, painting and other finishing, mechanical repairs to marine engines, woodworking, and machining. Additional Site features that supported these services included a shop (removed in 2010), a travel lift, marine railway, a stormwater treatment system, and a solvent recycling shack. Westman Marine operated a boat haul-out (travel lift), which allowed customers to perform do-it-yourself ("DIY") repairs in the gravel area east of the marine railway (TEC 2001), shown on Figure 4. General Site conditions and layout are shown in photographs in Appendix B.

Westman Marine was listed with the US Environmental Protection Agency (EPA) as a small-quantity generator of hazardous wastes including antifreeze, lead-acid batteries, motor oil, and solvents such as methyl ethyl ketone. Hazardous materials stored at the facility included gasoline, antifreeze, hydraulic oil, chain lubricant, methyl ethyl ketone and other solvents, and paints (TEC 2001).

A National Pollutant Discharge Elimination System (NPDES) industrial permit was obtained by Westman Industrial in 1987 (WA-003102-0). Westman Industrial operated under that permit until 1989, then Westman Marine operated under that permit until it was replaced by the General Boatyard permit in 1992. The same General Boatyard permit (WAG 030053) is still in use at the Site, by Walsh Marine.

The permit requires the operator to test stormwater discharging to the harbor for oils, total suspended solids, and the metals copper, zinc, and lead, and submit the data to Ecology. Ecology has worked with the various leaseholders to resolve issues associated with this permit including sampling, reporting, and housekeeping issues. The current tenant operations are described in Section 2.3.

2.2 Previous Site Observations and Investigations

Investigation activities prior to this RI were limited to visual observations during Site visits conducted by Ecology and the Port, a sediment investigation conducted by the Port in 2001 (LAI 2002), and a Site reconnaissance to observe for stormwater outfalls along the shoreline in 2013. The observations made during the Site visits by Ecology and the Port and the findings of the Site reconnaissance and sediment investigation are presented in the RI Work Plan (LAI 2013b) and summarized briefly below. The findings were used in the selection of RI sampling locations.

2.2.1 Site Visits by Washington State Department of Ecology and Port of Bellingham

In 1993 and 2001, Port personnel visited the Site to conduct compliance audits and offer technical assistance regarding pollution prevention and to observe environmental conditions and practices. Additionally, Ecology personnel visited the Site in 1993 to provide technical assistance for general pollution prevention, then in 2010 to conduct a compliance audit associated with the NPDES permit. The observations made during these visits are detailed in the RI Work Plan and summarized below. Pertinent observations of features relevant to the RI scope of work are shown on Figure 4.

- Abandoned waste was accumulating in the eastern portion of the Site.
- Heavily stained soil was observed at the northeast corner of the Site and north of the upland end of the marine railway.
- The unpaved boatyard area east of the marine railway had a high concentration of paint chips.
- “Considerable amounts” of sandblast grit were present throughout the Site and were potentially migrating into the waterway.
- Stormwater flowing across impervious surfaces was potentially transporting boatyard contaminants to other areas of the Site with gravel cover.
- Waste oil was stored in a secure tank along the eastern bulkhead for the marine railway well, where the stormwater treatment system is now located (Figure 4). Surface soil staining was evident adjacent to the tank.
- Improperly labeled drums and orphan waste were stored in the northeastern portion of the Site.
- One drainage outfall may have been present leading from the shop to the marine railway well.
- The marine railway had large openings in the deck edges, allowing washwater and paint chips to leak through to the marine waters below.

2.2.2 Sediment Investigation – 2001

In 2001, LAI conducted a sediment quality investigation in Blaine Harbor on behalf of the Port (LAI 2002). The purpose of the investigation was to evaluate marine surface sediment quality within Blaine Harbor for compliance with the SMS. This investigation evaluated sediment quality throughout much of Blaine Harbor, including the vicinity of the Westman Marine leasehold. The results of this investigation are presented in the sediment quality investigation report (LAI 2002) and the RI Work Plan (LAI 2013b). As presented in those documents, copper and tributyltin (TBT) were detected at concentrations greater than the SMS (Chapter 173-204 WAC) criteria or recommendations for surface sediment samples in the vicinity of the Site.

2.2.3 Site Stormwater Outfall Reconnaissance – 2013

On March 4, 2013, LAI conducted a reconnaissance of the shoreline to identify locations where surface water from the upland portion of the Site flows to the adjacent marine waters, either as surface water runoff or through stormwater outfalls. Inspection of paved parking areas and unpaved boat dry storage and repair areas found points of surface water runoff to marine waters on the east, west, and north sides of the marine railway tracks. Most of the surface water appeared to be entering the marine railway area from the west side and was either runoff from the roof of the covered and paved boatyard or surface water that was flowing through the covered boatyard. Runoff from both the roof and ground surface of the covered boatyard collected in and flowed along the rail tracks under the covered area leading to the marine railway. A smaller amount of surface water entered the marine railway from paved and unpaved areas to the north and east of the marine railway. Some standing water was present on the asphalt pavement near the former Westman Marine shop and in the unpaved boatyard to the west of the marine railway.

Field personnel observed a pipe protruding from the timber bulkhead wall near the marine railway in the location previously noted by Ecology as a potential outfall location. The pipe was white, 2-inch PVC, protruding from the bulkhead. However, despite heavy rain throughout the day, observations of standing water in the upland portion of the Site, and observations of overland flow, no water was observed discharging from the PVC pipe. No additional outfalls were observed along the west side of the marine railway and it was determined that surface water flow from the upland area to the in-water area is strictly via surface runoff.

2.2.4 Current Site Features and Uses

In 2007 (Wharf District Master Plan) and 2013 (Blaine Marine Area – Concept Selection), the Port considered various alternative uses for the Site. However, Boundary Fish has a lease that runs through 2034 with three 5-year options to 2049. In 2013, Boundary Fish built a new building on a portion of the Site. Walsh Marine has recently made stormwater upgrades and operates under the renewed General Boatyard Permit (WAG 030053). The Port recently determined that the marine railway should be maintained in Blaine to provide capacity to move older wood fishing boats and other large commercial fishing vessels into the boatyard. The Port determined it was important to maintain the boatyard capacity in Blaine to support the fishing fleet, which provides product to the fish processors, including Boundary Fish. The alternative of a large capacity travel lift was discussed. However, the cost of replacing the marine railway with a travel lift is prohibitive, and the ability to obtain the permits required for its construction is questionable. For these reasons, the Port does not anticipate substantive changes in Site so the need to maintain the marine railway will continue into the foreseeable future.

2.2.5 Constituents of Potential Concern

A list of constituents of potential concern (COPCs) was developed in the RI Work Plan (LAI 2013b) for the contamination at the Site, based on the results of the limited investigations and observations at the Site between 1993 and 2001, and contaminants commonly associated with boatyard activities. The initial COPCs for soil and groundwater included the following:

- Volatile organic compounds (VOCs)
- Semivolatile organic compounds (SVOCs, including naphthalenes and carcinogenic polycyclic aromatic hydrocarbons [cPAHs])
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc)
- Gasoline-range total petroleum hydrocarbons (TPH-G)
- Diesel-range total petroleum hydrocarbons (TPH-D)
- Motor oil-range total petroleum hydrocarbons (TPH-O)

- Polychlorinated biphenyls (PCBs)
- Organotins (tributyltin [TBT]).

Initial COPCs for sediment included the following:

- SVOCs (including naphthalenes and cPAHs)
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc)
- Total PCBs
- Organotins (TBT).

3.0 INTERIM ACTION

This section describes the remedial activities conducted by the Port as an interim cleanup action to remove contaminated soil encountered during construction of a new building at the Site. A technical memorandum was provided to Ecology on December 19, 2013 detailing proposed interim action activities (LAI 2013a), and a completion report, documenting the results of the interim cleanup action was provided to Ecology on June 3, 2014 (LAI 2014a).

3.1 Interim Action Background

In November 2013, a Port tenant, Boundary Fish, began construction activities for a new building in its lease area. This area is referred to in this report as the interim action area and is located partially within the Preliminary Site Boundary (Figure 5). The area overlaps a portion of the Site where historical boatyard activities occurred, but is outside of the area of current boatyard operations.

The Port consulted with Ecology and mobilized to collect surface soil samples within the proposed new building footprint as part of a preliminary investigation, to determine if soil contamination was present. Nine soil samples were collected from the building footprint on October 3, 2013. Results of the sampling indicated that copper, mercury, and cPAHs were present in soil at concentrations greater than the PSLs that had been developed for the RI and presented in the RI Work Plan (LAI 2013b, 2014c, e). The contaminants were identified in fill in the vicinity of the marine railway sidetracks. On December 19, 2013, the Port provided the analytical results for soil samples collected during this investigation to Ecology.

After the initial findings, the Port prepared an evaluation of several alternative interim actions to remediate contamination in the area, and presented a proposed interim action in the Boundary Fish Interim Action Plan (LAI 2013a). MTCA distinguishes an interim action from a cleanup action in that an interim action only partially addresses the cleanup of a site and achieves one of the following purposes [WAC 173-340-430(1)]:

- Is technically necessary to reduce the threat to human health and the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance [WAC 173-340-430(1)(a)]
- Corrects a problem that may become substantially worse or cost substantially more to address if the remedial action is delayed [WAC 173-340-430(1)(b)]
- Is needed to complete a site hazard assessment, RI/FS, or design a cleanup action [WAC 173-340-430(1)(c)].

The following three interim action alternatives were evaluated as potential options for addressing contaminated soil within the building footprint:

- Alternative 1: Excavation and Offsite Thermal Desorption
- Alternative 2: Excavation and Landfill Disposal

- Alternative 3: Containment In Place.

The Port proposed to implement Alternative 2, and determined in coordination with Ecology that that excavation and disposal would meet the requirements of MTCA described above by reducing the threat to human health and the environment. Ecology published the Interim Action Plan and, after holding a public comment period, authorized the Port to proceed with the interim action.

3.2 Interim Cleanup Action Implementation

In October 2013, two separate excavation events were conducted to remove contaminated soil identified in the interim action area. Following each excavation event, compliance samples were collected to evaluate remaining conditions. Figure 5 shows the boundary of the interim action area. Figure 6 shows the locations of all samples collected in the interim action area the soil removal boundary and the final confirmation sampling locations. In addition to collecting surface samples to guide removal efforts and document remaining conditions, several subsurface soil samples were collected using a direct-push boring rig to determine the extent of TPH-D contamination surrounding a concrete structure discovered during the initial excavation.

Approximately 420 tons of soil was excavated from the area and temporarily stockpiled nearby on Port property. The soil stockpile was placed on top of plastic sheeting and covered with plastic sheeting secured with sandbags pending offsite disposal. In March 2014, the soil was transported off Site and disposed of at an appropriate solid waste facility.

As discussed in the Interim Action Completion Report (LAI 2014a), compliance monitoring indicated that a small amount of soil containing cPAHs and metals above soil RI PSLs was left in place in the southeast corner of the Boundary Fish building footprint. The soil analytical results for soil samples collected during the interim action are provided in Table 1. The table indicates by color which samples represent soil removed following the interim action, and which represent soil remaining in place after the interim action.

3.2.1 Soil Removal

On October 14, 2014, based on the initial sampling results, approximately 200 cubic yards of shallow soil was excavated from within the building footprint to a total depth of approximately 1 to 2 feet (ft) below ground surface (bgs). Excavation was conducted by Boundary Fish's construction contractor with oversight provided by LAI personnel. Two features were exposed during this excavation (shown on Figure 6): concrete footings (and a metal rail) from an abandoned portion of the boatyard sidetracks in the southeastern portion of the building footprint, and an approximately 12 ft by 5 ft, bottomless concrete vault, roughly in the center of the building footprint. A photograph of the vault is included in Appendix B.

Petroleum-like odor and a slight sheen were observed during excavation on the surface of soil inside the structure, prompting the removal of soil at this location to a depth of 8 ft bgs (which was approximately 4 ft below the bottom of the vault structure). Groundwater was not encountered during this excavation.

Additional soil samples were collected to evaluate the soil remaining in place after excavation. Eleven samples were collected and analyzed for heavy metals and polycyclic aromatic hydrocarbons (PAHs; WM-SS-9 through WM-SS-19). Three soil samples collected from the bottom and sidewalls of the vault excavation were analyzed for heavy metals, PAHs, VOCs, TPH-D, and TPH-G (WM-BF-Vault B-1, S-1, and S-2). Four soil samples collected from an area of stained soil adjacent to the abandoned portion of the boatyard sidetracks were analyzed for heavy metals, TPH-D, and PAHs (WM-SS-20 through WM-SS-22).

Based on a comparison of the analytical results to the PSLs, the Port identified additional soil that required removal, and conducted additional subsurface investigation near the concrete vault to better delineate the extent of petroleum hydrocarbon contamination in this area. The Port used a direct-push boring rig to collect subsurface soil for observations and to collect samples for laboratory analysis. The borings were advanced to depths of approximately 12 ft bgs about 10 ft away from the vault in each direction. No visual or olfactory evidence of contamination was noted in soil from these borings. Subsurface soil samples (WM-BF-GP-1 through WM-BF-GP-4) were collected from 8 to 10 ft bgs and analyzed for TPH-D. The analytical results for these samples are provided in Table 1. The data indicated that the diesel contamination was limited to the immediate vicinity of the former vault.

On October 28, 2013, the Port conducted the final soil removal effort as part of the interim action, which targeted the concrete vault and soil near the historical boatyard sidetracks area. Approximately 15 additional cubic yards of soil was excavated from at and around the vault location, to an approximate depth of 10 ft bgs (6 ft below the bottom of the vault). Groundwater was encountered at approximately 9 to 10 ft bgs. There was no visual evidence of sheen or olfactory evidence of contamination in the groundwater. Additionally, approximately 15 cubic yards of soil was excavated to a depth of approximately 2.5 ft bgs near the abandoned portion of the boatyard sidetracks to remove cPAHs and metals contamination.

3.2.2 Remaining Conditions

After the final soil removal efforts, there was no field indication of contamination remaining at the concrete vault or near the sidetrack foundations, and the tenant was allowed to continue building construction. Based on the analytical results of the final confirmation samples, some residual soil contamination remains in place. Table 1 presents a summary of analytical results and indicates which samples collected during the interim action represent soil that was removed during this effort, and which samples represent soil remaining in-place beneath the newly constructed building. The analytical results for the compliance monitoring conducted during the Boundary Fish soil removal are presented in Section 7 in conjunction with the RI data. At the concrete vault, TPH-G concentrations from one sampling location (WM-BF-Vault-S-3) exceed the PSL. In addition, at the sidetrack foundation, cPAHs and some metals are present at concentrations above the PSLs. The data representing the remaining conditions after the soil removal efforts were carried forward into the RI for further evaluation.

3.2.3 Soil Disposal

The soil removed during the interim action weighed approximately 420 tons and was stored in lined and covered temporary stockpiles pending offsite disposal. After receiving an approved waste disposal profile from Republic Services, the Port contracted with Strider Construction to transport the soil to the Ferndale Intermodal Facility for transport to Republic Services Roosevelt Regional Landfill in Roosevelt, Washington. The contaminated soil was transported through the Ferndale Intermodal Facility on March 27 and 28, 2014. Weight tickets for each container were provided in the Interim Action Completion Report (LAI 2014a).

4.0 REMEDIAL INVESTIGATION FIELD ACTIVITIES

This section describes activities conducted during the RI to collect data to evaluate the nature and extent of contamination in soil, groundwater, and marine sediment at the Site. The results of these activities are discussed in Section 7.0 of this report. Field activities were conducted in accordance with the approved RI Work Plan (LAI 2013b). Additionally, two Work Plan addenda were prepared during the RI to address expansion of the RI scope (LAI 2014b, d), and were approved by Ecology prior to implementation. The scope of RI field activities are summarized in the sections below by Site area and phase of investigation, and the results are discussed in Section 7.0. Boring logs documenting the soil and sediment conditions encountered during the explorations and the well construction details for groundwater monitoring wells are provided in Appendix C.

4.1 Upland Area Investigation

The upland area investigation focused on evaluating potential impacts to soil and groundwater resulting from boatyard activities at the Site. The investigation area was developed based on the review of historical aerial photographs, engineering drawings provided by the Port, and observations made during previous Site visits, as discussed in the RI Work Plan (LAI 2013b). The upland investigation included two phases of investigation. Phase I of the upland RI was conducted in October 2013 to investigate soil conditions and to screen groundwater for potential contamination. Phase I included:

- The advancement of 19 direct-push borings
- The collection and analysis of 77 soil samples and 11 groundwater grab samples for initial Site characterization
- Groundwater grab samples were used as a screening tool to determine future groundwater monitoring well locations (Phase II).

Phase II of the upland RI was conducted between April and July 2014 to address data gaps identified during Phase I, and to investigate groundwater quality using groundwater monitoring wells (Phase I groundwater data were collected from open direct-push borings). Phase II included:

- The installation of 8 groundwater monitoring wells and the advancement of 24 direct-push borings
- The collection of 74 soil samples to delineate the nature and extent of soil contamination
- Groundwater samples were collected from the monitoring wells during wet-season and dry-season monitoring events to evaluate whether groundwater quality varied temporally.

Two technical memoranda were provided to Ecology to report the data collected during the two phases of the upland RI. On February 5, 2014, the Phase I upland data summary was submitted to Ecology (LAI 2014d), and on October 6, 2014 the Phase II upland data summary was submitted (LAI 2014b).

4.1.1 Soil Investigation

Soil borings during both phases of investigation were advanced with a truck-mounted, direct-push drill rig. Soil borings were advanced to at least 2 ft below the estimated depth of the groundwater table to conduct field screening for potential contamination, observe soil lithology, and collect samples for laboratory analyses. Borings were typically advanced to 15 ft bgs; however, some borings were extended deeper to characterize geologic conditions or when field screening identified potential contamination at the base of the boring. Soil at each boring was field-screened for potential contamination by observing for stains, sheen, or odor. The soil was also screened with a photoionization detector (PID) for VOCs.

Soil samples collected from the borings were placed into laboratory-supplied containers and stored in coolers at approximately 4°C in accordance with procedures described in the RI Work Plan. The samples were transported to Analytical Resources, Inc. (ARI) in Tukwila, Washington, under chain-of-custody procedures. Soil samples were analyzed by ARI for selected COPCs, as described in the following sections.

4.1.1.1 Phase I Soil Investigation

Phase I of the soil investigation was conducted between October 8 and October 10, 2013. During Phase I, 19 direct-push soil borings were advanced to approximately 15 ft bgs: (WM-GP-2 to WM-GP-19 and WM-HA-1; Figure 7). Sample locations and methodology did not change significantly from those presented in the Work Plan, with the few exceptions related to additional sample collection as noted in this section.

Samples were collected from the ground surface to 4 ft bgs in 1-ft intervals: generally from 0 to 1 ft, 1 to 2 ft, 2 to 3 ft, and 3 to 4 ft bgs. After conducting field-screening, additional soil samples were collected at any interval with visual or olfactory evidence of contamination. The uppermost interval (0 to 1 ft) was immediately analyzed by the laboratory for Site COPCs. The three remaining intervals (1 to 2 ft, 2 to 3 ft, and 3 to 4 ft) were archived at the laboratory and were subsequently analyzed if COPCs were identified at concentrations greater than the PSLs in the sample interval directly above.

These shallow soil samples were analyzed for the following COPCs:

- Total petroleum hydrocarbons (TPH) by the hydrocarbon identification method (NWTPH-HCID), with follow-up analyses by Method NWTPH-gasoline range (NWTPH-G) or NWTPH-diesel range extended (NWTPH-Dx) if petroleum hydrocarbons were identified
- PAHs by EPA Method 8270D selected ion monitoring (SIM)
- Arsenic, cadmium, chromium, copper, lead, mercury, and zinc by EPA Method 6020 and mercury by EPA Method 7471B.

As specified in the RI Work Plan, samples from some locations were analyzed for additional parameters, as follows:

- SVOCs by EPA Method 8270D (WM-GP-9, WM-GP-12, and WM-GP-14)
- PCBs by EPA Method 8082 (WM-GP-8, WM-GP-9, WM-GP 12, WM-GP-14, and WM-GP-16)
- Organotins by EPA Method 8270D SIM (WM-GP-5, WM-GP-6, and WM-GP-16)
- VOCs by EPA Method 8260C (WM-GP-14, WM-GP-7, and WM-GP-11)
- Total organic carbon (TOC) by Method PLUMB81TC and grain size by ASTM International (ASTM) Method D422 (WM-GP-17; to evaluate conditions relating to Site hydrogeology).

Deviations from the Work Plan

The following bulleted list summarizes deviations from the RI Work Plan, which primarily occurred where additional soil collection or analyses were conducted based on information gathered during the RI field activities:

- Two borings were added (WM-GP-18 and WM-GP-19) in the northeastern portion of the Site, where possible sheen and unusual odor were identified near the groundwater table (10 to 12 ft bgs) in a nearby boring (WM-GP-14). Soil samples were collected only from between 10 and 12 ft bgs at these additional borings.
- Three soil borings (WM-GP-7, WM-GP-11, and WM-GP-14) had visual or olfactory indications of potential contamination beneath the four intended sample intervals and additional samples were collected from greater depths.
- During soil excavation for the interim action (see Section 3.0), abandoned portions of the boatyard sidetracks were discovered in the southeastern portion of the Boundary Fish building footprint (Figure 6). Fill soil was present above the abandoned sidetracks, indicating that the elevation of the currently observed ground surface may differ from the historical ground surface in this area of the Site. As a result, soil samples collected from corresponding depths at nearby borings WM-GP-2 and WM-GP-5 were analyzed to evaluate conditions at the historical ground surface. In addition, samples collected at similar depth intervals from boring locations WM-GP-4, WM-GP-6, and WM-GP-17 were analyzed because shallower soil was composed of asphalt base course, likely placed above the former ground surface that was present during historical boatyard activities.

4.1.1.2 Phase II Soil Investigation

Phase II of the soil investigation was conducted between April 14 and April 16, 2014. During this phase, 24 soil borings (Figure 7) were advanced to depths of approximately 15 ft bgs. These borings (WM-GP-20 to WM-GP-35 and WM-MW-1 to WM-MW-8) were advanced to delineate the lateral extent of COPCs determined to be present during Phase I at concentrations greater than the PSLs, and to install the RI groundwater monitoring wells.

Soil samples were collected at target depth intervals based on nearby exceedances of COPCs from the Phase I analytical results. Samples from the target depth intervals were analyzed immediately and samples from above and below the target intervals were archived for further vertical delineation if the PSLs in the analyzed samples were exceeded. Archived samples were analyzed only for COPCs that exceeded their PSLs in the surrounding intervals. Soil samples were not generally collected at the ground surface during Phase II since surface samples collected during Phase I had adequately determined the extent of surface impacts.

The following soil borings were advanced during Phase II to further delineate the extent of COPCs detected at concentrations above PSLs during previous efforts:

- WM-GP-20 through WM-GP-23 were advanced in the northeastern portion of the Site to evaluate conditions in the interval of approximately 10 to 12 ft bgs. Borings in this area during Phase I (WM-GP-14, WM-GP-18, and WM-GP-19) encountered dark-colored soil in this interval that exhibited an organic odor and possible sheen, and metals and cPAHs were detected at concentrations greater than the PSLs. Samples from these additional borings were analyzed for the following COPCs:
    - TPH-G by Method NWTPH-gasoline range extended (NWTPH-Gx)
    - TPH-D and TPH-oil range (TPH-O) by Method NWTPH-Dx
    - Arsenic, copper, mercury, and/or zinc by EPA Method 200.8
    - PAHs by EPA Method 8270D SIM
    - VOCs by EPA Method 8260C (based on PID detections during field screening).
- WM-GP-24 through WM-GP-26 were advanced to evaluate conditions observed during Phase I at WM-GP-10, where metals and cPAHs were found at concentrations higher than the PSL. The sampling approach for these Phase II borings included collecting samples in 1-ft increments from ground surface to 10 ft bgs, since the Phase I investigation did not identify the maximum depth of impacts in this area. Samples from these borings were analyzed for the following COPCs:
    - TPH-D and TPH-O by Method NWTPH-Dx
    - Arsenic, copper, mercury, and/or zinc by EPA Method 200.8
    - PAHs by EPA Method 8270D SIM.
- WM-GP-27 through WM-GP-29 were advanced to 10 ft bgs just west of the marine railway to evaluate subsurface soil conditions around the Phase I boring WM-GP-11. Samples from these borings were analyzed for the following COPCs:
    - TPH-D and TPH-O by Method NWTPH-Dx
    - Arsenic, copper, mercury, and/or zinc by EPA Method 200.8
    - PAHs by EPA Method 8270D SIM.
- WM-GP-30 through WM-GP-32 and WM-GP-35 were advanced to approximately 15 ft bgs to evaluate subsurface soil conditions around Phase I boring WM-GP-07. Samples from these borings were analyzed for the following COPCs:
    - TPH-G by Method NWTPH-Gx
    - TPH-D and TPH-O by Method NWTPH-Dx
    - Arsenic, copper, mercury, and/or zinc by EPA Method 200.8
    - PAHs by EPA Method 8270D SIM

  - VOCs by EPA Method 8260C.
- WM-GP-33 and WM-GP-34 were advanced to approximately 15 ft bgs to evaluate subsurface soil conditions around Phase I boring WM-GP-12. Samples from these borings were analyzed for the following COPCs:
  - Arsenic, copper, mercury, and/or zinc by EPA Method 200.8
  - PAHs by EPA Method 8270D SIM
  - VOCs by EPA Method 8260C.

Additionally, four soil samples were collected from the saturated zone at the time of drilling and analyzed for the following parameters to evaluate hydrogeological conditions:

- TOC by Method PLUMB81TC (WM-GP-34)
- Grain size by ASTM Method D422 (WM-MW-3, WM-MW-5, and WM-MW-6).

4.1.2 Groundwater Investigation

The RI groundwater investigation was implemented in two phases. Phase I included collecting groundwater grab samples from soil borings as a screening-level evaluation of groundwater quality. The data would be used to plan appropriate locations for the installation of groundwater monitoring wells. Phase II included installing groundwater monitoring wells and analyzing groundwater samples from these wells to evaluate groundwater conditions and Site hydrogeology.

4.1.2.1 Phase I Groundwater Investigation

Phase I of the groundwater investigation was conducted between October 8 and October 10, 2013 in conjunction with Phase I of the soil investigation. The scope of work for this part of the investigation included collecting groundwater grab samples (Figure 7) from direct-push borings WM-GP-2, WM-GP-5, WM-GP-7, WM-GP-8, WM-GP-9, WM-GP-12, WM-GP-14, WM-GP-16, and WM-GP-17 for laboratory analysis.

The groundwater grab samples were collected from the direct-push borings using a 4 ft long, wire-wrapped, stainless steel screen (0.010-inch slot size) with a retractable protective steel sheath. The samples were collected through the screen, from a depth approximately 4 ft below the apparent groundwater table. The groundwater table was generally 5 to 7.5 ft bgs except at WM-GP-10, where it was encountered at approximately 3 ft bgs.

A groundwater grab sample was planned for collection at WM-GP-1. However, construction for the Boundary Fish building prevented access by the drill rig so the sample was instead collected from nearby WM-GP-2. The groundwater grab samples were analyzed for the following parameters:

- Petroleum hydrocarbons by Method NWTPH-HCID with follow-up analyses by Method NWTPH-G or NWTPH-Dx if petroleum hydrocarbons were identified
- PAHs by EPA Method 8270D SIM

- Total metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020 and mercury by EPA Method 7471B
- Dissolved metals, if total metals concentrations exceeded the PSLs, by EPA Method 6020 and dissolved mercury by EPA Method 7471B
- SVOCs by EPA Method 8270 (sampling locations WM-GP-9, WM-GP-12, WM-GP-14, and WM-GP-17)
- VOCs by EPA Method 8260C.

On October 4, 2013, a 1-inch-diameter well casing with a pre-packed filter (0.010-slot, 20/40 sand) was temporarily installed in boring near WM-GP-5 to evaluate the feasibility of using small-diameter, pre-packed wells at the Site. After installing the screen, it was developed by typical surge and pump methods. A total of 15 gallons of water were removed during this effort. Turbidity decreased from an initial measurement of 280 nephelometric turbidity units (NTUs) after 2 gallons of purging to 4.8 NTUs after 15 gallons, indicating the pre-pack filter provided an appropriate method for collecting representative groundwater samples at the Site. Based on these results, Ecology approved the use of small-diameter groundwater monitoring wells instead of the planned 2-inch-diameter monitoring wells identified in the Work Plan.

4.1.2.2 Phase II Groundwater Investigation

Phase II of the groundwater investigation was conducted between April 14 and July 7, 2014. The scope of work for this part of the investigation included the installation of eight permanent groundwater monitoring wells (Figure 7) in locations selected based on groundwater grab sample data from Phase I, and collection of groundwater samples from the newly installed wells during two events—1 in the wet season and 1 in the dry season.

Groundwater monitoring wells were constructed in accordance with Washington State Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC). Well installation was overseen by LAI field personnel familiar with environmental sampling and construction of resource protection wells. As detailed in the RI Work Plan Addendum (LAI 2014e), small-diameter casing and pre-packed screens were used to complete the installations in direct-push borings. A photograph taken during completion of WM-MW-04 is provided in Appendix B. Eight groundwater wells (WM-MW-01 through -08) were installed and developed between April 14 and April 16, 2014, as shown on Figure 7. Groundwater samples were collected from the wells on April 29, 2014 and again on July 7, 2014.

The wells were installed using direct-push drilling techniques, and were constructed with 1-inch-diameter casings, 0.010-inch machine-slotted screens, and pre-packed sand filters with 20/40 sand. The well screens were placed from approximately 5 to 15 ft bgs to intersect the water table. Additional filter pack material was placed around the pre-packed screens from the bottom of the well to approximately 1 ft above the top of the screen. A bentonite seal was placed above the filter pack material to within about 1 ft of the ground surface. Concrete was used to backfill the boring to the subgrade for placement of the protective cover and a flush-mounted monument was cemented in place to complete each monitoring well.

The newly installed wells were developed approximately 24 hours after installation. Development was accomplished by surging and purging the screen using a centrifugal pump and a Waterra™ foot valve until the water was relatively clear. During development, the purged groundwater was monitored for the following field parameters: pH, conductivity, temperature, and turbidity.

The newly installed groundwater wells were first sampled on April 29, 2014, and a second round of groundwater sampling was conducted on July 7, 2014. Groundwater collected from the wells was analyzed by ARI for the following parameters:

- PAHs by EPA Method 8270D SIM
- Petroleum hydrocarbons by Method NWTPH-HCID with follow-up analyses by Method NWTPH-Dx for samples with petroleum hydrocarbon detections (WM-MW-02 and WM-MW-05)
- Total metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020 with follow-up analyses for dissolved metals by EPA Method 6020 for samples with total metals exceeding the PSLs (WM-MW-02 through WM-MW-05, WM-MW-07, and WM-MW 08)
- SVOCs by EPA Method 8270 (WM-MW-06)
- PCBs by EPA Method 8082 (WM-MW-06 and WM-MW 07)
- Nitrate and sulfate by EPA Method 300.0 (July 2014 only).

4.2 Sediment Investigation

The in-water investigation focused on evaluating potential impacts from boatyard activities on surface and subsurface marine sediment. Marine sediment near the marine railway and travel lift may have historically been exposed to contaminants from a variety of activities including cleaning, sandblasting, painting, or other shop operations related to boat repair and maintenance. Wastes from these activities had the potential to be transported to the marine environment via surface run-off. The in-water RI was designed to delineate the lateral and vertical extent of sediment contamination at the Site and was conducted in three phases:

1) Phase I was conducted in October 2013 to characterize surface sediment quality in the harbor near the upland portion of the Site, and to establish appropriate bulk tributyltin (TBT) PSLs based on a correlation between porewater and bulk TBT concentrations.
2) Phase II was conducted in April 2014 to characterize subsurface sediment in the harbor near the upland portion of the Site to delineate the extent of an anomalous metals exceedance east of the Site identified in Phase I and to evaluate the distribution of selected persistent bioaccumulative toxins (PBTs), including PCBs and cPAHs, in marine surface sediment within and just outside Blaine Harbor.

3) Phase III was conducted in December 2014 to further delineate the lateral extent of hazardous substances in marine subsurface sediment that exceeded Site screening levels for benthic organisms. Additionally, selected surface sediment samples during Phase II and Phase III were tested for PCB congeners to provide data needed for further development of screening levels for marine sediment protective of human health.

Surface sediment samples were collected with a pneumatic power grab system owned and operated by Research Support Services, Inc. (RSS) of Bainbridge Island, Washington. A photograph of the sampling vessel and crew is provided in Appendix B. Subsurface sediment samples (sediment cores) were collected with a vibracore sediment coring system, also owned and operated by RSS. Surface and core sampling locations were surveyed in the field with an onboard GPS unit that was mounted on a hydraulic winch system. Vertical position was measured using a weighted tape to measure from the water surface to the sediment surface. Sample station coordinates and mudline elevations are provided in Table 4. All surface and subsurface sediment samples were collected and handled in accordance with the procedures presented in the RI Work Plan and associated addenda (LAI 2013b, 2014c, e).

4.2.1 Surface Sediment Collection

Surface sediment samples (Figure 8) were collected in 2013 and 2014 with a pneumatic power grab system from the predominantly biologically active zone, the uppermost 10 centimeters (cm) of the sediment. After retrieval from beneath the water, sediment was collected from the power grab sampler while excluding portions that were in direct contact with the sampling equipment. Large, unrepresentative material (e.g., shells, woody debris) was excluded from the sample. Sediment collected for total sulfide analysis was taken directly from the grab sampler, prior to homogenization. The remaining sediment sample was then homogenized to obtain a smooth consistency (based on color and texture) in stainless steel bowls, using a stainless steel spoon. After homogenization, the sediment was placed into laboratory-supplied containers, placed on ice, and stored in coolers at approximately 4°C.

Samples were transported to the laboratory under typical chain-of-custody procedures. Field sampling equipment, including the pneumatic power grab sampler, stainless steel bowls, and stainless steel spoons were decontaminated between sampling locations. A record of field activities was prepared during the investigation, including field notes, sampling forms, and sample chain-of-custody forms. Observations of subsurface sediment conditions are provided in sediment boring logs as part of Appendix C.

4.2.2 Subsurface Sediment Collection

Sediment cores (Figure 8) were collected in 2014 by advancing a vibracore sediment coring system into the sediment to various depths approximately 7 ft below the mudline elevation. During core collection, cores that had greater than 75 percent recovery length were retained for processing. Cores that had less than 75 percent recovery length were returned to the collection site. Subsurface sediment samples were collected from multiple intervals within the sediment cores during core processing, which occurred at the laboratory after sediment core collection was complete. Cores were stored on ice overnight in a secure location and held for processing.

During core processing at the laboratory, sediment cores were cut open lengthwise using sheet metal shears and the outer sediment surface was removed with a decontaminated stainless steel spoon. The core was then split in half lengthwise using a decontaminated stainless steel spatula. Sediment in the core was characterized on core exploration logs. This characterization included noting stratification, color, odor, grain size, a soil description consistent with the visual manual method, and any visual or olfactory indications of contamination, biological activity (e.g., shells, worms, etc.), debris, or other distinguishing features.

Sediment cores were subdivided into 1.5-ft elevation intervals, adjusted according to the percent retention (length of sediment sample retrieved/penetration depth of core tube) per core, which accounted for sediment compression within the core tube during core collection. For example, if 6 ft of sediment was retrieved from a core with a penetration depth of 8 ft, the retention ratio was 0.75 or 75 percent. The resulting 1.5-ft elevation intervals were then adjusted for 75 percent sediment retention. The uppermost subsurface sample interval began 1 ft below the mudline because co-located surface sediment samples (collected with the pneumatic grab sampler) were considered representative of the upper 1 ft of sediment.

As with the surface sediment samples, sediment in contact with the sampling equipment (core tube walls) was excluded from the sample collected for laboratory analysis. Sediment was homogenized in decontaminated stainless steel bowls, using a decontaminated stainless steel spoon. Sediment analyzed for total sulfides was collected directly from the core, prior to collection of sediment for homogenization. After sufficient homogenization, sediment was placed into laboratory-supplied containers, placed on ice, and stored in coolers at approximately 4°C. Sampling equipment, including the stainless steel bowls and stainless steel spoons, was decontaminated between sample intervals.

4.2.2.1 Phase I Sediment Investigation

Phase I of the sediment investigation was conducted on October 8, 2013. The scope of work for this part of the investigation included collecting and analyzing surface sediment samples from 15 locations (WM-SG-01 to WM-SG-15), shown on Figure 8. Samples were used to evaluate sediment quality and determine the lateral extent of potential impacts from boatyard activities. Surface sediment samples were analyzed for both bulk and porewater TBT to determine if the two methods of analysis have a good correlation for sediment at the Site.

A total of 15 surface sediment samples were submitted to ARI for analysis. Sediment samples were analyzed for the following SMS marine sediment parameters:

- Metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc) by EPA Method SW6010C/SW7471A/200.8

- SVOCs by EPA Method SW 8270D SIM
- TBT (bulk and porewater) by Method KRONE 88 and KRONE 89
- PCB Aroclors by EPA Method SW 8082A.

Surface sediment samples were also analyzed for the following conventional parameters:

- Grain size by Method PSEP-PS
- TOC by Method Plumb 81TC
- Total volatile solids (TVS) by Method SM2540E/G
- Total solids by Method SM2540B/G
- Ammonia as Nitrogen by Method EPA350.1M
- Total sulfides by Method EPA376.2/SM4500-S2D.

4.2.2.2 Phase II Sediment Investigation

The Port, a representative of the former tenant Westman Industrial , and Ecology met on March 13, 2014 to discuss the Phase I results and to confirm the scope of work for Phase II. Upon review of the Phase I sediment data, it was determined that additional characterization activities, beyond that in the original scope for Phase II, would be necessary. This included additional investigation to determine whether metals exceedances detected at sampling location WM-SG-15 were related to Site releases, and to further evaluate the distribution of PBTs (i.e., PCBs and cPAHs) in Blaine Harbor (Figure 8).

Phase II of the sediment investigation was conducted in April 2014. The final scope of work for this phase of the investigation included the following:

- Collecting two surface sediment samples (WM-SG-16 and WM-SG-17) to further evaluate conditions (metals in surface sediment) near sampling location WM-SG 15
- Collecting eight surface sediment samples throughout Blaine Harbor and two surface sediment samples from outside the harbor entrances on the west and east ends (WM-SG-18 through WM-SG-27) to evaluate the distribution of selected PBTs in Blaine Harbor
- Collecting five sediment cores (WM-SC-01 through WM-SC-04, and WM-SC-06) to evaluate subsurface sediment quality in the vicinity of the marine railway and travel lift piers, where elevated concentrations of COPCs were detected during Phase I.

Surface samples WM-SG-16 and WM-SG-17 were analyzed for metals (cadmium, chromium, copper, lead, and zinc) to further delineate the boundary of the anomalous and elevated concentrations of the metals detected at location WM-SG-15, located adjacent to the Sawtooth Dock. These samples were also analyzed for conventional parameters (grain size, TOC, TVS, total solids, ammonia, and total sulfides).

Ten harbor-wide surface sediment samples were collected and analyzed for cPAHs and PCBs, the PBTs found during Phase I to be present at concentrations above the human health PSLs throughout the initial investigation area. Samples collected closest to the historical boatyard area were analyzed first, then those collected from incrementally farther distances from the Site uplands were analyzed if the nearer samples had concentrations of PCBs or cPAHs that exceeded their respective PSLs. Testing continued progressively outward from the Site investigation area until the detected concentrations were below PSLs or all samples were tested. All 10 surface sediment samples were analyzed for cPAHs and 9 of the 10 samples were analyzed for PCBs to assess their distribution within the harbor. PCBs were evaluated in surface sediment as the sum of Aroclors and the cPAH concentrations were evaluated in accordance with the procedure described in WAC 173-340-708(8)(e).

The six sediment cores collected during Phase II were subdivided into 1.5-ft sample intervals, adjusted for sediment compaction. The number of intervals selected for testing from each core was determined based on the lithology observed during core processing. Samples from the layer of recent sedimentation that overlies the native sediments were analyzed sequentially from the shallowest interval down. When the tested sample exceeded one or more of the sediment PSLs, the underlying archived sample was analyzed for the constituents that exceeded the PSLs. Testing continued progressively downward until no PSL exceedances were detected, or the lowest collected sample was analyzed.

4.2.2.3 Phase III Sediment Investigation

The Port, a representative of the former tenant Westman Industrial, and Ecology met on November 7, 2014 to discuss the RI results and conducting Phase III of the investigation to fill data gaps in the marine portion of the Site that remained following completion of Phase II of the in-water portion of the RI. Phase III of the in-water RI included collecting surface and subsurface sediment samples from seven locations (WM-SG-34, WM-SG-35, and WM-SC 29 through WM-SC-33), as shown on Figure 8. Surface sediment samples were collected from six locations, and subsurface samples were collected from five locations.

At sampling location WM-SG-28, eight unsuccessful attempts were made to collect surface sediment using the pneumatic grab sampler. The shoreline in this area consists of rock armory. As shown in the photograph of this area in Appendix B, in some areas along this shoreline area, small amounts of sediment had been deposited over the rock. However, not enough sediment had accumulated in the vicinity of WM-SG-28 to collect a sample for analysis.

Surface sediment samples were collected at WM-SG-29 through WM-SG-31, WM-SG-34, and WM-SG-35 to better delineate the lateral extent of contamination near the marine railway. These samples were analyzed for copper, zinc, and organotins.

Subsurface sediment samples were collected at five locations (WM-SC-29 through WM-SC-33) to evaluate the extent of subsurface PCBs exceeding the SMS benthic criteria in the vicinity of

WM-SC-10. WM-SC-29 through WM-SG-31 were closest to WM-SC-10, so subsurface samples from these locations were analyzed for PCBs. As is discussed in Section 7.0, concentrations of total PCBs were below the PSL for protection of benthic organisms at these locations so it was not necessary to analyze subsurface samples from WM-SC-32 or WM-SC-33.

Additionally, as part of Phase III, five samples collected during Phase II and Phase III of the sediment RI (WM-SG-20, WM-SG-22, WG-SG-24, WM-SG-27, WM-SG-31) were analyzed for PCB congeners. All other Site PCB data were based on Aroclor analysis. Aroclor is a common trade name for specific mixtures of PCB congeners used in industrial processes, identified in part by the percentage of chlorine present by weight (e.g., Aroclor 1242 is 42 percent chlorine by weight). PCBs are often analyzed during site characterization activities by EPA Method 8082, which provides Aroclor data at a much lower cost compared to quantifying the individual congeners, and allows for determining distribution more efficiently. The additional analysis of these five samples was conducted to quantify the 209 chemically-specific PCB congeners present to evaluate the congeners present in surface sediment to assess the bioaccumulative risk to humans and higher trophic-level species.

A subset of 12 PCB congeners displays toxicological properties similar to chlorinated dibenzo-p-dioxins. Toxicity equivalency factors (TEFs) for fish, birds, and mammals have been developed for these particular PCB congeners. TEFs allow the toxicity of a mixture of PCB compounds (e.g., dioxin-like PCB congeners) to be summed and expressed as a single number, called the toxicity equivalency (TEQ).

5.0 ENVIRONMENTAL SETTING

This section describes the physical conditions, geology, hydrogeology, natural resources, and land and navigational uses at the Site. The upland portion of the Site was created by placing fill, primarily dredge spoils, over former tideflats in the northeastern portion of Drayton Harbor. Dredging of these former tideflats created Blaine Harbor, and provided fill for creating the uplands. The dredged area now provides boat access to the upland portion of the Site, which supports the local commercial marine industry and private boaters. Boatyard activities, fish processing, and net storage are the primary marine commercial industries supported at the Site and in the immediate vicinity.

5.1 Physical Condition

Site physical conditions are relevant because they have the potential to affect the fate and transport of hazardous substances. Physical conditions discussed below generally include visible characteristics, such as the shoreline features, topography, and bathymetry, surface cover materials, and stormwater management.

5.1.1 Shoreline Features

Shoreline features have not changed significantly since the late 1940s or early 1950s. The shoreline was created by constructing a timber bulkhead around the perimeter of the upland fill area. Much of the bulkhead and piling supporting the numerous docks around the upland perimeter are constructed of wood treated by creosote and other wood-preserving chemicals.

In some areas, the bulkhead is armored at its base with riprap. Along the eastern portion of the Site, between the uplands and the Sawtooth Dock, the shoreline consists of a riprap slope. As shown in the 1956 aerial photograph in Appendix A, the original shoreline may have consisted solely of a double-row timber bulkhead and the riprap may have been placed to stabilize a section of failing bulkhead, though no timber bulkhead is currently visible at this location.

As shown on Figure 2, marine railway tracks extend from near the covered boat maintenance area, out into the harbor. The railway system provides a means for haul-out of large boats using a rolling carriage system that rides on the rails and historically, along the perpendicular side-tracks in the Uplands. The shoreline around the three sides of the marine railway consists of a timber bulkhead, creating what is referred to in this report as a marine railway well.

As shown on Figure 2 and in the aerial photograph taken in 2010 (Appendix A), additional shoreline features include pile-supported piers that extend over the water to provide a working platform and runners for the travel lift, and floating docks tethered to the fixed structures.

5.1.2 Topography and Bathymetry

The upland portion of the Site is relatively flat with a surface elevation ranging between 14 ft and 15 ft mean lower low water (mllw). Because of the limited topographic relief, a Site topographic map was not prepared for this report.

The bathymetric contours in Blaine Harbor near the Site are shown on Figure 4 and two surveys (1997 and 2012) are provided in Appendix D. Site bathymetry generally ranges from approximately elevation 11 ft mllw to –14 ft mllw. Site bathymetry from 1997 was compared to that surveyed in 2012. Figure 9 shows the interpreted sedimentation or erosion by evaluating the differences in elevations between the two surveys presented in Appendix D. The 1997 survey did not extend to the shoreline off the south side of the Site uplands, so it does not provide evidence of sediment accretion in this area. Based on the comparison of the 1997 and 2012 bathymetric surveys, sedimentation is occurring in Blaine Harbor within the deeper potions of the Site boundary beyond the depths affected by wave action and prop wash. In some of these deeper areas, greater than 1.5 ft of sediment has accumulated over the 15-year period between surveys, and sediment accumulation rates appear to be about 2.5 cm (1 inch) per year. The comparison of bathymetric surveys indicates erosion along the perimeter of the Site in the intertidal and shallow subtidal areas (above about elevation –10 ft mllw), although this may be, in part, an artifact of the limited extent of the 1997 survey.

5.1.3 Tides, Flooding, Storm Surge, Tsunamis, and Climate Change

The tides for 2014 in Drayton Harbor (which Blaine Harbor resides within) ranged from a minimum of –2.7 ft to a maximum of 11.0 ft mllw, according to the National Oceanic and Atmospheric Administration (NOAA; accessed March 13, 2015) based on information from the tidal station in Drayton Harbor (Station ID 9449679). Flooding, storm surge, and tsunamis (in decreasing order of probability of occurrence) could increase the water levels in Blaine Harbor on rare occasions. In regard to sea-level rise due to climate change, the Port is assuming a potential 2.4-ft rise in sea level over the next 100 years based on a variety of projections made by the University of Washington Climate Impacts Group (UWCIG and Ecology 2008) and the Intergovernmental Panel on Climate Change (IPCC 2007).

5.1.4 Surface Cover

The upland portion of the Site is covered by impermeable surfaces consisting of either asphalt pavement or buildings, except east of the marine railway, where the surface cover is gravel.

5.1.5 Stormwater Management

No storm drains or stormwater outfalls were observed during the April 2013 reconnaissance of the Site shoreline (see Section 2.2.3). A stormwater treatment system was installed between 1993 and 1996 to treat stormwater that collects in a sump associated with the travel lift pad and the marine railway cradle equipment (Figure 4). This treatment system reportedly includes flocculation and settling prior to discharge. This treated water was historically discharged to Blaine Harbor, although in recent years it has reportedly been discharged to the sanitary sewer. An environmental compliance assessment conducted by the Port in 2001 indicated that this system was in disrepair and had disconnected flanges that allowed stormwater collected from the rail lift to discharge directly to the harbor without treatment (Port of Bellingham 2001). The current NPDES general boatyard permit requires testing stormwater for oils, total suspended solids, and the metals copper, zinc, and lead, prior to discharge from the Site.

Other stormwater at the Site infiltrates (in unpaved areas, such as east of the marine railway), or flows overland and discharges directly to Blaine Harbor. Surface flow patterns observed in the upland portion of the Site in 2001 (TEC 2001) and during the April 2013 reconnaissance are shown on Figure 4.

5.2 Geology

General geologic information for the Site was obtained from the Geologic Map of the Bellingham 1:100,000 Quadrangle, Washington (Lapen 2000). According to Lapen, the fill present at the Site overlies glaciomarine drift. Glaciomarine drift can have various distributions of gravel, sand, silt, and clay, although finer sediments (silt, and clay with fine sand) are most typical, with coarse sand and gravel occurring as “dropstones.” Glaciomarine drift in the area is typically soft or loose, although where exposed to drying or other consolidation after deposition, it can form a hardened crust several feet in thickness.

Site RI borings generally extended to a depth of only 15 ft bgs. Information on deeper geologic conditions was obtained from two geotechnical investigations conducted in the Site vicinity. Geotechnical borings were advanced near the Site in 1998 as part of a breakwater improvement project. Additional information regarding the deeper subsurface conditions was collected in 2012 during a geotechnical investigation conducted for the repair of a section of failing bulkhead approximately 300 ft northwest of the Site (LAI 2012). Logs of these borings indicate that glaciomarine drift is present from about 25 ft bgs to greater than 46 ft bgs. The glaciomarine drift encountered in the 2012 geotechnical investigation consisted of very soft to medium stiff, silty clay and pockets of sandy clay that were present to the maximum depth of the explorations (46 ft bgs).

Geologic conditions at the Site were evaluated based on the 43 borings completed during the RI for sample collection and groundwater monitoring well installation. The conditions observed at these borings is generally consistent with our understanding that the Site uplands were created by dredging and filling over aquatic lands that previously existed as tideflats.

The ground surface varies across the Site, consisting of asphalt, concrete, or gravelly sand. East of the marine railway, the ground surface is gravelly sand except for the concrete travel lift pad. West of the marine railway, the surface is mostly paved with asphalt or concrete, except a small area south of the sidetracks (near boring locations WM-GP-05 and WM-MW-03) where it is gravelly sand. Along Berg

Street, at boring locations WM-GP-17, WM-MW-5, WM-GP-09, WM-GP-19, and WM-GP-20), the ground surface is paved with asphalt. Concrete paving is limited to the areas along the sidetracks west of the marine railway, on the floor of the marine railway where it extends into the uplands, and to a smaller degree, where it appears to be related to previous buildings at the Site (near boring location WM-GP-08).

The fill at the ground surface and below the concrete and asphalt pavement consists primarily of gravelly sand with relatively little silt. The thickness of this granular fill varies, but is typically about 1 ft. The fill material underlying the granular fill surface layer was typically sandy silt or silty sand, with small amounts of gravel, shell fragments, and organic debris, and extended to between about 10 and 15 ft bgs. It is assumed that this finer-grained material is the dredge fill used to construct the uplands and the granular fill was likely placed above the dredge fill to provide a more stable working surface or base course layer for pavement.

A layer of wood debris with a thickness of between 6 inches and 1.5 ft was observed in most borings throughout the Site. The wood debris was usually about 1 ft in thickness and was encountered at the base of the finer-grained fill material between 10 and 15 ft bgs. However, in the northeastern portion of the Site, the wood debris was somewhat thicker, and there was often a second, shallower layer of wood debris present. Figure 10 shows where the wood was encountered, the estimated thickness, and presents a photograph of the wood debris for reference.

The wood debris consisted of heavily decomposed wood chips or shavings, often with a hydrogen sulfide-like odor. The source of the wood is not clear, although detections of cPAHs in the wood at some locations indicate some of the wood may have been treated with wood-preserving agents such as creosote. Because the relatively continuous layer of wood debris is located at or near the contact with native soil/sediment, it may have been used as fill prior to dredging, or be associated with undocumented, historical activities that pre-date creation of the Site uplands.

Beneath the fill (and wood debris, where present), the native marine deposits encountered during the RI consisted of fine sand to silty fine sand, which were encountered at approximate depths of between 13 and 15 ft bgs. Because the dredge fill was sourced from areas adjacent to the Site, the composition of the dredge fill and underlying marine deposits are similar so the contact between these two units was not always readily apparent. As a result, this contact was inferred based on changes in the abundance of shells, observations of sulfur-like odors, a darkening from light to dark gray color, or the layer of wood debris. Lithologic changes typically observed at the fill/native interface included the reduced presence of clay deposits, reduced silt content, and an increase in poorly graded, fine sand.

Surface sediment in samples collected at the Site ranged in consistency from primarily dark gray, sandy silt to silty fine to medium sand. Shells and shell fragments were prevalent in the samples. There were no observations of strong chemical odors or visible evidence of contamination in the sediment samples. A small number of live clams and one anemone were brought up within the sampler during collection. Sediment core samples penetrated through recent sediment deposits (estimated to have been deposited after dredging of the tideflats in the 1930s) and into the underlying native sediment. The native sediment deposits are presumed to be the sediment floor exposed during dredging of the harbor, and the overlying recent sediments are identifiable based on apparent relative density and obvious changes in material consistency from the loose sandy silt and silty fine sand, to stiff gray clay (glaciomarine drift).

5.3 Hydrogeology

Groundwater elevation data were collected in April and July 2014 to evaluate groundwater flow direction and velocity during wet and dry seasons, respectively. The groundwater elevation at each of the eight Site monitoring wells was determined by subtracting the measured depth to water from the surveyed elevation at the top of the casing. Depth-to-water measurements were obtained using a Solinst® electronic water level indicator. Measurements and surveying data were recorded to the nearest 0.01 ft. Electrical conductivity (EC) of the groundwater was measured in the monitoring wells to evaluate for the presence of seawater in groundwater beneath the Site uplands. Groundwater elevation and EC data are provided in Table 2 and the interpolated potentiometric groundwater surface contours are shown on Figures 11 and 12 for April and July 2014, respectively.

The depth to groundwater ranged from approximately 6.5 ft to 10.3 ft during the wet season and from approximately 5.9 ft to 9.8 ft during the dry season. The greatest depth to water occurred near the shoreline because groundwater elevations were measured during periods of low tide, which resulted in lower water elevations near the shoreline.

Groundwater elevations ranged from 2.87 ft to 7.67 ft over the Site during the wet season and from 3.50 ft to 7.33 ft during the dry season, indicating only a modest increase in groundwater elevation during the wet season.

5.3.1 Saturated Thickness, Flow Direction, and Marine Water Influence

Groundwater flow through the Site is primarily through the sand and silty sand deposits (dredge fill) and the uppermost portions of the underlying native marine deposits. The saturated thickness of the fill unit located above the native deposits is estimated to be approximately 7 ft at the northern Site boundary and 5 ft at the southern Site boundary, based on the water levels observed during April and July 2014.

Groundwater elevations are influenced by tidal fluctuations, with greater influence observed in wells located near the shoreline. The direction of groundwater flow can be interpreted by the contours shown on Figures 11 and 12, with the assumed groundwater flow direction being perpendicular to water level contour lines. As shown on these figures, groundwater at the Site flows from inland portions of the Site uplands toward the shoreline.

The Site is paved or covered by buildings to the west of the marine railway and unpaved to the east in the gravel work area. As a result, recharge to Site groundwater is a combination of groundwater that originates from the north and recharge (infiltration of precipitation) within the unpaved eastern portion of the Site.

EC measurements taken during groundwater monitoring in April and July are summarized in Table 2. The data indicate that groundwater near the shoreline of the Site is affected by the adjacent marine water of Blaine Harbor. Moderately elevated EC measurements from the other monitoring wells ranging from 1,870 to 15,000 microSiemens per centimeter (µS/cm) likely indicate that marine water intrudes at depth beneath the Site uplands and intermixes with the overlying upland groundwater. This interpretation is consistent with the Blaine Harbor Industrial Area being an upland area surrounded by marine waters on all sides.

5.3.2 Hydraulic Conductivity, Hydraulic Gradient, and Groundwater Flow Velocity

The hydraulic conductivity of the saturated fill materials and native marine deposits was estimated based on literature values for similar soil. A grain-size sieve analysis (ASTM D422) was conducted on soil samples from the saturated zone at WM-GP-17, WM-MW-3, WM-MW-5, and WM-MW-6. The results are provided in Table 3. Sieve analyses indicate that silty to very silty sands dominate the saturated thickness beneath the Site. Freeze and Cherry (1979) provide a range of hydraulic conductivity values for silty sand between approximately 0.03 and 300 ft/day. Likewise, Schwartz and Zhang (2003) report typical hydraulic conductivity values for silts and fine sands between approximately 0.06 and 60 ft/day. Fetter (2000) gives typical hydraulic conductivity values for silty sands between 0.03 and 3 ft/day. Based on the large proportion of silt in Site soils, the hydraulic conductivity of the saturated zone is expected to be toward the low end of the literature values and is likely within the smaller range of values provided by Fetter (2000), between 0.03 and 3 ft/day (average value 1.5 ft/day).

Average hydraulic gradients were estimated throughout the Site based on water level measurements taken in both the wet and dry seasons. The average wet season hydraulic gradient, in the predominant groundwater flow direction (north to south), was estimated to be approximately 0.014 (dimensionless). The average dry season hydraulic gradient, also generally in the north-south direction, was estimated to be approximately 0.013.

Average groundwater linear velocity (v [ft/day]) was estimated from an adaptation of Darcy's Law with the equation:

$$v = Ki/n$$

where:

K = Hydraulic conductivity (ft/day)
i = Hydraulic gradient (dimensionless)
n = Effective porosity (dimensionless).

Based on the hydraulic gradient observed in the wet-season (0.014) and assuming a hydraulic conductivity of 1.5 ft/day and an effective soil porosity of 0.3, the estimated groundwater velocity at the Site is 7.1 x 10-2 ft/day (26 ft / year). This calculation was repeated using the range of observed average hydraulic gradients and the range of hydraulic conductivity values reported by Fetter to estimate the potential minimum and maximum velocities. Based on this evaluation, the estimated groundwater velocity could range between 1.3 x 10-3 and 0.14 ft/day (0.5 to 50 ft/year).

Volumetric groundwater flux was estimated using Darcy's law:

$$Q = KiA$$

where:

K = Hydraulic conductivity (ft/day)

i = Hydraulic gradient (dimensionless)

A = Cross-sectional area perpendicular to the direction of flow (square feet [ft^2]).

The cross sectional area is estimated by multiplying the average saturated thickness (6 ft) by the width across which groundwater discharges, measured perpendicular to groundwater flow. A curved surface was used to estimate the width of groundwater discharge because of the radial nature of Site groundwater flow, as it flows to the southern, eastern, and western directions toward surface water. A length of 315 ft is used in the calculation based on projecting the 7.5-ft groundwater contour shown on Figure 11 across the width of the Site uplands. Based on the resulting cross-sectional area of 1,890 ft^2, and again on the hydraulic gradient observed in the wet season (0.014) and the hydraulic conductivity of 1.5 ft/day, the estimated groundwater flux is approximately 40 cubic feet per day (0.2 gallons per minute).

5.4 Natural Resources

This section summarizes information on natural resources at and near the Site. Included is a discussion of the types and functions of habitats, and plant and animal species. Between 1998 and 1999, the Port created four construction mitigation sites in Blaine Harbor to establish salt marsh vegetation near the marina and to enhance the intertidal zone with cobbles and gravel near the breakwater at the west end of Blaine Harbor. The four sites are described in the As-Built Report (Pacific International Engineering 2000).

5.4.1 Upland Habitat

The upland portion of the Site is currently estimated to be slightly more than 1 acre in area and has been used since about 1949 for commercial and industrial purposes, after its creation in the 1940s by filling a former tideflat area. The quality of the habitat for wildlife is considered to be low (WAC 173-340-900, Table 749-1). The upland portion of the Site is considered unlikely to attract wildlife because most of the Site is covered with pavement, buildings, or gravel; lacks vegetation or standing water; and has a relatively high level of industrial and commercial activity. The nearest terrestrial habitat is the Blaine Marina Park, approximately 1,000 ft northeast of the Site. The terrestrial ecological setting of the Site is not expected to improve during future Site redevelopment, since redevelopment will include paving over the remaining unpaved portion of upland area, preventing adequate upland habitat from being established. Based on the current and anticipated future terrestrial ecological setting, the Site is exempt from the requirement of conducting a terrestrial ecological evaluation in accordance with WAC 173-340-7491.

5.4.2 Marine Habitat

The marine environment in Blaine Harbor is tidally influenced and protected from wave action by an offshore breakwater, as shown on Figure 2. The harbor has been used as a marina since at least the 1960s. Figure 4 shows the bathymetry near the Site uplands based on a 2012 survey (Appendix D), which extends to a depth of approximately –12 ft to –14 ft mllw offshore of the uplands.

The predominant shoreline features of the marine area are bulkheads and riprap erosion protection along the shoreline, and docks supported on wooden pilings extending into the harbor, as shown on Figure 4. The Port has made substantial investments that have increased the habitat value within Blaine Harbor to support ecosystem functions by constructing and monitoring mitigation sites based on the 1997 draft Environmental Impact Statement for the harbor expansion project, as discussed in monitoring reports from 2006 (Grette Associates 2006) and 2010 (Grette Associates 2010). The monitoring reports indicate that the mitigations are successfully improving habitat quality in Blaine Harbor.

The shoreline east of the Site uplands has been armored with rock. Some fine-grained sediment is present within the rock, although it was not present in sufficient quantities at most locations to allow collection of a surface sediment sample during the RI. Aquatic habitat along the shoreline where vertical bulkheads are present is of limited value. The intertidal zone consists of moderately steep slopes, some with riprap, against a vertical bulkhead face bordering much of the upper intertidal zone above approximately elevation 8 ft mllw. Intertidal habitat value is higher in areas of the Site where the shoreline slopes are less steep. The mitigation sites described above are within Blaine Harbor and outside the preliminary Site boundaries.

5.4.3 Plant and Animal Species

Although the Site does not provide high quality upland or aquatic habitat, the habitat quality within Blaine Harbor is increasing in value through Port improvements and some animal species may frequent the Site. The significant plant and animal species observed at the Site are summarized below.

5.4.3.1 Plants

As previously mentioned, the upland portion of the Site is essentially devoid of vegetation. Small patches of weeds may occasionally populate unpaved portions of the Site, although no significant coverage is present. At the Blaine Marina Park approximately 1,000 ft northeast of the Site, grasses and small shrubs are present in landscaped portions of the park near the shoreline and salt marsh vegetation is increasing in density within Blaine Harbor through successful Port mitigation projects. Blaine Marina Park is known to attract waterfowl and other birds.

5.4.3.2 Terrestrial Wildlife

Wildlife that may be present at the Site and in the vicinity is limited to those species typically observed along the urban waterfront including various songbirds, gulls, crows, and ravens. It is unlikely that the Site is frequented by other terrestrial wildlife, which are probably common in the Blaine, Washington area such as squirrels, raccoons, or opossums. These species are potential visitors, but unlikely to be found frequently due to the industrial activity at the Site, the relative isolation of the upland area (which can be accessed only from the mainland by Sigurdson Avenue), and the lack of suitable upland habitat. Terrestrial wildlife near the Site is likely to be attracted toward the higher quality habitat of the Blaine Marina Park, away from the Site.

5.4.3.3 Aquatic Wildlife

A general discussion of aquatic wildlife is provided for this region of Puget Sound based on resources located in Bellingham Bay, approximately 20 miles to the south. Threatened, endangered, and sensitive species in this region of the Puget Sound include the bald eagle, peregrine falcon, marbled murrelet, Pacific salmon, bull trout, and orca whale.

Fish and Marine Invertebrates

Documented fisheries resources potentially present in the Site area include the following:

- **Surf Smelt and Sand Lance:** Surf smelt and Pacific sand lance are common fish that spawn in the high intertidal portions of coarse sand and gravel beaches.
- **Pacific Herring:** Pacific herring spawn in inland marine waters of Puget Sound between January and June in specific locations. There is typically a 2-month peak within the overall spawning season. Herring, which deposit their eggs on marine vegetation such as eelgrass and algae in the shallow subtidal and intertidal zones between 1 ft above and 5 ft below mllw, are known to congregate in the deeper waters in Puget Sound.
- **Salmonids:** Anadromous salmonid species, including coho, chum, Chinook, pink, and sockeye salmon, and steelhead, cutthroat, and bull trout likely frequent the Site vicinity, and nearby rivers and streams that discharge to Puget Sound.
- **Groundfish:** Several species of groundfish occur in both shallow and deep waters in the northern Puget Sound area for part or all of their life.

A variety of marine invertebrates, ranging from infauna (worms, clams, and small ghost shrimp that penetrate benthic sediments) to epibenthic plankters (organisms such as very small crustaceans that live off the substrate surface) to larger invertebrates such as oysters, crabs, and shrimp may additionally be supported in the Site vicinity.

Sea Birds and Marine Mammals

The greater Bellingham Bay area and its shallow estuarine habitats support a number of birds in all seasons. Although Bellingham Bay is approximately 20 miles south of the Site, it is likely to support similar types of sea birds and marine mammals as the marine waters near the Site. Waterfowl sited in Bellingham Bay include dunlin, gull, scaup, tern, grebe, pigeon, sand piper, heron, brant, snow geese, mallard, widgeon, green-winged teal, and pintail. The area also serves as an overwintering area for diving birds such as loon, cormorant, scoter, and golden eye. Western Washington is also within a large bird migration route (the Pacific Flyway) extending from Alaska to Patagonia.

Limited information is available on the presence and residence time of marine mammals in the area. Several species have been reported in the northern Puget Sound area, including the harbor seal, sea lion, orca whale, gray whale, and harbor porpoise. The local population of orca whale is listed as endangered under the Endangered Species Act (ESA) and the Steller sea lion is listed by Washington State as a threatened species. The other marine mammals are not threatened or endangered species under the ESA, but they are protected from hunting under the Marine Mammal Protection Act. Seals and sea lions have been noted in the area and migrating gray whales have been noted to feed in subtidal areas of Puget Sound. Orca whales are occasionally observed in and near Rosario Strait and near the San Juan Islands.

5.5 Historic and Cultural Resources

No known archaeologically significant cultural or historic resources are present at the Site. As discussed in Section 2.1, prior to development of the uplands in the late 1940s, the Site area was undeveloped aquatic lands of Drayton Harbor. Since the 1940s, the Site area has been used for commercial and light industrial activities in support of the marine trades. Because the native ground surface was originally subtidal and located some distance from the original shoreline, the potential for Native American archaeological material to be present at the Site beneath the dredge fill is low.

5.6 Land and Navigation Uses

The Site is currently used for boatyard activities to support the commercial marine industry and recreational boaters. The land is owned by the Port and DNR, as discussed in Section 1.0, and is zoned for commercial use with surrounding properties zoned for commercial or industrial use with limited public access. No changes to local zoning or land use are planned or anticipated in the immediate vicinity of the Site as a result of the Port’s planned redevelopment activities. No changes to navigation and marine uses are planned or anticipated.

6.0 SITE SCREENING LEVELS

This section presents the development of screening levels (SLs) for potential media of concern that are adequately protective of the potential receptors and exposure pathways identified herein. The Site SLs were developed in accordance with MTCA requirements and are consistent with the approach detailed in the Harris Avenue Shipyard RI/FS Screening Level Workbook. This section includes a summary of potential contaminant sources, migration pathways, potentially affected media, potential contaminant exposure routes to human or ecological receptors, and development of SLs. Although surface water is a potentially affected medium, it is addressed through the development of groundwater SLs that are protective of marine surface water rather than developing surface water SLs directly.

PSLs were developed in the RI Work Plan (LAI 2013b), and were used to interpret the results of the RI during implementation of field activities in order to select where additional sampling or analysis was required to determine the nature and extent of contamination. In developing the PSLs, cleanup levels were evaluated for protection of potential receptors and exposure routes prior to conducting the RI. With characterization of soil, groundwater, and sediment now complete, some of the SLs have been revised from the PSLs based on the RI data to evaluate which migration or exposure routes are complete.

Indicator hazardous substances (IHSs) are identified in Section 9.0, which represent the hazardous substances that contribute the greatest risk to human health and the environment, and proposed cleanup levels (PCLs) are also developed in Section 9.0 for all IHSs in all affected media. Site cleanup levels are established by Ecology in the cleanup action plan for the Site following finalization of the RI/FS report.

6.1 Potential Contaminant Sources, Migration Pathways, and Media of Potential Concern

The potential sources of contamination at the Site are generally related to the boatyard activities conducted at the Site. Maintenance activities included sandblasting, hull scraping, painting, cleaning, mechanical repairs, and woodworking. Wastes produced during these activities may have been released to the ground surface, and from there may have been transported to deeper soils, groundwater, or the adjacent marine environment. Potential contaminant sources include the following:

- Anti-fouling agent such as copper or TBT, commonly found in coatings on marine vessels and released during sandblasting, scraping, or other maintenance activities
- Mechanical repairs may have released petroleum hydrocarbons or PCBs.

TBT is a biocide that belongs to a group of chemicals called organotins. TBT-based antifouling paints for marine vessels were first in use in the 1960s. In the 1970s, most seagoing vessels used TBT containing anti-fouling paints on their hulls. As the use of TBT containing anti-fouling paints grew, impacts to ecological receptors began to be reported. Thereafter, national and international legislation was introduced to ban or restrict the use of TBT in 1988, and the restrictions were further tightened in 2005 to effectively eliminate the use of TBT anti-fouling paints for non-military applications.

Based on our understanding of Site conditions and potential contaminant sources, the potential migration pathways for contaminants include the following, although some may be determined to be incomplete pathways by evaluation of the RI data:

- Transport of contaminants from the ground surface to shallow soil
- Leaching of contaminants from soil into groundwater
- Transport of contaminants in soil to marine sediment by erosion
- Transport of contaminants in soil to outdoor air via wind or fugitive dust
- Transport of contaminants in soil to surface water and marine sediment via stormwater runoff
- Transport of contaminants in groundwater to adjacent marine surface water and sediment
- Direct release of contaminants to sediment from boat maintenance activities within, or in the immediate vicinity of, the marine railway well and/or travel lift piers
- Resuspension and mixing of marine sediments via bioturbation (i.e., mixing of sediment by benthic animals), marine vessels coming in and out of the area, and/or tidal currents.

Based on our understanding of Site conditions, the media of potential concern consist of the following:

- Soil
- Outdoor air
- Groundwater
- Surface water
- Sediment.

6.2 Potential Receptors and Exposure Pathways

This section identifies potential receptors and the potential exposure pathways for the receptors based on the current and future land uses expected for the Site.

6.2.1 Potential Receptors

Potential receptors of Site contaminants could be humans, terrestrial ecological receptors (i.e., wildlife, soil biota, and plants), or benthic and aquatic biota. Each of these potential receptors was evaluated based on the current and anticipated future use of the Site, as follows:

- Humans: Because the Site is used, and will continue to be used, for marine industrial purposes (commercial and light industrial use), employees working at the Site, construction workers conducting intrusive activities, and Site visitors are considered potential human receptors.
- Terrestrial Ecological Receptors: For the reasons described in Section 5.4, terrestrial ecological receptors (wildlife, soil biota, and plants) are not considered potential receptors.
- Benthic and Aquatic Organisms: Due to the presence of marine surface water and sediment at the Site, benthic and aquatic organisms in Blaine Harbor are considered to be potential receptors, as well as humans that ingest benthic or aquatic organisms affected by Site releases.

Based on this evaluation, potential receptors for Site contaminants consist of:

- Humans
- Marine benthic and aquatic organisms.

6.2.2 Potential Exposure Pathways

Potential exposure pathways may be present that would allow Site releases to affect human health or aquatic ecological receptors. These potential exposure pathways are presented by medium below.

Soil:

- Direct contact (including incidental ingestion) by Site workers or visitors.
- Inhalation of dust from soil that has been impacted by contaminants.
- Leaching to groundwater and subsequent migration to marine surface waters and/or sediment where benthic or aquatic biota could be exposed.
- Erosion into the adjacent marine surface waters where benthic or aquatic biota could be exposed.

Groundwater:

- Direct contact (including incidental ingestion) by Site workers or visitors. Currently, direct contact with groundwater at the Site is unlikely. During construction or other intrusive activities that could encounter groundwater, Site workers could be exposed to affected groundwater.
- Based on its close proximity to marine surface water, groundwater at the Site is likely highly saline and is not considered a potable source of drinking water. As a result, exposure through groundwater ingestion is not considered a potential pathway.
- Migration of groundwater to the adjacent marine surface water and/or sediment where benthic and aquatic biota could be exposed.

Surface Water:

- Exposure of aquatic organisms to contaminants released from the Site to surface water. This may result in the uptake of contaminants in these organisms.

- Human ingestion of marine organisms that were impacted by releases from the Site.

Sediment:

- Exposure of benthic organisms to contaminants released from the Site to marine sediment. This may result in the uptake of contaminants in these organisms.
- Exposure of benthic organisms to contaminants released from the Site via groundwater discharge through the biologically active zone of sediment (the upper 10 cm below the mudline). This may result in the uptake of contaminants in these organisms.
- Exposure to higher trophic-level species that may feed on benthic organisms.
- Human ingestion of marine organisms that were impacted by releases from the Site.

6.3 Upland Screening Levels

MTCA provides three approaches for establishing cleanup levels for soil and groundwater: Method A, Method B, and Method C. The Method A approach is appropriate for sites that have few hazardous constituents. The Method B approach is applicable to all sites. The Method C approach is applicable for specific site uses and conditions. The Method B and Method C approaches use applicable state and federal laws and risk equations to establish cleanup levels. However, the Method B approach establishes cleanup levels using exposure assumptions and risk levels for unrestricted land uses, whereas the Method C approach uses exposure assumptions and risk levels for restricted land uses such as industrial properties. For practical purposes, MTCA requires cleanup levels developed using MTCA Method B and Method C approaches to be set no lower than the practical quantitation limit (PQL) or natural background level, even if these are above the calculated cleanup levels.

In general, the Method B approach was used for the development of the proposed soil and groundwater SLs for the Site. However, Method A cleanup levels were applied to certain constituents for which Method B cleanup levels have not been promulgated, such as petroleum hydrocarbons.

6.3.1 Groundwater Screening Levels

Groundwater SLs are developed in Table 5 for Site COPCs. Because human ingestion of groundwater is not a potential exposure pathway, potable groundwater SLs levels were not developed for Site groundwater. The SLs for groundwater were developed to be protective of marine surface water and to prevent marine sediment recontamination.

In the absence of applicable criteria protective of these exposure pathways, MTCA Method A cleanup levels were used for TPH SLs. For metals, SLs were developed based on protection of marine surface water, in accordance with WAC 173-340-201A, 40 Code of Federal Regulations (CFR) 131, and marine surface water criteria from the federal Clean Water Act. Except for TPH and metals, the SLs for groundwater were developed based on surface water standards protective of human health. For arsenic, the PSL was conservatively established in the RI Work plan as the PQL to ensure sufficient groundwater data were available to evaluate this COPC. The SL for arsenic developed in Table 5 is based on the MTCA Method A cleanup level, established based on background concentrations for arsenic in Washington State groundwater.

Some adjustments to SLs were made so that the SL was no less than the PQL in accordance with WAC 173-340-730(5)(c). Reporting limits from ALS Laboratories and ARI for the groundwater analytical methods were used as PQLs.

6.3.2 Soil Screening Levels

Soil SLs are developed in Table 6 for Site COPCs. In the RI Work Plan, PSLs were developed for protection of human health and groundwater quality. Soil PSLs for protection of groundwater quality were based on the calculated contaminant concentration in soil at which groundwater quality, if impacted by the soil, would remain below the groundwater PSLs. However, based on the RI data as presented in Section 7.0, it was empirically demonstrated that the existing concentrations of copper, mercury, and zinc in soil are protective of groundwater quality since those COPCs were not detected at concentrations greater than the groundwater SLs. As a result, the soil SLs for these COPCs are based on protection of human health by direct contact (ingestion).

Soil SLs were developed for protection of human health using applicable risk assessment procedures specified in WAC 173-340-708 based on the reasonable maximum exposure to occur at the Site. Although Site use is commercial and light industrial, soil SLs protective of human health were developed based on the requirements under WAC 173-340-740 for unrestricted land use, which represents a conservative basis for soil SLs given the reduced level of exposure associated with commercial and light industrial site use. MTCA specifies that Method B soil cleanup levels must be as stringent as:

- Concentrations established under applicable state and federal laws
- Concentrations protective of direct human contact with soil
- Concentrations protective of groundwater.

MTCA Method B soil SLs protective of direct human contact were determined in accordance with WAC 173-340-740(3) using Ecology’s Cleanup Levels and Risk Calculations (CLARC) database (Ecology 2015). The MTCA Method A soil cleanup levels for unrestricted site use were used to address TPH and mercury because MTCA Method B criteria are not available for these COPCs.

Some adjustments to SLs were made so that the SL was no less than the PQL or natural background metals concentrations in accordance with WAC 173-340-730(5)(c).

6.4 Sediment Screening Levels

Sediment SLs must consider protection of benthic organisms, higher trophic-level species, and human health to comply with the SMS regulations. The SMS provides numerical criteria for protection of benthic species for all Site COPCs, with the exception of TBT. The SMS specifies the approach for developing numerical criteria protective of human health and higher trophic-level species, but does not provide directly applicable numerical criteria.

The SMS bounds the acceptable range for sediment cleanup standards. The sediment cleanup objective (SCO) is the contaminant concentration that represents the goal for protection of human health and the environment, and is the most conservative cleanup criterion developed under the SMS. The cleanup screening level (CSL) is the maximum allowable concentration of any contaminant and level of biological effects permissible at a site after completion of the cleanup action. The sediment cleanup level is the contaminant concentration or level of biological effects in sediment selected for a site, and falls between the SCO and the CSL. The following sections discuss the development of marine sediment SLs protective of benthic organisms, human health, and higher trophic-level species.

6.4.1 Benthic Screening Levels

Two sets of numerical screening levels are presented in the SMS for protection of the benthic community: 1) The SCO (WAC 173-204-320), the concentration above which adverse effects to benthic organisms may occur; and 2) the CSL (WAC 173-204-520), the concentration above which adverse effects to benthic organisms are likely to occur. The PSLs presented in the RI Work Plan presented these criteria and they are carried forward as SLs without modification for protection of benthic organisms, and are provided in Table 7.

Because the SMS benthic criteria for a number or organic compounds are normalized to TOC, Ecology recommends that dry-weight equivalents for these criteria be considered along with the TOC-normalized criteria for sediment with TOC values lower or higher than the typical range of 0.5 to 3.5 percent. Low TOC in sediment can result in carbon-normalized reporting limits that exceed the SCO and/or CSL criteria, and the potential exists that bioavailability may not change predictably for sediment with high TOC. As a result, the lowest apparent effects threshold values (LAETs) and the second-lowest apparent threshold values (2LAETs), which are the dry-weight equivalents to the SCO and CSL criteria, respectively, are provided in Table 7; marine sediment criteria are also compared to these criteria.

The SMS does not promulgate SCO and CSL marine sediment criteria for TBT. However, Ecology considers the Dredged Material Management Program (DMMP) promulgated criteria for TBT in sediment porewater equivalent to the SCO and CSL (DMMP 2009). However, porewater analysis is difficult and expensive to conduct on subsurface sediment samples because of the large volume of sediment required for the analysis. As discussed in Section 4.2, RI surface sediment samples were analyzed for both porewater and bulk TBT to evaluate whether a strong statistical correlation exists at the Site. After validating Site TBT data, a linear regression analysis was conducted on 15 co-located porewater and bulk TBT data points to evaluate the strength of correlation. The linear regression correlation between bulk and porewater TBT concentrations is presented in Appendix E, which developed the following relationship:

TBTbulk (μg/kg*) = (TBTporewater [μg/L**] – 0.0024)/0.0002

* μg/kg = micrograms per kilogram
** μg/L = micrograms per liter

As discussed in the Phase I upland data summary (LAI 2014d), the TBT bulk/porewater correlation has an R2 value of 0.94, indicating very strong correlation. Based on the strong correlation between bulk and porewater TBT concentrations, Ecology approved the use of bulk TBT SLs equal to the SCO- and CSL-equivalent DMMP TBT porewater criteria, allowing sediment cores to be analyzed only for bulk TBT. Additional consideration of the bioaccumulative impacts from TBT on higher trophic-level species and humans is provided in the following section.

6.4.2 Human Health Screening Levels

The protection of human health and higher trophic-level species requires the consideration of food chain effects resulting from PBTs. The SMS provides a two-tiered approach for setting sediment cleanup levels for PBTs. Site SLs for PBTs were developed consistent with this approach and in accordance with guidance provided by Ecology in the Sediment Cleanup User's Manual II (Ecology 2017). Using this approach, an SCO and a CSL were developed to be protective of the most sensitive receptor group between the benthic community, higher trophic-level species, or humans for each PBT. The development of SLs for PBTs is presented in Appendix F and summarized in the following paragraphs. SLs for all sediment COPCs, including PBTs, are provided in Table 7.

In accordance with the SMS, the SCO for PBTs should be established as the highest value of 1) natural background concentrations; 2) the analytical PQL; or 3) risk-based concentrations (RBCs) calculated to be protective of the benthic community, upper trophic-level species, or human health (whichever results in the lowest and most protective value). The CSL should be set at the highest value of 1) regional background concentration; 2) the PQL; or 3) RBCs.

The following COPCs are considered PBTs under SMS:

- PCBs
- cPAHs
- TBT
- Metals (arsenic, cadmium, lead, and mercury).

For the PBT metals (arsenic, cadmium, lead, and mercury), the natural background concentration is selected as the appropriate SCO SL in accordance with SCUM II guidance (Ecology 2017). For total PCBs, dioxin-like PCBs (PCB-TEQ), cPAHs, and TBT, the SCO and the CSL are identified by first calculating RBCs protective of upper trophic-level species and humans, and comparing these concentrations to the PQL and natural background concentration (for the SCO) and to the PQL (for the CSL). Regional background concentrations are not yet available for the Site vicinity, so the CSL is developed without consideration of this criterion.

Exposure scenarios for human health impacts include consuming seafood that has been affected by contaminants in the sediment. Consumption of clams from contaminated sediment often presents the highest risk of exposure, since the rate of contaminant uptake for clams can be high, and because they are immobile, they are assumed to have spent their entire lifespan exposed to contaminated sediment. In contrast, mobile species such as finfish and crabs have a home range that may extend well beyond the limits of a contaminated area and be less impacted. Because there are no suitable locations for clamming within Blaine Harbor, the maximum reasonable exposure scenarios for Site sediment are based on consumption of finfish or crabs. This includes fishing or crabbing at the Site (which is unlikely to occur), and consumption of species that may have been affected by contaminated sediment but are caught elsewhere. As part of the RI, sediment samples were collected throughout Blaine Harbor and just outside its limits, to determine the extent of affected sediment. These data were used to develop species-specific site utilization factors (SUFs), which are based on the area of the harbor (where species could be affected) and the home-range area for specific species.

RBCs for cPAHs, total PCBs, and PCB-TEQ were developed for the protection of human health (Appendix F). Total PCBs include 209 unique compounds (congeners). A subset of 12 of these congeners exhibit toxicity similar to dioxins and are represented by the PCB-TEQ, which addresses the toxicity of these compounds as a group, normalized to the toxic effects of 2,3,7,8-tetrachlorodibenzodioxin. Ecology prefers RBCs for PCBs that are based on PCB-TEQ. However, much more PCB data are available for the Site based on Aroclor analysis. As a result, RBCs for total PCBs were developed using these data in addition to the RBCs for dioxin-like PCBs based on PCB-TEQ concentrations from congener data. As discussed in Appendix F, the RBCs developed for cPAHs, total PCBs, and PCB-TEQ were the most conservative SL values, so were adapted as the SCO (based on 1x10-6 cancer risk) and the CSL (based on 1x10-5 cancer risk).

After calculating RBCs for TBT, it was determined that the criteria developed for the protection of benthic species were more protective than the RBCs for protection of human health or higher trophic-level species, so the benthic criteria were retained as the TBT SLs.

7.0 NATURE AND EXTENT OF CONTAMINATION

This section describes the nature and extent of contamination detected in groundwater, soil, and marine sediment at the Site. The laboratory data were validated in accordance with the Sampling and Analysis Plan (LAI 2013b). Data validation memoranda are provided in Appendix G. Site RI analytical data were compared to the SLs developed in Section 6.0 of this report to assess the nature and extent of contamination in the following sections.

7.1 Groundwater

RI groundwater characterization included the screening-level evaluation conducted during Phase I using direct-push borings, and the two groundwater monitoring events conducted during Phase II using the eight groundwater monitoring wells at the Site. The results are described below. Groundwater analytical data are compared to Site SLs in Table 8. Summary statistics for the groundwater investigation analytical results are provided in Table 9.

7.1.1 Phase I Groundwater Screening Level Evaluation

Groundwater grab samples were collected from direct-push borings (Figure 7), and analyzed for the groundwater COPCs to assist in identifying appropriate locations for installation of groundwater monitoring wells and to identify hazardous substances that should be eliminated from future testing due to a lack of detection during this initial phase of groundwater quality characterization. The reported concentrations of many COPCs may be biased high in direct-push boring grab samples because these constituents bind to soil particles, and grab samples collected from temporary wells (open borings) often have elevated levels of suspended solids or turbidity in comparison to groundwater samples collected from monitoring wells. As a result, the reported concentrations of metals, TPH, and SVOCs are conservatively high, which is considered appropriate for a screening-level evaluation but may not represent actual groundwater conditions. As a result, groundwater grab samples are not used in the evaluation of the nature and extent of groundwater contamination and are not included in the summary statistics presented in Table 9.

For metals, groundwater samples were first analyzed for total metals, and if concentrations were greater than the SL, the samples were then analyzed for dissolved metals. Concentrations of total metals exceeded the SLs for arsenic, copper, lead, and zinc. Concentrations of dissolved metals exceeded the SLs for arsenic and copper. There were no detections of mercury in the groundwater grab samples.

SVOCs, including cPAHs, were detected in samples from two locations at concentrations greater than the SLs. Concentrations of cPAHs were greater than the SLs in one groundwater sample, WM-GP-9. At WM-GP-12, the SVOCs acenaphthene and fluorine were detected at concentration greater than the SL. The concentrations of all other SVOCs, including cPAHs, were less than SLs in all other groundwater grab samples.

As outlined in the RI Work Plan, Phase I groundwater data were evaluated and a revised list of groundwater COPCs was submitted to Ecology for review and approval prior to conducting Phase II of the upland groundwater investigation. Because there were no detections of mercury during Phase I in the groundwater grab samples, mercury was removed from the list of groundwater COPCs and was not analyzed for in subsequent groundwater sampling events. VOC detections were very infrequent in groundwater grab samples and all detected concentrations were below the SLs. As a result, VOCs were also removed from the list of groundwater COPCs.

7.1.2 Phase II – Groundwater Quality

Based on the Phase I groundwater data, eight groundwater monitoring wells were installed and sampled on two occasions in 2014, as discussed in Section 4.1. The analytical results are summarized in Table 8.

Concentrations of cPAHs, petroleum hydrocarbons, and PCBs were below reporting limits in all samples collected in both April and July. The only COPCs detected at concentrations greater than Site SLs were arsenic and copper. All detections of COPCs at concentrations greater than Site SLs are shown on Figure 13.

Similar to Phase I, Phase II groundwater samples were analyzed initially for total metals. Samples with total metals concentrations greater than the Site SL were then analyzed for dissolved metals. Total cadmium, lead, and zinc concentrations were below SLs in all samples collected in both April and July, so dissolved metals were not analyzed for those metals. Only copper and arsenic were detected at concentrations greater than their SLs in the dissolved-phase samples.

Dissolved copper concentrations were less than the SL in all samples collected in April, and slightly exceeded the SL in one sample (WM-MW-7) in July 2014. The reported concentration was flagged as approximate based on the confidence in reporting at the low concentration detected (2.5 µg/L), and therefore is only a potential exceedance of the SL (2.4 µg/L). Further, the detected concentration of dissolved copper in July may be a result of the impact of marine water on groundwater quality and not from Site releases. Marine water appears to have the greatest influence on groundwater from monitoring well WM-MW-7, based on the elevated EC value at this well (31,308 µS/cm; Table 2), and the higher groundwater elevation observed at this well during the dry season sampling event, as discussed in Section 5.3.

Concentrations of dissolved arsenic exceeded the SL in two wells, MW-4 and MW-5. Arsenic was detected in both wells at a concentration of 6 µg/L during the April 2014 sampling event and was detected in MW-5 only, at a concentration of 9 µg/L, during the July 2014 sampling event. These concentrations are slightly above the background arsenic concentration of 5 µg/L, which is the arsenic SL established for the Site. It should also be noted that MW-5, the monitoring well exhibiting the highest arsenic concentration and the only well where the arsenic SL was exceeded in both sampling rounds, is also at the upgradient extreme of the Site and was installed to assess background water quality for the Site.

Based on the presence of the extensive amount of wood debris across the Site, as discussed in Section 5.2, the presence of arsenic in groundwater may be a result of reducing (low oxygen) conditions due to organic decomposition. The potential presence of reducing conditions was evaluated by the collection of ferrous iron, sulfate, and nitrate data during the July 2014 sampling event. These data were used to evaluate whether reducing conditions are present at the Site, which are the probable cause of the slightly elevated arsenic concentrations detected in groundwater.

Groundwater samples collected in July 2014 confirmed that the saturated zone conditions are reducing, as demonstrated by elevated concentrations of ferrous iron and low concentrations of nitrate, as presented in Table 8. The following bulleted list provides a summary of the relevant redox conditions:

- Ferrous iron was detected in groundwater samples from five of eight wells with the highest detected concentration of 6.0 milligrams per liter (mg/L; indicating the most reducing conditions) at WM-MW-5, where the highest arsenic concentrations were detected.
- Nitrate was detected in groundwater samples from only one well, near the detection limit (WM-MW-8). Low nitrate concentrations are also an indicator of reducing aquifer conditions.
- Sulfate was detected in all samples from the eight wells. The lowest concentration of sulfate (indicating the most reducing conditions) coincides with the sampling location with the highest arsenic concentration, WM-MW-5. The relatively low sulfate concentrations could be due to less marine influence at this location.
- Hydrogen sulfide odor was observed near the saturated zone contact in numerous RI borings, which is associated with wood decomposition and reducing conditions.
- Although field measurement of oxidation-reduction potential (ORP) is somewhat less reliable than these laboratory-analyzed parameters, the average ORP during April and July was strongly negative (–174 millivolts), which is further indication of reducing conditions.

Based on the results of these analyses, Site groundwater exhibits multiple characteristics associated with reducing groundwater conditions. Because there does not appear to have been any large releases of organic contamination that would be a potential cause of reducing conditions, the presence of extensive deposits of wood debris is the only apparent source of significant organic matter at the Site capable of causing the observed reduced conditions. Given the relative lack of elevated arsenic concentrations in soil (discussed in Section 7.2.1.1), the reducing conditions are the likely cause of elevated arsenic concentrations in groundwater. This conclusion is further supported by the fact that MW-5, the only monitoring well where groundwater samples exceeded the arsenic groundwater SL in both rounds of monitoring, is located at the upgradient limit of the Site and is unlikely affected by current or historical boatyard activities.

Sufficient groundwater data were evaluated to determine the nature and extent of contamination. Only minor exceedances of the groundwater SLs were found, and these were not clearly attributable to Site releases.

7.2 Soil

This section summarizes the results of RI soil characterization. The analytical results for soil samples are summarized in Table 10, and summary statistics are provided in Table 11. The distribution of COPCs in soil is shown on Figures 14 through 17. On each of these figures, the data collected in the interim action area represent in-place conditions, and not soil that was removed as part of the interim action. The figures organize the data into the following depth intervals: 0 to 2 ft bgs, 2 to 4 ft bgs, 4 to 8 ft bgs, and greater than 8 ft bgs. If multiple samples were collected within an interval, the data presented on Figures 14 through 17 represent the maximum concentration detected in the interval. The RI soil data collected during each phase of investigation were used to determine the vertical and horizontal distribution of COPCs discussed below.

In addition to the chemical data collected for comparison to SLs, the RI also evaluated the thickness of soil accumulated in the upland portion of the marine railway well (where the marine railway tracks rise above the mean higher high water elevation of 8.5 ft mllw). Based on the use of hand tools at four locations in this area, the thickness of accumulated soil ranges from 0.3 to 1.4 ft above a concrete floor. The thickest accumulation was observed in the area farthest upland. Sediment samples collected near this area (WM-SG-01 and WM-SG-14) are impacted by heavy metals, SVOCs, TBT, PCBs, and cPAHs. For the purposes of the RI, the material is assumed to be contaminated; if it is removed as part of Site remediation, additional samples may be required to support proper disposal.

7.2.1 Metals

Four of the seven original metal COPCs identified for the Site were detected at concentrations greater than the PSLs developed in the RI Work Plan: arsenic, copper, mercury, and zinc. As discussed in Section 6.0, the SLs for three of these constituents (copper, mercury, and zinc) were adjusted to be protective of human health via direct contact instead of groundwater, based on empirical evidence that groundwater has not been contaminated by these metals. However, because human health criteria for direct contact are not currently available for mercury, the Method A cleanup level, which is protective of groundwater, was retained as the mercury SL.

7.2.1.1 Arsenic

Arsenic was detected in all analyzed samples. Concentrations ranged from 1.4 to 82.7 milligrams per kilogram (mg/kg), with an average detected concentration of 7.5 mg/kg. Arsenic is naturally occurring in soil in this region at similar concentrations. The distribution of arsenic in soil is shown on Figure 14. Arsenic was detected above the SL of 20 mg/kg in only one surface sample, from the work yard east of the marine railway (WM-GP-16) in the sample collected at the surface.

Arsenic was detected at a concentration greater than the SL at one location in the 4 to 8 ft bgs interval (WM-GP-21), and at one location, deeper than 8 ft bgs (WM-GP-23). Each of the exceedances of the SL in deeper soil corresponds to locations where wood debris was encountered. Based on the presence of wood debris at these sampling locations, it is likely that the elevated arsenic concentrations are due to poor fill quality and not from Site releases.

The presence of arsenic, copper, and cPAHs with the wood debris in the northeastern portion of the Site suggests that this may be treated wood, perhaps associated with wood used during construction of the perimeter bulkhead in the 1930s or 1940s.

7.2.1.2 Copper

Copper was detected in all analyzed soil samples. The distribution of copper in soil is shown on Figure 15. As indicated on the figure, the concentrations of copper in surface soils are elevated along the sidetracks, near the marine railway, and in the work yard east of the marine railway, but exceed the SL at only one location. The concentrations of copper in these areas vary considerably, but generally range from about 50 to 2,500 mg/kg, except at WM-GP-13. The maximum copper detection (3,920 mg/kg) was in surface soil at WM-GP-13, near the travel lift. This is the only sampling location where the copper concentration exceeds the SL of 3,200 mg/kg. Concentrations decrease to significantly lower values in the deeper intervals at WM-GP-13 and elsewhere throughout the Site.

7.2.1.3 Mercury

Mercury was detected in about 75 percent of the Site soil samples analyzed. The distribution of mercury in soil is shown on Figure 16. The concentrations of mercury are highest in surface soil along the sidetracks to the west of the marine railway, and in the work yard to the east of the marine railway, ranging generally from about 0.5 to 2 mg/kg in these areas. The highest concentration of mercury (17.7 mg/kg) was detected in near-surface soil (1 to 2 ft bgs) at WM-GP-16, which is located in the work yard east of the marine railway. Concentrations of arsenic and copper were also elevated in shallow soil at this location.

The concentration of mercury is greater than the SL of 2 mg/kg at four locations in the upper 2 ft of soil, and at two locations (WM-GP-07 and WM-GP-32) in deeper intervals just west of the marine railway. It should be noted that the SL of 2 mg/kg is based on protection of groundwater because human health risk input parameters for ingestion are not currently available for development of a mercury Method B cleanup level for direct contact. Prior to withdrawing the human health risk input parameters from the CLARC database, the Method B cleanup level for mercury based on direct contact was 24 mg/kg, which is higher than any of the concentrations detected in Site soil and more than an order of magnitude greater than the Site mercury SL. As a result, the mercury SL for Site soil is considered very conservative.

7.2.2 Semivolatile Organic Compounds

Only one non-cPAH SVOC (pentachlorophenol) was detected at a concentration above its SL. Pentachlorophenol was detected in surface soil at WM-GP-12 at a concentration of 180 µg/kg, which is slightly above its SL of 160 µg/kg. The remainder of this section discusses the distribution of cPAHs at the Site.

Carcinogenic PAHs were detected throughout the Site, in 72 percent of the analyzed samples. The distribution of cPAHs in soil is shown on Figure 17. The concentration of cPAHs in shallow soil (the upper 4 ft of soil) is generally highest along the railway sidetracks west of the current boatyard working area. The concentrations of cPAHs in shallow soil at the current boatyard working area were typically below the SL of 140 µg/kg except at one location, WM-GP-31, adjacent to the marine railway. The highest concentration of cPAHs detected in shallow soil (1,794 µg/kg) was detected in a surface soil sample collected to the east of the current boatyard working area (WM-GP-02).

The highest concentrations of cPAHs at the Site were detected in deeper soil, generally 6 to 12 ft bgs. The highest cPAH concentrations are in the northeastern portion of the Site where concentrations as high as 9,600 µg/kg were detected. The elevated concentrations in the deeper soil intervals appear to be related to poor fill quality based on the presence of wood debris at these sampling locations. Borings in the northeast corner of the Site encountered reducing conditions with a sulfur smell, an organic sheen (not interpreted to be an oil sheen), and hydrogen sulfide odors. These observations correlate to the elevated cPAH detections and appear related to the decaying wood debris encountered in this area.

It is uncertain how far north the elevated concentrations of cPAHs extend in the deeper intervals since they are likely due to poor fill quality and not Site releases. Although the northern extent of elevated cPAH concentrations is unclear, the northernmost sampling locations along Berg Street (WM-GP-09, - 17, -19, and -20) have concentrations of cPAHs about an order of magnitude lower than the adjacent samples to the south at similar depth intervals, suggesting that concentrations are decreasing rapidly to the north. Carcinogenic PAHs have very low solubility and high affinity to soil particles and, as a result, have relatively low migration potential, which is evidenced by the lack of cPAHs at detectable concentrations in Site groundwater.

7.2.3 Polychlorinated Biphenyls

Nine shallow soil samples were analyzed for PCBs. PCBs were detected in six of these samples and total PCBs were present above the SL of 160 µg/kg in one surface soil sample (WM-GP-16) at a concentration of 350 µg/kg. PCBs were not detected in a sample analyzed from the 1- to 2-ft depth interval at this location. One soil sample (WM-GP-14) from the northeastern portion of the Site was analyzed for PCBs to evaluate whether PCBs were present in the wood debris material in this area that exhibits elevated cPAH concentrations. No PCBs were detected in that sample.

7.2.4 Total Petroleum Hydrocarbons

Samples from across the Site were analyzed for the presence of petroleum hydrocarbons in the gasoline, diesel, and lube-oil ranges using Method NWTPH-HCID. When detections were identified based on HCID analysis, those samples were analyzed for TPH using Method NWTPH-G, or NWTPH Dx. One sample from each of the TPH ranges exceeded the respective SL. SL exceedances were observed in WM-GP-11 (TPH-D; 4,000 mg/kg) from 5 to 6 ft bgs, WM-GP-35 (TPH-O; 3,000 mg/kg) from 5 to 6.5 ft bgs, and at WM-BF-VAULT-S3 (TPH-G; 110 mg/kg) in the interim action area. Because very few samples exceeded the SL, a figure has not be prepared to illustrate the distribution.

7.2.5 Organotins (TBT)

Soil samples from seven locations were analyzed for organotins to screen for the presence of TBT. Two of these locations (WM-GP-5 and -6) are west of the marine railway and the remaining locations are east of the marine railway. TBT was detected at the five locations east of the marine railway (WM-GP-10, WM-GP-11, WM-GP-12, WM-GP-13, and WM-GP-16), and the samples exhibited concentrations ranging from 260 to 3,100 µg/kg. TBT was not detected at WM-GP-5 and WM-GP-6, which are located west of the marine railway. The highest concentrations of TBT in upland soil were detected in surface soil at WM-GP-16 (2,100 µg/kg), which also exhibited the highest concentrations of arsenic and mercury in Site soil, and near the travel lift at WM-GP-13 (3,100 µg/kg), which also exhibited the highest concentration of copper in Site soil. The concentration of TBT was less than the SL in a sample collected from WM-GP-16 from 1 to 2 ft bgs, indicating that the contamination is limited to the surface.

Samples submitted for organotin analysis were generally collected from surface soil, although samples from underlying intervals in shallow soil were also analyzed from WM-GP-5 and WM-GP-16. Organotins were not detected in any of the subsurface samples analyzed.

Soil SLs were not developed for TBT or other organotins because applicable criteria are not available. Although no soil SL is established for TBT, it was evaluated in the RI to assess the upland distribution for use in developing the CSM (Section 9.4) since TBT has been detected in marine surface sediment at the Site.

7.3 Marine Sediment

Marine sediment samples were collected and analyzed for the parameters described in Section 4.2 to characterize Site marine sediment quality. This section presents the results of the investigation with a comparison of the RI data to the SLs developed in Section 6.4. Analytical results for surface sediment samples are summarized in Tables 12 and 13, and the results for subsurface sediment samples in Tables 14 and 15. Tables 12 and 14 present analytical data on a dry-weight basis and Tables 13 and 15 present the data after carbon-normalization. Statistical information for sediment analytical results are presented in Tables 16 and 17.

The SMS benthic SLs for most organic compounds are based on carbon-normalized criteria. Samples with organic carbon content ranging from greater than 3.5 percent TOC to less than 0.5 percent TOC are also compared to dry weight equivalent criteria, as described in Section 6.4. Additionally, very low organic carbon content can result in SLs based on carbon-normalized criteria being lower than the carbon-normalized laboratory reporting limits. In both of these instances, analytical results were compared to dry-weight SLs in addition to the carbon-normalized criteria.

Data collected during the RI from sampling location WM-SG-15 are shown in the figures and tables to aid in the discussion of Site marine sediment quality (shaded gray in figures that present concentration data). However, the metals present at elevated concentrations at WM-SG-15 were determined to be unrelated to Site releases due to differences in concentrations and the assemblage of metals present relative to that observed in samples collected closer to the area of Site boatyard activities. This was evidenced by much higher metals concentrations at WM-SG-15 with a decreasing concentration trend toward the area of boatyard activities, the only exceedance of the chromium SL being observed at this location, and much lower TBT concentrations at this location. Ecology concurred that the impacts observed at WM-SG-15 are not likely related to Site releases and that this location would not be considered as part of the Site (Matthews 2014).

The following sections compare RI data to SMS benthic and human health criteria.

7.3.1 Comparison to Benthic Criteria

The following sections summarize the analytical results for surface and subsurface sediment samples relative to SLs protective of benthic organisms. Sediment SLs are applicable to the predominant biologically active zone (the uppermost 10 cm of sediment). Because future Site usage could include dredging to maintain or achieve adequate vessel draft, and Site cleanup could involve removing the affected marine sediment, the RI also addresses subsurface sediment conditions.

Much of the benthic criteria are based on OC-normalized data. As indicated in Section 6.4.1, if sediment TOC is less than 0.5 percent or greater than 3.5 percent, the analytical results should also be compared to dry-weight equivalents of the SMS benthic criteria. There were 12 instances of TOC less than 0.5 percent, and one instance of TOC greater than 3.5 percent. At only one of these locations, WM-SG-03, did the additional comparison of the results to dry-weight criteria result in a change in whether a results was above or below SLs. This is discussed further in Section 7.3.1.4.

7.3.1.1 Metals

Sediment samples were analyzed for the metal COPCs listed in Section 4.2. Of the eight metals analyzed, copper, mercury, and zinc were detected at concentrations greater than the SCO or CSL protective of benthic organisms. The analytical results for these metals are shown on Figures 18, 19, and 20. The figures indicate by color (yellow or red) whether the detections exceed the SMS benthic criteria (SCO –yellow; CSL – red). The figures show the results for surface sediment at the top, and subsurface sediment at the bottom of each figure.

Copper

The distribution of copper in Site sediment is shown on Figure 18. Concentrations of copper in surface sediment exceed the SCO and CSL benthic criteria (390 mg/kg for both criteria) in samples collected along the marine railway and extending out approximately 100 ft (WM-SG-01, WM-SG-02, WM-SG-10, and WM-SG-14), at the travel lift (WM-SG-03), and adjacent to (east of) the upland portion of the Site (WM-SG-16). Concentrations at these locations range from 609 to 6,930 mg/kg, with the highest detection at WM-SG-14 within the marine railway well. No subsurface sediment samples exceeded the copper SLs.

Mercury

The distribution of mercury in Site sediment is shown on Figure 19. Mercury is present at a concentration greater than the SCO and CSL benthic criteria (0.41 mg/kg and 0.59 mg/kg, respectively) in surface sediment at one location, MW-SG-01 (0.91 mg/kg), which is located in the marine railway well. Mercury is also considered a PBT for this evaluation, as discussed further in Section 7.3.2. No subsurface sediment samples exceeded the mercury SLs for protection of benthic organisms.

Zinc

The distribution of zinc in Site sediment is shown on Figure 20. Zinc is present in surface sediment at concentrations greater than the benthic CSL (960 mg/kg) within the marine railway well (WM-SG-01 and WM-SG-14) and greater than the SCO (410 mg/kg) at the travel lift and adjacent to (east of) the east work area in the Site uplands (WM-SG-16). None of the subsurface samples had zinc concentrations above the benthic SLs.

7.3.1.2 Organotins (TBT)

Marine sediment samples were analyzed for organotins to determine TBT concentrations. Figure 21 shows the distribution of TBT in Site sediment. TBT is present in surface sediment at concentrations greater than the CSL (738 µg/kg) at two locations within the marine railway well (WM-SG-01 and WM-SG-14), and at the head of the travel lift piers (WM-SG-03). TBT is present in surface sediment at concentrations greater than the bulk TBT SCO (238 µg/kg) but below the CSL at sampling locations WM-SG-02, WM-SG-05, WM-SG-08, and WM-SG-10. In deeper intervals, at WM-SC-02 and WM-SC 03, the SCO exceedances extend to depths of 2 and 2.5 ft below the mudline, respectively.

At WM-SG-05 and WM-SG-08, the bulk concentrations of TBT are greater than the SCO developed for bulk TBT based on correlation to TBT porewater criteria. Using porewater data is preferable to bulk data when characterizing TBT. Porewater data exist for all Site surface sediment sampling locations, and the concentration of porewater TBT is lower than the SCO at WM-SG-05 and WM-SG-08. As such, TBT is not considered to exceed the TBT SLs at these locations.

TBT is considered a PBT and is discussed further in Section 7.3.2. However, the SLs developed for the protection of human health for this compound in Appendix F are higher than the benthic criteria discussed above, and as a result, the lower and more conservative benthic criteria will be used to evaluate the extent of TBT contamination.

7.3.1.3 Semivolatile Organic Compounds

There were minor exceedances of the SCO or CSL benthic criteria for SVOCs other than cPAHs. These include bis(2-ethylhexyl)phthalate, which exceeded the CSL at WM-SG-01 and exceeded the SCO at WM-SG-14; phenol, which exceeded the SCO at WM-SG-06; 2-methylnaphthalene, which exceeded the CSL at WM-SG-24; fluoranthene, which exceeded the SCO at WM-SG-26; and high molecular weight polycyclic aromatic hydrocarbons (HPAH), which exceeded the SCO at WM-SG-14. The elevated SVOC detections at WM-SG-01 and WM-SG-14 are co-located with other incidents of SCO and CSL exceedances in the marine railway well. Sample locations WM-SG-24 and WM-SG-26 are distant from areas of Site activities, near the eastern and western entrances to Blaine Harbor. Elevated SVOC concentrations observed at these locations do not appear related to Site releases due to the large distance and because the SVOCs are not found at elevated concentrations in marine sediment samples collected near the Site uplands.

The phenol concentration from the sample collected at WM-SG-06 is the only detection of phenol in sediment above the SCO or CSL. Because phenol was not detected at concentrations above the SCO or CSL in sampling locations closer to the area of historical Site boatyard activities, it does not appear related to Site releases. Phenol can be produced in marine environments during the decay of aquatic vegetation, and as such, may result from naturally occurring conditions.

7.3.1.4 Polychlorinated Biphenyls

PCBs were detected in exceedance of the SCO for protection of benthic organisms in the locations indicated on Figure 22. As indicated on the figure, total PCBs were greater than the SCO in surface sediment samples WM-SG-01 and WM-SG-03, and at subsurface sediment sampling locations WM-SC-02 and WM-SC-10.

At SG-03, the TOC in sediment was 3.57 percent, which is slightly above the appropriate range (0.5 to 3.5 percent) for comparing OC-normalized data to SMS benthic criteria, which is OC-normalized. As a result, the dry weight analytical result for this sample is compared to the LAET value, based on the dry-weight equivalent of the SMS criteria, in Table 12. Based on this comparison, the dry-weight concentration of 163 µg/kg total PCBs at this location is slightly above the dry-weight SCO equivalent of 130 µg/kg, though well-below the dry-weight CSL equivalent of 1,000 µg/kg. It should be noted that this SCO exceedance is consistent with the evaluation of PCBs as a PBT, as discussed further in Section 7.3.2.

At WM-SC-02, the PCB contamination extends to 2 ft bgs and at WM-SC-10 it extends to 2.5 ft bgs. Subsurface samples collected from three locations around these exceedances (WM-SG-29 through WM-SG-31) were analyzed for total PCBs to evaluate the extent of these subsurface impacts. PCBs were not detected in WM-SG-29 or WM-SG-30, and were below the SCO at WM-SC-31.

As noted above, PCBs are considered a PBT and are discussed further in Section 7.3.2.

7.3.2 Sediment Persistent Bioaccumulative Toxins

The following COPCs detected in Site marine sediment are considered PBTs based on SMS guidance:

- Mercury
- Arsenic
- Lead
- Cadmium
- TBT
- PCBs
- cPAHs.

Analytical results for these COPCs are presented in Tables 13 and 15 with comparison to the appropriate PBT SLs, under the portion of the tables titled "Persistent Bioaccumulative Toxins."

7.3.2.1 Mercury

As discussed above in relation to the SMS benthic criteria, the distribution of mercury in Site sediment is shown on Figure 19. Both the SCO and CSL for mercury as a PBT are the natural background concentration of 0.2 mg/kg. Mercury is present at three sampling locations at concentrations greater than the background, each along the marine railway (WM-SG-01, WM-SG-02, and WM-SG-14). At WM-SG-02, mercury was detected at a concentration greater than the PBT SL to an approximate depth of 3.5 ft below the mudline elevation. At WM-SC-01, the concentration of mercury was less than the reporting limits in a sample collected from 1 to 2.5 ft bgs. Subsurface sediment was not collected from location WM-SG-14, but due to its presence in the marine railway well, it is anticipated that SL exceedances would extend to a similar depth as encountered at WM-SC-02. Each of the exceedances of the mercury PBT SL coincides with the presence of other COPCs detected at concentrations above SLs protective of benthic organisms.

7.3.2.2 Arsenic

The SCO and CSL for arsenic as a PBT are the natural background concentration of 11 mg/kg. Arsenic is present in surface sediment at five locations at concentrations greater than its PBT SL, along and extending outward from the marine railway (WM-SG-01, WM-SG-02, WM-SG-14, WM-SG-10, and WM-SG-12). Each of these occurrences of arsenic above the PBT SL coincides with the presence of other COPCs detected above SMS criteria for the protection of benthic organisms, except WM-SG-12. The concentrations of COPCs that appear indicative of boatyard activities (copper, mercury, zinc, TBT, and cPAHs) are much lower at sampling location WM-SG-12 than in the samples collected closer to the marine railway. The arsenic concentration detected at WM-SG-12 (12 mg/kg) is only slightly greater than the natural background concentration of 11 mg/kg and may not be related to Site releases. Arsenic did not exceed its PBT SL in any subsurface samples.

7.3.2.3 Lead

The SCO and CSL for lead as a PBT are the natural background concentration of 21 mg/kg. Lead is present in surface sediment at four sampling locations at concentrations greater than its PBT SL, along the marine railway (WM-SG-01, WM-SG-14), the travel lift (WM-SG-03), and adjacent to (east of) the upland portion of the Site (WM-SG-16). Each of these occurrences of lead above the natural background concentration coincides with the presence of other COPCs detected at concentrations above SMS criteria for the protection of benthic organisms. Lead did not exceed its PBT SL in any subsurface samples.

7.3.2.4 Cadmium

The cadmium PBT SL, developed for the protection of human health, is the natural background concentration of 1 mg/kg. No sediment samples collected at the Site contained cadmium at concentrations above the natural background level.

7.3.2.5 Organotins (TBT)

As discussed in Section 6.4, the SL developed for TBT as a PBT is less protective than the SL developed for protection of benthic criteria, based on the relatively higher sensitivity of benthic organisms to TBT. As a result, the Site-specific SLs developed for bulk TBT based on SMS benthic criteria (SCO of 238 µg/kg and CSL of 738 µg/kg) are used to evaluate the extent of TBT contamination in sediment. The distribution of TBT in sediment is shown on Figure 21 and discussed in Section 7.3.1.2.

7.3.2.6 Polychlorinated Biphenyls

The PBT SLs for PCBs include criteria for total PCBs and PCB-TEQ for dioxin-like congeners. Ecology prefers that PCB cleanup levels and assessment of the nature and extent of contamination for protection of human health be based on PCB congener data. However, much more PCB Aroclor data are available for the Site than congener data, and the concentrations of total PCB Aroclors and total PCB congeners for Site data are similar, as presented in Table 13. As a result, PCB Aroclor data were used for developing the SLs for total PCBs and assessing the extent of PCB contamination for total PCBs. The SCO for total PCBs as a PBT is 6 µg/kg and the CSL is 53 µg/kg based on protection of human health. The SCO for PCB dioxin-like congeners is 0.2 parts per trillion (ppt) and the CSL is 2.0 ppt based on protection of human health. These SLs are developed in Appendix F.

Total Polychlorinated Biphenyls

The distribution of total PCBs in marine sediment throughout Blaine Harbor as determined by summing all detected Aroclors is shown on Figure 23. As shown on the figure, total PCBs are present at concentrations greater than the human health SCO throughout most of Blaine Harbor.

Concentrations of total PCBs above the human health CSL were limited to four locations in the area near the marine railway and travel lift (WM-SG-01, WM-SG-03, WM-SG-10, and WM-SG-14). The maximum concentration of total PCBs was detected adjacent to the marine railway at WM-SG-01 (620 µg/kg) and the second-highest concentration was detected at the head of the travel lift piers (163 µg/kg).

Concentrations of total PCBs were detected above the human health SCO and/or the CSL in subsurface sediment at three locations. The total PCB CSL was exceeded to a depth of 2 ft below mudline at WM-SC-02 and to a depth of 2.5 ft at WM-SC-10. The concentration of total PCBs is greater than the SCO deeper than 5 ft at WM-SC-02 and to a depth of 2.5 ft at WM-SC-03.

Total PCBs were not detected in the sample collected outside the harbor to the west (WM-SG-27) based on PCB Aroclor analysis. This sample was also analyzed for PCB congeners, which indicated total PCBs are present at a concentration of 0.7 µg/kg, which is below the SCO for total PCBs. Concentrations of total PCBs were detected below the SCO of 6 µg/kg just inside the east opening to the harbor at WM-SG-24. The sample from outside the east harbor opening (WM-SG-25) was not analyzed because the total PCB concentration in WM-SG-24 was below the SCO. Note that PCBs were not detected at WM-SG-23, but this was the only location within the harbor where a sample was collected from the area dredged for the marina expansion in 2000.

Polychlorinated Biphenyl Dioxin-Like Congeners

Five sediment samples collected from throughout the harbor (WM-SG-20, WM-SG-22, WM-SG-24, WM-SG-27, and WM-SG-31) were analyzed for PCB congeners to determine the PCB-TEQ concentration for dioxin-like congeners to support the development of SLs for this parameter and to compare Site PCB-TEQ concentrations to the resulting SLs. The PCB-TEQ concentrations for dioxin-like congeners detected in the five RI marine sediment samples analyzed for PCB congeners are between the SCO and CSL. As summarized in Table 13 and shown on Figure 23, the results range from 0.01 ppt (outside the harbor to the west, WM-SG-27) to 1.4 ppt near the marine railway (WM-SG-31).

Based on these results, the CSL for PCB-TEQ for dioxin-like congeners was not exceeded in the samples analyzed, and the SCO exceedances do not extend outside of the harbor. Additionally, the SCO exceedances for the PCB-TEQ do not extend as far to the west as the SCO exceedances for total PCBs. It should be noted that concentrations of PCB-TEQ may be greater than the CSL in close proximity to the marine railway well based on the relatively high concentrations of total PCB Aroclor concentrations in that area.

7.3.2.7 Carcinogenic Polycyclic Aromatic Hydrocarbons

The SCO for total cPAHs is 40 µg/kg, and the CSL is 402 µg/kg based on protection of human health, as developed in Appendix F. The distribution of cPAHs in surface sediment throughout Blaine Harbor is shown on Figure 24. As shown on the figure, cPAHs are ubiquitous and concentrations exceed the SCO throughout most of the harbor, although they are generally lower in the eastern portion of Blaine Harbor. Detections of cPAHs above the CSL were generally limited to near the marine railway and travel lift areas, extending south to the breakwater separating Blaine Harbor from Drayton Harbor. The maximum detected cPAHs concentration was 1,625 µg/kg at WM-SG-14, located within the marine railway well.

Carcinogenic PAHs in marine sediment within Blaine Harbor appear to be predominantly the result of creosoted marine structures (bulkheads, docks, wharfs, and floats) present throughout the industrial area peninsula rather than related to specific Site releases. This is evidenced by the lack of creosote-treated wood in marine infrastructure in the eastern portion of the marina, where lower concentrations of cPAHs are present. Further, cPAH concentrations in shallow upland Site soil, the most likely potential source of Site releases to marine sediment, are generally low relative to marine sediment concentrations.

The concentration of cPAHs is above the SCO at WM-SG-27, which is outside the western entrance to Blaine Harbor. The cPAH concentration detected at this sampling location is consistent with impacts from marine infrastructure as the source of the elevated concentration, based on the presence of the creosoted public wharf at the harbor entrance, the creosoted marine infrastructure on the west side of the industrial area uplands, and the lack of a concentration gradient from the aquatic portion of the Site.

8.0 CONTAMINANT FATE AND TRANSPORT

This section addresses contaminant fate and transport processes, including source control, transport, and natural attenuation. The discussion in this section is focused on general fate and transport processes associated with affected media.

8.1 Source Control

Limited source control measures have been implemented to prevent releases of contaminants from Site operations. These include paving working surfaces, conducting work in a covered area, and collecting and treating stormwater runoff. Cleanup activities will need to provide further source control by preventing erosion of upland soil into the marine environment.

8.2 Transport and Attenuation Processes

Attenuation and transport processes are generally media- and contaminant-specific. Exceedances of screening criteria for soil and groundwater contaminants include cPAHs and metals, and to a limited extent, PCBs and petroleum hydrocarbons. Attenuation and transport processes associated with these contaminants, as applicable, are discussed for each affected medium in the following subsections.

8.2.1 Soil

The transport of Site soil COPCs is expected to occur primarily through physical transport of soil particles as dust or erosion due to the high affinity of the metals and organic compound COPCs present at the Site for adsorption to soil particles. Although transport via leaching to groundwater is a potential pathway, groundwater quality data indicate that leaching of Site soil COPCs to groundwater is not occurring at levels that cause groundwater contamination. Based on the high affinity of the COPCs detected in Site soil at concentrations exceeding Site soil SLs, contaminant concentrations in soil are expected to attenuate rapidly from the source of the release.

8.2.2 Groundwater

As discussed in Section 5.3, groundwater flows through the upland portion of the Site toward the marine waters of Blaine Harbor. If soil contamination were to leach into groundwater, it would potentially be transported to the marine environment depending on the attenuation characteristics of the COPC. However, detections of COPCs in groundwater at concentrations exceeding the SLs were very limited and do not appear to be the result of Site releases. Arsenic is the only COPC detected in Site groundwater at concentrations exceeding its SL in more than a single location and sampling event, and would be anticipated to attenuate rapidly in the vicinity of the shoreline due to hydrodynamic dispersion (tidal flushing) and the change in oxidation state of groundwater from reducing to a higher oxidation state near the groundwater/surface water interface.

8.2.3 Sediment

The primary transport mechanism for sediment is wave erosion and prop wash from larger vessels. The amount of erosion due to waves varies with water depth. In relatively shallow water depths (e.g., less than 10 to 15 ft), wind-driven waves can produce increases in bottom velocities that can re-suspend settled sediment, and thus cause sediment transport and redistribution. However, the aquatic portion of the Site is relatively protected from wave action, so wave-generated sediment transport is anticipated to be relatively low.

Vessel prop wash is anticipated to be the primary source of sediment transport at the Site, resulting from vessels maneuvering to load and unload from the marine railway, and to a lesser extent from the travel lift piers. The degree to which prop wash causes sediment transport is dependent on the size and draft of the vessels using the Site facilities, and to a lesser extent, vessels that navigate through the harbor past the Site. Based on the relatively limited distribution of elevated concentrations of most Site sediment COPCs (e.g., copper and zinc), significant sediment transport from the source of Site releases has not occurred.

The potential exception to the apparent limited transport of Site marine sediment COPCs is PCBs, which exhibit a broader distribution in marine sediment than other Site COPCs. However, the broader distribution of PCBs in marine sediment are largely driven by its much lower SL for protection of human health than other sediment COPCs and possibly by low concentration non-point source releases elsewhere in the Site vicinity.

Similar to PCBs, cPAHs also exhibit a broader distribution in marine sediment within Blaine Harbor. This is in part due to its low SL for protection of cPAHs and the presence of creosote-treated marine infrastructure, and potentially other diffuse or non-point-source releases.

The most effective process for attenuation of hazardous substances in marine sediment is sediment deposition and bioturbation. This process involves burial of the contaminated surface sediment over time by natural deposition of clean sediment so that the depth of the contaminated sediment is below the predominantly biologically active zone, thereby reducing risk to benthic organisms. Benthic organisms cause intermixing of surface and underlying sediment through bioturbation. Bioturbation can result in affected surface sediment being mixed with underlying clean sediment, which reduces the contaminant concentration in the predominantly biologically active zone over time, and can result in contaminant concentrations in surface sediment being reduced to below levels that pose an unacceptable risk to human health or the environment. Collectively, these processes are referred to as natural recovery.

Based on the lack of maintenance dredging required to maintain navigation drafts within Blaine Harbor, it appears that the sedimentation rate in the Site vicinity is relatively low, indicating that natural recovery would also occur at a low rate.

9.0 DEVELOPMENT OF CLEANUP STANDARDS

This section identifies regulatory cleanup requirements through the development of a CSM and proposed cleanup levels (PCLs) based on the results of the RI and consideration of potentially applicable laws and regulations. The list of COPCs and media of potential concern are refined herein based on the RI data into a list of IHSs. Final Site cleanup levels will be established by Ecology in the Cleanup Action Plan following completion of the RI/FS process.

9.1 Conceptual Site Model

Historical Site activities, environmental data, and the physical processes that control the fate and transport of contaminants were used to develop the CSM. The CSM describes the Site contaminant sources, fate and transport processes, migration pathways, and potential receptors. Figure 25 illustrates the CSM for the Site.

Historical boat maintenance and repair activities conducted on the boat cradle in the marine railway well resulted in releases of contamination to the ground surface and potentially directly to marine sediment at the Site. Concentrations of copper, arsenic, and mercury exceeded their respective SLs in shallow soil; PCB concentrations exceeded their SLs at one location only. The area affected by cPAHs is more widespread, at both the surface and at depth. The distribution of COPCs indicates that they were released to the marine railway well through either direct release or via erosion and stormwater discharge where they enter the marine environment. Limited releases to marine sediment appear to have also occurred along the eastern side of the Site uplands through these mechanisms. Additionally, contaminated upland fill may be entering the marine environment due to erosion through gaps or breaks in the aging timber bulkhead lagging.

Potential receptors for contamination include Site workers or visitors who could contact contaminated soil, benthic and aquatic organisms that could be affected by contaminated sediment, and higher trophic-level species and humans that consume aquatic or benthic organisms that include the Site vicinity within their home range.

9.2 Frequency of Detection and Screening Level Exceedances

This section presents a summary of the frequency of detection for Site COPCs and a discussion of COPCs that were detected at concentrations greater than the SLs. Tables 9, 11, 16, and 17 present summary statistics used in this evaluation. These tables show the number of samples collected, the number of detections, minimum and maximum detections, and reporting limits. COPCs that were not detected at concentrations greater than SLs for a given medium, or do not have a frequency of detection greater than 5 percent, are not carried forward as IHSs. Table 18 presents a summary evaluation of COPCs that were detected with a frequency greater than 5 percent, and were detected at least once at a concentration greater than the SL. Table 19 presents IHS considerations for sediment. Table 20 provides a summary list of Site IHSs by medium.

9.2.1 Indicator Hazardous Substances in Groundwater

The following list summarizes groundwater COPCs that were detected at least once with a concentration greater than their respective SL; each has a frequency of detection greater than 5 percent:

- Arsenic
- Copper.

Arsenic was detected in three groundwater samples collected from two locations at concentrations greater than the SL. Based on the evaluation discussed in Section 7.1, the arsenic detections in groundwater do not appear to be related to releases from the Site. Copper was detected at a concentration above the SL in 1 of 12 samples. The single exceedance was only slightly higher than the SL and was flagged as an estimate. Copper was not detected in the second sample from the same location. Based on these considerations, arsenic and copper are not carried forward as groundwater IHSs and groundwater does not appear to be an affected Site medium.

9.2.2 Indicator Hazardous Substances in Soil

The following list summarizes soil COPCs that were detected with a frequency of greater than 5 percent, with at least one detection greater than SLs:

- Arsenic
- Copper
- Mercury
- Diesel-, lube oil- and gasoline-range TPH
- Total PCBs
- cPAHs.

Petroleum hydrocarbons were detected only once above the SLs (for each range), and were co-located with cPAHs. Based on the low number of exceedances (3 percent or less), the limited distribution at the Site, and because TPH exceedances were all co-located with cPAH exceedances, petroleum hydrocarbons are not carried forward as IHSs. Arsenic, copper, mercury, PCBs, and cPAHs were each detected at concentrations greater than the SL and are carried forward as IHSs.

9.2.3 Indicator Hazardous Substances in Sediment

The following list summarizes sediment COPCs that were detected with a frequency of greater than 5 percent, with at least one detection greater than SLs:

- Metals (arsenic, copper, mercury, and zinc)
- PCBs

- SVOCs (cPAHs, bis[2-ethylhexyl]phthalate, phenol, 2-methylnaphthalene, HPAHs)
- TBT.

Each of these COPCs except for bis(2-ethylhexyl)phthalate, phenol, 2-methylnaphthalene, and HPAHs are carried forward as IHSs. Phenol and 2-methylnaphthalene were anomalous detections not likely related to Site releases. Bis(2-ethylhexyl)phthalate and HPAHs exceeded their SLs at only one location, and are co-located with other IHSs (including cPAHs). Because cleanup actions that address cPAHs will also address these isolated exceedances, bis(2-ethylhexyl)phthalate and HPAHs are not carried forward as IHSs.

9.3 Proposed Cleanup Standards

Based on the results of the RI, the CSM, and consideration of potentially applicable laws and regulations, cleanup standards can be developed for each IHS identified for the media of concern. As noted in the previous section, no IHSs are identified for groundwater, so development of cleanup standards are not required for the medium. The remainder of this section discusses the development of cleanup standards (i.e., cleanup levels and points of compliance) for IHSs in soil and sediment.

9.3.1 Cleanup Standards – Soil

The PCLs for the IHSs identified in soil are the SLs previously developed through the course of this RI for soil IHSs. The PCLs are presented in Table 18. The point of compliance for the soil PCLs will be throughout the Upland Site Unit.

9.3.2 Cleanup Standards – Sediment

The PCLs for marine sediment must be established between the SCO and the CSL; establishment of the PCLs greater than the SCO requires demonstrating that it is not technically possible to achieve and maintain the SCO and/or that meeting and maintaining the SCO will have a net adverse environmental impact on the aquatic environment. An evaluation of appropriate PCLs for the IHSs identified for the Marine Site Units is provided in Appendix H.

The PCLs for copper zinc, and TBT in sediment are established at the SCO (based on protection of benthic criteria). For those metals that are considered PBTs (i.e., arsenic, cadmium, lead, and mercury), the PCLs are set at the corresponding natural background values. Because of the broad distribution of PCBs and cPAHs at concentrations exceeding the SCOs based on protection of human health, the PCLs for these two PBTs are established above the SCO based on the evaluation approach summarized in Appendix H. The resulting PCLs for the IHSs in sediment are presented in Table 21; the point of compliance for these PCLs is the predominantly biologically active zone (upper 10 cm of sediment) and horizontally natural extent.

Compliance with the cleanup standards to protect benthic organisms will be based on a point-by-point comparison of detected contaminant concentrations in sediment to numerical cleanup criteria.

Compliance with the cleanup standards to protect human health will be based on area-wide mean concentrations for PBTs, in accordance with SCUM II guidance (Ecology 2017), since human health and higher trophic-level species have area-wide exposures. SCUM II recommends that area-wide mean concentrations be calculated using Thiessen polygons, which are shown on Figure 29 for reference.

10.0 REMEDIAL INVESTIGATION CONCLUSIONS

The nature and extent of contamination has been adequately delineated for affected Site media to develop an accurate CSM, and to develop and evaluate cleanup alternatives for the Site. Data gaps that were identified prior to implementation of the RI have been filled.

In the upland portion of the Site, IHSs present at concentrations above the soil SLs include cPAHs and metals, and to a lesser extent PCBs. These IHSs are the most broadly distributed in shallow soil. The cPAHs, metals, and PCBs exceeding the SLs in the surface and shallow soil appear to be caused by releases at the Site based on their distribution, the assemblage of IHSs present, and the CSM. The cPAHs, and to a lesser degree arsenic, present in deeper soil at concentrations exceeding the SLs, appear to be related to poor fill quality based on the association of contamination with the presence of wood debris and the lack of a viable migration pathway between the area of Site activities and the location of contamination that would be consistent with the CSM. Groundwater is not affected by Site releases, and consequently is not considered an affected medium for the Site.

In the marine portion of the Site, IHSs are present in marine sediment at concentrations that exceed the SLs based on protection of benthic organisms in the vicinity of the marine railway well and the travel lift area, and extending south about 200 ft from the shoreline, as shown on Figures 18 through 22. Exceedance of the CSLs protective of benthic organisms is limited to the immediate vicinity of the marine railway well and travel lift piers. The depth of sediment contamination in this area is limited to approximately the upper 2.5 ft, and does not extend deeper than surface sediment beyond about 100 ft from the shoreline for all IHSs except for PCBs; PCBs exceed the SCO in subsurface sediment about 200 ft from the shoreline at WM-SC-10. Localized marine surface sediment contamination is also present adjacent to the eastern side of the Site uplands, although only limited sediment is present in this area due to the presence of erosion protection (riprap).

PCBs and cPAHs are present in marine surface sediment at concentrations above the SLs protective of human health and higher trophic-level species throughout much of Blaine Harbor, as shown on Figures 23 and 24. Generally, the SLs for these IHSs for protection of human health are not exceeded beyond the area where SCOs protective of benthic organisms are exceeded. Marine infrastructure constructed using creosoted wood appears to be a significant source of cPAHs in Blaine Harbor that is unrelated to Site releases and the cause of most of the cPAH SCO exceedances beyond the area exhibiting benthic SL exceedances. It is possible that diffuse or non-point source releases of PCBs to Blaine Harbor from non-Site sources could be contributing to the low concentrations of PCBs and cPAHs present at distance from the marine railway.

11.0 FEASIBILITY STUDY

The purpose of the FS is to develop and evaluate a range of cleanup action alternatives and identify the preferred alternative for Site cleanup. MTCA has established requirements for selecting a cleanup action and the expectations for cleanup action alternatives in WAC 173-340-360 and 173-340-370. This section begins with a discussion of the interdependent relationship between the Site Units requiring cleanup, then establishes remedial action objectives (RAOs) and identifies potentially applicable laws relevant to the cleanup of the Site.

11.1 Site Units

The Site has two separate and distinct impacted areas that warrant designation and evaluation as independent Site Units. The Site Units are the Upland Site Unit and the Marine Site Unit, as identified on Figures 26 and 27. Alternatives are developed and evaluated to clean up each Site Unit, and a preferred alternative is selected that achieves RAOs for both Site Units.

Although the environmental settings of the two Site Units are separate and distinct, the primary sources of contamination are contiguous between the two Site Units. As a result, the cleanup actions selected for each Site Unit are interdependent and will need to be integrated for an effective Site-wide cleanup action. Additionally, implementation of some cleanup action elements may need to be sequenced in a specific manner to be effective. The interrelationship between, and coordination of, the Upland and Marine Site Unit cleanup alternatives are discussed as appropriate in the applicable sections of the FS. The physical factors, land and navigation use, and natural resource value for each Site Unit are described below.

11.1.1 Upland Site Unit

The Upland Site Unit is slightly more than 1 acre and is generally bounded by Berg Street on the north, Blaine Harbor to the south and east, and a boundary on the west developed during the RI based on the extent of historical boatyard activities, as shown on Figure 26. The Upland portion of the Site is owned by the Port and DNR, as previously discussed, and is currently zoned for commercial use with surrounding properties zoned for commercial or industrial use with limited public access. Upland land use will likely remain unchanged for the foreseeable future.

The upland habitat of the Site is sparse, as discussed in Section 5.4.1 (Upland Habitat). The Site is currently used for boatyard activities to support the commercial marine industry and recreational boaters, and is divided approximately in half by the marine railway. The eastern side of the Site uplands consists of a gravel-covered area used for boat maintenance. The western portion of the Site uplands is paved with three buildings: a covered boat maintenance area directly adjacent to the marine railway, and two buildings at the northwest and southwest end of the Site owned by Boundary Fish. No vegetation is present on the upland portion of the Site that would impact the selection or implementation of a cleanup action at the Site.

11.1.2 Marine Site Unit

As discussed previously, sediment contamination resulting from Site releases is present in the area around the marine railway. Figure 27 presents the Marine Site Unit, including the boundaries of SMA-1 and SMA-2. SMA-1 comprises two subunits (i.e., SMA-1A and SMA-1B). Figures 28 and 29 show benthic and PBT criteria SCO exceedances throughout SMA-1 and SMA-2. Figure 30 shows benthic criteria SCO and CSL exceedance locations in SMA-1. The data presented on these figures were used to establish the sediment management area boundaries.

The boundary of SMA-1A is the approximate half-acre area generally surrounding the marine railway and travel lift, extending south from the uplands about 200 ft, where concentrations of IHSs exceed the SCOs based on protection of benthic species. There were no concentrations of IHSs that exceed the benthic criteria outside of this area except in one localized area adjacent to the eastern side of the Site uplands, which is designated as SMA-1B (as delineated on Figure 27).

IHS concentrations in both subunits of SMA-1 exceeding the SCOs are mostly limited to the upper 1 ft of sediment, although in some areas extend to a depth of approximately 2.5 ft. All exceedances of the CSLs for PBTs are also contained within SMA-1.

Outside of SMA-1, the remainder of the harbor is defined as SMA-2, which is approximately 26 acres in area. The PBTs cPAHs and PCBs are the only IHSs that exceed the SCO in SMA-2. PCB Aroclor concentrations generally decrease with distance from the marine railway until they are undetectable near the eastern and western harbor boundaries. The concentrations of cPAHs are highest near the marine railway. However, outside of SMA-1, cPAHs were detected at various concentrations exceeding the SCO throughout the harbor indicating that the harbor-wide cPAH concentrations in SMA-2 are related to creosote-treated marine infrastructure and not Site releases, as previously discussed in Section 10. Bulkheads and dock pilings throughout much of the industrial area in the harbor are constructed of creosote-treated timber, which appears to be the primary source of CPAHs in harbor-wide sediment.

11.2 Remedial Action Objectives and Potentially Applicable Laws

The RAOs identify the goals that must be achieved by a cleanup alternative in order to attain cleanup standards and provide adequate protection of human health and the environment. The RAOs must address all affected media and a cleanup alternative must achieve all RAOs to be considered a viable cleanup action. The characterization of Site conditions presented in Section 7.0 (Nature and Extent of Contamination), the preliminary cleanup standards discussed in Section 9.0 (Development of Cleanup Standards), and the review of applicable or relevant and appropriate requirements (ARARs) (discussed in Section 11.2.2) have culminated in the development of RAOs for the Site.

11.2.1 Remedial Action Objectives

RAOs can be either action-specific or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve a specific chemical concentration criterion. Media-specific RAOs are based, in part, on the PCLs discussed in Section 9.0.

The action-specific and media-specific RAOs identified for the Site are as follows:

- **RAO-1**: Prevent direct human contact with soil containing hazardous substances at concentrations exceeding the soil PCLs
- **RAO-2**: Prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment
- **RAO-3:** Prevent exposure of marine biota to sediment containing hazardous substances at concentrations that exceed cleanup standards protective of benthic organisms
- **RAO-4:** Prevent exposure of humans and higher trophic-level species to PBTs at concentrations that exceed cleanup standards protective of humans and higher trophic-level species.

11.2.2 Potentially Applicable State and Federal Laws

The extent to which each alternative meets these RAOs will be determined by applying the specific evaluation criteria identified in MTCA and SMS. In accordance with MTCA, all cleanup actions conducted under MTCA must comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate (collectively referred to as the ARARs). This section provides a brief overview of potential ARARs for Site cleanup.

The primary ARARs are cleanup standards under the SMS and MTCA cleanup levels and procedures for implementation of a cleanup under MTCA. Other potential ARARs include the following, which will be further evaluated during the remedial design phase based on the actual cleanup alternative selected for implementation:

- Washington Water Quality Act and Washington Water Pollution Control Act and the following implementing regulations: Water Quality for Surface Waters (Revised Code of Washington [RCW] 90.48; Chapter 173-201A WAC) and SMS (Chapter 173-204 WAC).
- State Environmental Policy Act (SEPA; Chapter 197-11 WAC).
- Resource Conservation and Recovery Act (RCRA) and Subtitle C regulations, to the extent that any hazardous wastes are discovered during the cleanup action.
- Washington Hazardous Waste Management Act and the implementing regulations, Dangerous Waste Regulations (Chapter 173-303 WAC), to the extent that any dangerous wastes are discovered during the cleanup action.

- Clean Water Act, with respect to water quality criteria for surface water (Blaine Harbor) and in-water work associated with dredging or sediment capping (40 CFR 230; 33 CFR 320, 323, 325, and 328).
- Construction in State Waters, Hydraulic Code Rules (RCW 75.20; Chapter 220-1101 WAC).
- EPA Water Quality Standards (National Toxics Rule) – 40 CFR 131.
- Washington's Shoreline Management Act, with respect to construction activities conducted near the shoreline during the cleanup action (RCW 90.58; Chapters 173-18 and 173-20 WAC).
- Dredge and fill requirements under CFR 320-330 and Hydraulic Code Rules under Chapter 220-110 WAC.
- Endangered Species Act.
- Washington Clean Air Act (Chapter 70.94 WAC).
- Occupational Safety and Health Act, (29 CFR Subpart 1910.120; Chapter 296-62 WAC).
- Critical Areas Ordinance of the City of Blaine (Blaine Municipal Land Use Code Chapter 17.82 Critical Areas Management).

MTCA, Water Quality Standards for Surface Waters, SMS, and the Clean Water Act were considered in the discussion of cleanup standards in Section 9.0. RCRA Subtitle C and Dangerous Waste Regulations are not expected to apply unless dangerous wastes are discovered or generated during the cleanup action. Dangerous wastes are not known to be present at the Site. The Shoreline Management Act, dredge and fill requirements, and Hydraulic Code Rules may apply during the implementation of a particular cleanup action but do not directly influence the evaluation of applicable cleanup alternatives.

A draft biological evaluation will be prepared for US Army Corps of Engineers (USACE) review and approval, as part of the permitting process for the selected cleanup remedy, to address any in-water construction activities.

11.3 Future Land Use

Remedial alternatives must consider both current and foreseeable future land use to ensure that the cleanup alternatives are effective and will remain effective through their intended lifespan, even if future land use changes within reasonably predictable limits. The Port intends future Site use to be the same or similar to current Site use, although significant repair to existing infrastructure is anticipated. The Port has no current plan for redevelopment or re-purposing the Site because of the continued need for a shipyard to support the Blaine fishing fleet.

The aquatic portion of the Site will remain in commercial and recreational maritime use, which will require maintaining, and possibly deepening channel depth to accommodate vessel drafts. It is anticipated that the existing marine railway system will remain to service commercial vessels, particularly heavier vessels and wood-hulled fishing boats that cannot utilize travel lifts or crane lifts located in Bellingham.

The permanent removal of the marine railway and replacement with a travel lift was considered. However, a new travel lift would be difficult to permit because it would require an individual permit while the existing marine railway could be replaced as part of the cleanup action under a Nationwide 38 permit, and for the reasons noted would not provide the same functionality. Moreover, the cost of replacing the marine railway with a new travel lift system would need to be included in the remedial alternatives cost estimates, and would likely result in higher costs than replacement of the marine railway in kind.

11.4 Screening of Remedial Technologies and Institutional Controls

The purpose of the FS is to develop and evaluate cleanup action alternatives to enable an appropriate cleanup action to be selected for the Site. This FS complies with the requirements under MTCA for performance of an FS (WAC 173-340-350) and selection of a cleanup action (WAC 173-340-360). Additionally, it is consistent with the Bellingham Bay Comprehensive Strategy and meets the Bellingham Bay Action Team's objectives for contaminated Site cleanup, habitat restoration, and integrated land use (Makers et al. 2013).

MTCA regulations place a preference on the use of permanent cleanup methods such as removal, disposal, or treatment, relative to those that manage contaminants in-place using institutional controls and/or containment. This preference is reflected in the MTCA and SMS evaluation criteria, and the comparative analysis of remedial alternative technologies. The development of cleanup action alternatives involves the screening of remedial technologies to identify those capable of meeting cleanup requirements and then assembling the applicable technologies into a range of remedial alternatives that achieve all of the RAOs. These remedial alternatives are then evaluated and compared to criteria established in the MTCA and SMS regulations; a preferred alternative is identified based on this evaluation. Section 9.0 (Development of Cleanup Standards) presents the cleanup requirements for the Site and Section 11.1 (Site Units) identifies the site units for which cleanup alternatives will be developed. This section describes pertinent considerations for the development of cleanup alternatives for the Site, reviews a range of potentially applicable cleanup technologies, and selects those technologies to be retained for development into the cleanup alternatives presented in Section 11.5 (Description of Remedial Alternatives).

Cleanup alternatives must consider both current and potential future Site uses to determine their long-term effectiveness. This requires that applicable cleanup elements be considered in the context of both current and potential future land uses to determine whether these uses could compromise the effectiveness of the cleanup action and, if so, modified so the cleanup element reasonably accommodates the anticipated land use.

Based on these considerations, remedial technologies were screened and those technologies anticipated to be effective and compatible with current and anticipated future Site uses were identified for development into Site remedial alternatives. The identified potentially applicable technologies screened are summarized in the following sections.

11.4.1 Upland Site Unit (Soil)

Two RAOs are applicable to the Upland Site Unit: RAO-1 (prevent direct contact with contaminated soil) and RAO-2 (prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment). The following remedial technologies or response actions were screened for consideration in the development of cleanup action alternatives for the Upland Site Unit and were compared to the applicable RAOs.

11.4.1.1 Capping/Containment

Engineered caps are commonly implemented to contain contaminated materials and prevent human and terrestrial ecological exposure to contaminated materials (RAO-1). Caps prevent migration of soil via erosion or mechanical disturbance by covering contaminated soil with a physical protective barrier, addressing RAO-2. At the Site, capping would be achieved by placing a soil cap, pavement, and/or building cover to limit potential future human exposure to contaminated soil. Potential capping technologies considered include a clean soil/sand cap and an asphalt cap. Because groundwater is not an affected medium, a low permeability cap is not required.

Asphalt pavement and building slabs currently cover most of the Site to the west of the marine railway; the ground cover to the east is mostly gravel. Although the asphalt pavement and building slabs are not considered engineered caps, they do provide effective soil containment by limiting human exposure to contaminated soil (RAO-1). Some existing pavement may be suitable for providing a long-term cap, though some modification may be required to match final Site grades.

If a paved cap is used to prevent direct contact with underlying contaminated soil, the cap could be constructed using asphalt or concrete pavement, constructed in accordance with typical paving design for a pavement section, including a sub-base layer and pavement mix. Pavement thickness would be a minimum of 4 inches.

If a soil cap is used to prevent direct contact with underlying contaminated soil, the soil would be underlain by a non-woven geotextile to mark the depth of clean soil above the contaminated soil. Soil cap thickness would be a minimum 2 ft in thickness to provide a sufficient physical barrier to incidental intrusive activities.

Lateral containment along the upland shoreline perimeter of the Site is required to prevent the release of contaminated soil to the marine portion of the Site. The current bulkhead is in poor condition and gaps are present between timber lagging boards. As a result, contaminated soil is eroding or “winnowing” from exposed areas at the face of the bulkhead. Replacement of the bulkhead is required to prevent this erosion, and to allow for dredging contaminated Site sediment, due to stability concerns if sediment is removed from the base of the current bulkhead. Replacement of the existing bulkhead is addressed in the Marine Site Unit remedial alternatives, but it will also support upland containment by preventing the erosion of contaminated soil into the aquatic environment.

Both soil and pavement caps are carried forward as remedial technologies for further evaluation.

11.4.1.2 Removal and Offsite Disposal

Physical removal (excavation) and offsite disposal of the contaminated soil would achieve RAO-1 by removing the source of contamination. Standard excavation techniques would be used for removal, although the cost and difficulty of removal would increase for excavations extended to depths below the groundwater table, particularly in the vicinity of the shoreline. Removed contaminated soil would be disposed of at an appropriate licensed and permitted solid waste disposal facility. Removal and offsite disposal of contaminated soil is carried forward as a remedial technology for further evaluation.

11.4.1.3 Soil Treatment/Stabilization

Soil can be treated to directly reduce contaminant concentrations, or stabilized to immobilize contaminants. These technologies can be applied *in situ* or *ex situ*. Stabilization techniques typically involve mixing an admixture such as cement into the soil to bind with and immobilize contaminants. However, it has been demonstrated that groundwater at the Site is not affected by contaminants leaching from the soil, so stabilization techniques are not considered appropriate or necessary for achieving Site RAOs.

Other soil treatment technologies (both *in situ* and *ex situ)* are likewise not considered appropriate or necessary. Potentially applicable soil treatment technologies include soil washing (inorganic and organic contaminants), bioremediation (organic contaminants), and thermal treatment (organic contaminants). Given that both organic and inorganic contaminants are present in Site soil, soil washing would be the only soil treatment technology potentially capable of treating Site soil for all IHSs.

However, inorganic (metals) and organic (e.g., cPAHs) IHSs would require different treatment solutions if soil flushing were applied; for metals, washing soil with acidic water would be required to leach metals from the soil and soil washing for cPAHs would require the use of an organic solvent and/or surfactant. Soil washing for treatment of either organic or inorganic contaminants is more expensive on a unit cost basis than excavation and offsite disposal, so treatment for both would be much more expensive. Based on these considerations, soil treatment/stabilization technologies are not carried forward for further evaluation.

11.4.1.4 Institutional Controls

Institutional controls are an administrative measure that would use restrictive covenants to achieve RAO-1 by preventing Site activities that could lead to direct contact with contaminated soil. Institutional controls are not considered a stand-alone remedial alternative, but would be an integral part of any capping or containment alternative. As a result, institutional controls are carried forward for further evaluation.

11.4.2 Marine Site Unit (Sediment)

The RAOs applicable to the Marine Site Unit are:

- **RAO-2:** Prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment
- **RAO-3:** Prevent exposure of marine biota to sediment that contains hazardous substances at concentrations that exceed cleanup standards protective of benthic organisms
- **RAO-4:** Prevent exposure of humans and higher trophic-level species to PBTs at concentrations that exceed cleanup standards protective of humans and higher trophic-level species.

RAO-2 will be addressed by preventing the migration of upland soil to the aquatic environment, the management of stormwater to prevent releases to surface water that exceed applicable regulatory limits, and the replacement of the bulkhead to prevent winnowing of upland soil from the bulkhead face. The rationale for these actions and the approach for implementation is discussed in Section 11.5.

There are generally three categories of sediment cleanup technologies that can meet RAO-3 and RAO-4: 1) monitored natural recovery (MNR) and enhanced MNR (EMNR), 2) sediment capping, and/or 3) sediment removal by dredging or excavation. These technologies are summarized individually below with references to Site-specific applications, including how each could address RAOs, and where each could be applied at the Site. *In situ* treatment technologies are under development and are not considered further in this FS, except as noted for EMNR, which could include amendments of media (such as activated carbon) to bind contaminants, making them unavailable for biological uptake. The following sections describe the remedial technologies screened for consideration for applicability at the Site. Section 11.5 describes the remedial action alternatives, which comprise multiple cleanup technologies used in combination to meet all RAOs.

11.4.2.1 Monitored Natural Recovery

Sediment natural recovery is a term used to describe the natural processes by which sediment quality can improve without intervention. These natural processes can include physical processes such as sedimentation, advection, diffusion, dilution, dispersion, and bioturbation; biological processes such as biodegradation, biotransformation, phytoremediation; chemical processes such as oxidation/reduction, sorption; or other processes that may reduce bioavailability. These processes result in a reduction in concentration in the predominantly bioactive zone by intermixing newly deposited sediment with more affected sediment, containing affected sediment beneath more recently deposited affected sediment, and/or destroying or otherwise reducing the bioavailability or toxicity of contaminants in sediment through chemical and biological processes. The predominant mechanism among these is sedimentation. Sediment accretion can provide a layer of uncontaminated habitat in surface sediment—the location of the predominantly biologically active zone (uppermost 10 cm of sediment). MNR remedies take advantage of naturally occurring processes such as this, which have low-implementation costs and are non-invasive in nature.

A disadvantage of MNR is that it can be slower to reduce risks in comparison to other remedies such as capping or dredging. Therefore, its use should be limited to where natural recovery is already demonstrably occurring, and where sediment quality monitoring can be carefully implemented to track progress toward complete restoration within a reasonable timeframe. In accordance with SCUM II guidance (Ecology 2017), a reasonable restoration timeframe for sediment recovery is approximately 10 years.

As discussed in Section 5.1.2 and shown on Figure 9, sediment accretion is occurring at the Site in the deeper portions of the Site Marine Area (depths greater than about –10 ft mllw) at an estimated rate of approximately 2.5 cm (1 inch) per year, and sediment erosion appears to be occurring in shallower sediment in the areas to the west and northeast of the upland portion of the Site. This sediment accretion rate was estimated by comparing the bathymetric surface elevation based on a survey conducted in 2012 to surface elevations based on a 1997 survey. This evaluation is considered approximate, since the surveyed points were not identical between survey events. However, the evaluation strongly supports the conclusion that a net positive depositional environment exists throughout the portions of the Marine Site Area located below depths affected by wave action and prop wash, and as a result, MNR is carried forward as an applicable remedial technology for further evaluation.

11.4.2.2 Sediment Capping

Sediment capping approaches range from a thin-layer cap (typically 1 ft, or less) to enhance the natural recovery process to an engineered cap that contains contaminated sediment by physically, and in some cases chemically, isolating contaminated sediment from the predominantly biologically active zone. Engineered caps typically include a containment media layer (e.g., sand) at least 2 ft thick. In areas subject to erosional forces such as wave action and/or vessel prop wash (such as a marina), an erosion protection layer to prevent disturbance or breaching of the containment layer (e.g., cobble-size or greater, depending on applicable erosional forces) at least 1 ft thick is typically placed over the containment layer. In some instances, a layer of finer-grained material is placed over the erosion protection layer to provide a stratum that can be recolonized by benthic organisms. Based on these design needs, an engineered cap in a working harbor such as Blaine Harbor would typically be at least 3 ft thick, and potentially 4 ft or greater in thickness.

Placement of a thin layer of clean soil or sediment over contaminated sediment creates a predominantly biologically active zone unaffected by Site contamination. The cap material would provide a clean stratum for colonization by benthic organisms, thus preventing exposure of marine biota to underlying contaminated sediment, which would address RAO-3. Thin-layer capping as part of an EMNR remedy is a widely accepted technology for addressing sediment contamination and is carried forward as a remedial technology for further evaluation.

A thin-layer cap as part of an EMNR remedy is generally limited to areas of sediment accretion because the purpose of such a cap is to accelerate natural sediment accretion processes, not physically contain contaminated sediment. As a result, thin-layer caps are typically not appropriate for intertidal areas subject to vessel wake or moderate wind wave action, or shallow subtidal areas subject to vessel prop wash or heavy wind wave action. Because the current and potential future land use at the Site is as a boatyard, vessel prop wash is of particular concern in maintaining a thin-layer cap in SMA-1 due to the loading, unloading, and maneuvering of vessels in this area. Based on these limitations, and the level of commercial and recreational vessel activity in Blaine Harbor, it is assumed for the purposes of this FS that thin-layer capping, and thus EMNR, is applicable only to depths greater than –10 ft mllw.

Both thin-layer and engineered capping are widely accepted technologies for addressing sediment contamination. However, the use of an engineered cap in Blaine Harbor would interfere with maintaining required depth to accommodate vessel drafts for ongoing operation of the harbor. As a result, the thin-layer cap technology to promote EMNR is carried forward for further evaluation but the engineered cap is screened out as being incompatible with long-term Site use.

11.4.2.3 Removal and Offsite Disposal

Physical removal (dredging) and offsite disposal of the contaminated sediment at a permitted disposal facility could address RAO-3. Standard dredging techniques could be used to remove sediment throughout the aquatic portion of the Site. In SMA-1B, located east of the upland area, mechanical dredging may not be implementable because sediment contamination appears to be limited to a thin veneer overlying riprap. However, suction dredging, likely using a vactor truck, could be used during periods of low tide to remove contaminated sediment at this location. Sediment removed from the Site would be disposed of offsite, at an upland licensed and permitted solid waste facility.

Removal and offsite disposal of contaminated sediment is carried forward as a remedial technology for further evaluation.

11.4.2.4 Institutional Controls

Institutional controls can be used to limit exposure to contaminated sediment by preventing seafood consumption and beach-play activities. Based on the Site setting, clamming and beach-play activities do not occur in Blaine Harbor. Impacts from PBTs would not be addressed through institutional controls, since the maximum reasonable exposure is through consumption of finfish or crabs, which have a large home-range, of which the Site is only a small portion. As a result, no institutional controls are planned for implementation as part of cleanup activities in the marine portion of the Site. The potential effectiveness of institutional controls will be reconsidered during the remedial design phase to determine if institutional controls could assist in Site cleanup or protection of human health and the environment.

11.5 Description of Remedial Alternatives

This section describes the remedial alternatives that were developed for each Site Unit using the cleanup technologies screened and selected in Section 11.4 (Screening of Remedial Technologies and Institutional Controls). For each alternative, this section provides the following information:

- A description of the cleanup actions, including habitat, land use, and navigation considerations relevant to the cleanup action
- A summary of costs and schedule
- A discussion of how each alternative would meet the RAOs for the Site.

Sufficient detail is included for each alternative to provide the reader with a conceptual understanding of the design’s intent and to provide an adequate basis for developing the cost estimates for each alternative.

11.5.1 Marine Railway System – Source Removal and Control

One element common to all remedial alternatives will be the temporary removal of the marine railway system. This action will generally consist of removing the rails, rail ties, and support pilings to provide the necessary access to contaminated areas of both the Upland and Marine Site Units, thereby allowing implementation of the cleanup alternatives discussed below to meet RAO-1, RAO-3, and assist in meeting RAO-4. The marine railway will be reconstructed following implementation of the cleanup action to return it to pre-construction functionality, but the upland side rails will not be replaced.

In the past, the marine railway system acted as a significant contaminant migration pathway. However, recent upgrades to boatyard practices and stormwater management are anticipated to prevent ongoing releases of contaminants to the aquatic environment. Additionally, Site grading conducted as part of all upland cleanup alternatives will direct stormwater away from the marine railway well to prevent direct discharge of stormwater to the marine environment.

The marine railway system includes the railway well (approximately 40 ft wide by 150 ft long), a rail system that extends from the head of the well into the water to about 130 ft beyond the timber bulkhead, and upland side-tracks extending perpendicularly to the well to the west and east. The upland sidetracks extend approximately 100 ft to the west and 80 ft to the east of the well. There are three sets of rails on each side, each apparently supported by approximately 36-inch-wide, 8-inch-thick concrete foundation pads, based on the portion of the rail system exposed during the interim action. Portions of the system are currently exposed while others have been covered with more recent fill and/or pavement. Removal of the sidetracks would provide access to shallow contaminated soil for alternatives that include upland soil removal.

The primary components of the conceptual design for the temporary removal of the marine railway are shown on Figure 31. Estimated costs for the components of the marine railway system's temporary removal and reinstallation will be integrated as part of the evaluation for the Site Unit to which the component is most directly related. For example, costs for removal of the upland sidetrack infrastructure will be included as part of the estimated costs for the Upland Site Unit remedial alternative evaluation process. Similarly, removal and replacement of the marine railway components in the Marine Site Unit, extending up into the marine railway well, are included as part of the costs for Marine Site Unit remedial alternatives.

11.5.2 Cleanup Alternatives for Upland Site Unit

The following three remedial alternatives were developed for the Upland Site Unit using a combination of the remedial technologies discussed in Section 11.4.1:

- Alternative U-1 – Shallow soil excavation and offsite disposal of contaminated soil, containment with soil cap, and institutional controls
- Alternative U-2 –Near-surface excavation and offsite disposal of contaminated soil, containment with an asphalt cap, and institutional controls
- Alternative U-3 – Site-wide removal of contaminated soil.

The following sections describe the remedial alternatives developed for the Upland Site Unit.

11.5.2.1 Upland Site Unit Alternative U-1: Shallow Soil Excavation, Containment of Residual Contaminated Soil, and Institutional Controls

Alternative U-1 includes the excavation offsite disposal of the upper 2 ft of contaminated soil. This would provide a significant amount of contaminant mass removal from shallow depths where future Site intrusive activities could potentially expose workers to contaminated soil and/or cause releases of hazardous substances to the environment. The excavation would be backfilled with clean, granular soil to existing grades to contain the remaining contaminated soil. Two ft of clean soil cover is considered by Ecology to be the minimum thickness necessary for a soil cap without a paved surface layer to prevent inadvertent direct contact with contaminated soil at similar cleanup sites (Ecology 2019). The primary components of the conceptual design for Alternative U-1 are shown on Figure 32.

Alternative U-1 achieves both RAO-1 (prevent direct contact with contaminated soil) and RAO-2 (prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment) through a combination of source control, containment, institutional controls, and stormwater management. The following sections provide a more detailed description of the cleanup actions included for Alternative U-1.

Contaminated Soil Excavation and Offsite Disposal

The extents of the proposed excavations for this alternative are shown on Figure 32. The extent of excavation includes most of the Site not covered by buildings. Approximately 2,000 cubic yards (yd^3) of soil would be excavated, removing hazardous substances from the upper 2 ft of soil across most of the Site. Based on the RI data, the excavated soil should be accepted for disposal at a RCRA Subtitle D landfill. Deeper soil contamination would be contained in place by the soil cap in conjunction with institutional controls. A non-woven geotextile layer would be installed at the base of the excavation as a marker layer indicating the presence of underlying contaminated soil.

Demolish and Remove the Marine Railway System Side Rail System

As discussed in Section 11.5.1, the demolition and removal of the marine railway system side rails are a required element of all of the upland cleanup alternatives. This action would allow for the upland regrading needed to better direct and manage stormwater to achieve RAO-2. The side rails are not used by the current tenant, Walsh Marine, so their permanent removal will not affect the functionality of the marine railway system.

Stormwater Management

It is assumed for the purposes of this FS that existing operations would continue on the clean soil surface created through the cleanup action and that the surface would be graded away from the marine railway well. As part of this alternative, stormwater collection and control would be required because current and potential future Site uses involve activities that require an NPDES Boatyard General Permit, an industrial stormwater general permit, or an individual permit. All of these permits require the collection and analysis of stormwater samples, and the potential treatment of stormwater if applicable benchmark criteria are exceeded.

Approximately half of the Upland Site Unit is currently covered with asphalt pavement or concrete building foundations. For the purposes of this FS, it is assumed that the Site surface would be contoured to provide drainage and route stormwater to either a tenant-provided water treatment system or a bioswale, but no other costs for stormwater management or treatment are included in this alternative.

Institutional Controls

Institutional controls would include an environmental covenant for the Site to prevent activities that could compromise the integrity of the cleanup or otherwise result in unacceptable risks to human health or the environment. The restricted activities would include those that could result in releases of hazardous substances or exposure of workers to contaminated soil. The restrictive covenant language would be recorded in the property deed with Whatcom County, and would be binding on the owner's successors and assignees.

Alternative U-1 Cost

The estimated cost to implement Upland Cleanup Alternative U-1 is $1,100,000. A summary of the cost components included with Alternative U-1 is provided in Table I-1 in Appendix I.

11.5.2.2 Upland Site Unit Alternative U-2: Near-Surface Soil Removal, Containment of Residual Contaminated Soil, and Institutional Controls

Alternative U-2 includes removal and offsite disposal of the upper 1 ft of contaminated soil, grading, and paving of the resulting surface in the areas shown on Figure 33. The excavation would be backfilled with clean soil and/or base course material, then capped with asphalt. As with Alternative U-1, this alternative includes demolishing and removing the marine railway upland side rail system, and providing grading for stormwater management. The primary components of the conceptual design for Alternative U-2 are shown on Figure 33.

Alternative U-2 would achieve RAO-1 (prevent direct contact with contaminated soil) and RAO-2 (prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment) through:

- Removal of contaminated soil at the ground surface
- Containment of the remaining contaminated soil with an asphalt cap
- Stormwater management
- Institutional controls.

Near-Surface Excavation and Offsite Disposal

The areas proposed for excavation were selected using the analytical results for samples collected during the RI. Soil in these locations contain IHS concentrations greater than the PCL in the upper 1 ft of soil. The excavation areas are bounded either by sampling locations without PCL exceedances within these depth intervals and/or by the estimated edge of the marine railway sidetrack foundations, which will be permanently removed as part of the marine railway temporary removal.

Approximately 1,000 yd^3 of near-surface soil would be removed by excavation after removal of the marine railway side rail tracks (see Section 11.5.1). This near-surface excavation would remove hazardous substances in the upper 1 ft of soil across the Site and would facilitate the installation of an asphalt pavement cap consistent with surrounding grades. Based on the RI data, the excavated soil should be accepted for disposal at a RCRA Subtitle D landfill. Contamination found in deeper soil during the RI would be contained in place using a pavement cap to prevent direct contact with human or ecological receptors. A non-woven geotextile layer would be installed at the base of the excavation as a marker layer indicating the presence of underlying contaminated soil. Excavations would be backfilled and graded for drainage prior to installing the pavement cap.

Asphalt Pavement Cap

An asphalt pavement cap would be installed to provide a physical barrier to prevent direct human and stormwater contact with contaminated soil, eliminating these potential exposure and transport pathways. Installation of the cap would require some Site preparation and regrading activities so that the finished paving surface can be tied into the adjacent grades with an assumed maximum transitional slope of 5 percent. Due to the proximity and constraints of the existing Boundary Fish buildings on the western edge of the Site, it is assumed that the upper 1 ft of contaminated soil would be excavated and disposed of offsite to allow existing grades to be maintained.

The asphalt pavement cap would be designed for light use, such as parking and light traffic consistent with the current facility operations. For the purposes of FS cost estimation, it is assumed that the cap will consist of up to 8 inches of crushed rock road base, and 4 inches of asphalt pavement. Additional costs are included in the estimate to import and install gravel fill for grading purposes. Note that soil removal within the marine railway well is included as part of the aquatic portion of the aquatic area alternatives.

Alternative U-2 Cost

The estimated cost to implement Upland Cleanup Alternative U-2 is $1,200,000. A summary of the cost components included with Alternative U-2 is provided in Table I-2 in Appendix I.

11.5.2.3 Upland Site Unit Alternative U-3: Site-Wide Removal of Contaminated Soil

Alternative U-3 would include removal and offsite disposal of soil within the Upland Site Unit containing IHSs at concentrations greater than the PCLs. The extent of the proposed excavation is shown on Figure 34. The boundaries of the excavation subareas were developed based on RI data. The excavation extent is bounded either by sampling locations without PCL exceedances or by the property boundary at the north end of the Site, where poor fill quality has been identified as the cause of deeper soil PCL exceedances extending farther north. Approximately 3,900 yd^3 of contaminated soil would be removed through excavation. The excavation would be backfilled with clean, granular fill. It is assumed based on the RI data that the soil would be accepted for disposal at a RCRA Subtitle D landfill. It is also assumed that excavation dewatering would be required for excavation areas that extend greater than 8 ft bgs, based on the measured depth to water in these areas.

Because all contaminated soil would be removed from the Upland Site Unit under this cleanup alternative, institutional controls would not be necessary. Stormwater management would be limited to grading for drainage consistent with adjacent areas, with any stormwater management/treatment requirements dependent on Site use and not a part of the Site cleanup action. Alternative U-3 would achieve RAO-1 (prevent direct contact with contaminated soil) and RAO-2 (prevent releases of hazardous substances in upland soil and stormwater to surface water and marine sediment) by removing all contaminated soil and backfilling the excavation with clean soil. The primary components of the conceptual design for Alternative U-3 are shown on Figure 34.

Alternative U-3 Cost

The estimated cost to implement Upland Cleanup Alternative U-4 is $2,100,000. A summary of the cost components included with Alternative U-3 is provided in Table I-3 in Appendix I.

11.5.3 Cleanup Alternatives for the Marine Site Unit

Four remedial alternatives were developed for the Marine Site Unit using a combination of the technologies discussed in Section 11.4.2:

- Alternative M-1 – Sediment Dredging and EMNR in SMA-1 and MNR in SMA-2
- Alternative M-2 – Sediment Dredging in SMA-1 and Contingent MNR in SMA-2
- Alternative M-3 – Sediment Dredging in SMA-1 and Contingent EMNR in SMA-2
- Alternative M-4 – Harbor-Wide Removal and Offsite Disposal of Contaminated Sediment.

Each of the alternatives would include the demolition and reconstruction of the elements of the marine railway system located in the marine portion of the Site and the marine railway well, and replacing the existing bulkhead within the dredging area. The following sections provide a description of the alternatives.

11.5.3.1 Alternative M-1: Sediment Dredging and EMNR in SMA-1 and MNR in SMA-2

Sediment cleanup Alternative M-1 was developed to represent the lowest-cost alternative that would meet the threshold requirements required by MTCA and SMS. This alternative consists of: 1) temporary removal and reinstallation of the marine railway system, 2) replacing the existing bulkhead within the dredging area, 3) placing a thin layer of clean sediment in the portions of SMA-1 deep enough to support EMNR (see Section 11.4.2), 4) dredging in the portions of SMA-1 that are not of sufficient depth to support EMNR, and 5) implementing an MNR program in SMA-2 until cleanup standards are achieved throughout the Marine Site Unit. The extent of the Marine Site Unit is shown on Figure 27.

Because EMNR is unlikely to be effective at depths shallower than approximately –10 ft mllw in SMA-1 based on hydrodynamic forces that may prevent the thin-layer cap from remaining in place (see Section 11.4.2.2), the area over which EMNR would be applied is very limited. The EMNR area would be limited to an area of about 4,800 square feet (ft^2) (about 0.1 acre). This limited area essentially eliminates the applicability of EMNR from Alternative M-1, resulting in Alternative M-1 being substantively equivalent to Alternative M-2. As a result, Alternative M-1 is eliminated from further consideration.

11.5.3.2 Alternative M-2: Sediment Dredging in SMA-1 and Contingent MNR in SMA-2

Alternative M-2 uses sediment dredging to remove contaminated sediment exceeding the SCO based on protection of benthic organisms within SMA-1 and contingent MNR in SMA-2. Dredging in SMA-1 would also address the only exceedances of the CSL based on protection of human health.

As previously discussed for Alternative M-1, EMNR is not applicable to SMA-1 due to hydrodynamic forces active in this area that would compromise the effectiveness of a thin-layer sediment cap, eliminating the only other potential option to dredging in this area, given the current and likely future land uses in this area. Alternative M-2 consists of temporary removal and replacement of the marine railway system, replacing the bulkhead within the dredging area, removing contaminated sediment from SMA-1 by dredging, and implementing a contingent MNR program in SMA-2 until cleanup standards are achieved throughout the Marine Site Unit. Figure 35 provides a plan-view of SMA-1 with a summary of the primary remedial activities associated with this alternative.

Because this alternative includes dredging to meet the PCLs based on protection of human health and benthic organisms within SMA-1, and does not include capping in SMA-2, there is a high degree of confidence that Alternative M-2 would be consistent with current and potential future Site uses. Additional details regarding the elements of Alternative M-2 are provided in the paragraphs below.

Temporary Removal of the Marine Railway System

As discussed in Section 11.5.1, the temporary removal and replacement of the marine railway system is a required element of all the sediment cleanup alternatives. The system’s temporary removal is anticipated to achieve RAO-2 by eliminating the marine railway well as a potential contamination migration pathway, and will provide unimpeded access to the sediments in SMA-1A for remediation. Achieving RAO-2 would also be supported by removing a significant amount of creosote-treated wood from the aquatic environment, which is a likely source of cPAH contamination to marine sediment in SMA-1A.

Replace Bulkhead in Dredging Area

The existing bulkhead that separates the uplands from the marine portion of the Site is in poor condition and is exhibiting areas of localized failure. Additionally, design and as-built records of its construction are not available to provide a basis for engineering analysis of its stability under current or modified loading conditions. Based on LAI’s experience at similar sites, the bulkhead would likely not be determined to be stable under dredging conditions if sediment is removed from near the toe of the bulkhead. As a result, either extensive shoring would be required to support the bulkhead during dredging, or the bulkhead would require replacement. Based on structural analyses and cost estimating conducted for a similar site, the cost of shoring would likely exceed the cost of bulkhead replacement. As a result, it is assumed for the purposes of the FS that the bulkhead would be replaced with a steel sheetpile bulkhead placed immediately in front of the existing bulkhead to allow for sediment dredging, as shown on Figure 35.

The current condition of the bulkhead is allowing contaminated upland soil to erode from the bulkhead face and discharge to marine sediment. As a result of eliminating this erosion, the bulkhead replacement would also provide source control for the soil-to-sediment migration pathway.

Replacement of the bulkhead would partially achieve RAO-2, RAO-3, and RAO-4.

Removal of Contaminated Sediment from within SMA-1 by Dredging

After the marine railway system is removed and the bulkhead replaced, dredging of contaminated sediment would be conducted throughout SMA-1. This alternative assumes that mechanical dredging would be conducted throughout SMA-1A using a clamshell or environmental bucket, or using a fixed-arm excavator operated over water from a barge and/or from the uplands shoreline. In SMA-1B, east of the Upland Site Unit, suction dredging using vacuum-excavation equipment operated from the uplands would be used to remove the thin veneer of contaminated intertidal sediment overlying the shoreline protection material in this area. Removing contaminated sediment from SMA-1 would achieve RAO-3, and partially achieve RAO-4.

The conceptual design includes removal of approximately 1,600 yd^3 (2,400 tons) of contaminated sediment throughout SMA-1. A small amount of additional sediment would be removed from the portion of SMA-1B (east of the Upland Site Unit). It is assumed that dredging depth throughout SMA-1A would be 2.5 ft for the purposes of FS cost estimation, but would be determined more accurately during the remedial design phase.

A silt curtain would be used to control turbidity and redistribution of contaminated sediment during construction, and thus limit impacts to surface water quality and sediment redistribution. Surface water quality monitoring would be conducted during the construction period to confirm compliance with applicable regulations.

It is assumed that dredged sediment would be dewatered on a small barge and the decanted water drained into the harbor. For cost estimating purposes, it was assumed that sediment would then be offloaded to trucks and hauled off Site for disposal at a permitted upland RCRA Subtitle D solid waste disposal facility, although it may be determined during construction bidding that it is more cost effective to transport dredged sediment via barge to an offloading facility in the Seattle area. For the purposes of FS cost estimating, it is assumed that the contaminated sediment in the small area east of the Upland Site Unit would be removed by a vacuum-truck from the uplands, and that four trips with a 5,000-gallon truck would be sufficient to remove the available sediment in this area to depths of up to 6 inches. Only trace amounts of sediment are present in this area, which contains a significant amount of large rock or riprap for shoreline protection.

Compliance monitoring would be conducted following dredging to confirm post-construction sediment quality. This would include collecting surface sediment samples throughout SMA-1, analyzing the sediment for IHSs, and comparing the results to the cleanup standards established for protection of benthic organisms at the Site. Bathymetric surveys would also be conducted both pre- and post-construction to confirm dredging volumes, that dredging design depths and lateral limits were achieved, and to confirm that the dredging residuals layer was properly placed (if applicable).

It is common for sediment resuspension during the dredging process to result in a thin veneer of contaminated sediment residuals that settle on the clean dredge surface. If compliance monitoring indicates that a residuals layer has formed on the dredge surface, a thin layer of clean soil/sediment would be placed across the newly exposed sediment surface after dredging to address this veneer of dredging residuals. The thickness of this residuals cover layer is assumed to be 6 inches for cost estimating purposes.

Contingent Monitored Natural Recovery in SMA-2

It is anticipated that the sediment PCLs for protection of human health will be achieved immediately following completion of cleanup within SMA-1. As stated in Section 9.3.2, compliance of PBT PCLs for protection of human health is evaluated on an area-weighted basis throughout the Marine Site Unit (SMA-1 and SMA-2 combined). With this approach, removal of sediment contamination throughout SMA-1 results in harbor-wide PBT area-weighted concentrations that will be within human health cleanup standards (based on RI sediment core data).

However, even with the application of all reasonable and appropriate measures to control turbidity and contaminated sediment suspended in the water column during dredging, some degree of contaminated sediment residuals redistribution could occur outside of SMA-1. Although unlikely, there is a potential for contaminated residuals to result in an area-weighted average PCB concentration that exceeds the PCL based on post-dredging sediment compliance monitoring data. As a result, natural recovery in SMA-2 is included as part of Alternative M-2 as a contingent action for protection of human health throughout the aquatic portion of the Site, if needed.

As discussed in Section 5.1.2, the natural sediment deposition rate in the Marine Site Unit is estimated to be about 2.5 cm (1 inch) per year. Based on this estimated range in sediment deposition, and the limited thickness of the dredging residuals layer anticipated to result from dredging SMA-1, it is anticipated that the cleanup standards for PCBs would be achieved on an area-weighted average within 5 years of completion of dredging.

Compliance with sediment cleanup standards in SMA-2 would be evaluated by collecting sediment grab samples and conducting chemical analyses to evaluate the recovery process and surface sediment quality. Chemical analyses for MNR would be limited to cPAHs and PCBs. For FS cost estimating purposes, it was assumed that PCBs congeners would be analyzed for and the first round of monitoring for MNR would be conducted 1 year following completion of the alternative cleanup action in SMA-1. The need for, and timing of, subsequent rounds of monitoring would be determined in conjunction with Ecology, but for cost estimating purposes it is assumed that additional monitoring for natural recovery would be conducted in years 3 and 5 following construction. A total of 11 samples would be collected from throughout SMA-1 and SMA-2 for each round of monitoring. The specifics of the monitoring program would be developed during the remedial design phase.

Alternative M-2 Cost

The estimated cost to implement Marine Site Unit Cleanup Alternative M-2 is $5,000,000. A summary of the cost components included in Alternative M-2 is provided in Table I-4 in Appendix I.

11.5.3.3 Alternative M-3: Sediment Dredging in SMA-1 and Contingent EMNR in SMA-2

Sediment cleanup Alternative M-3 is similar to Alternative M-2, but includes contingent EMNR to accelerate the natural recovery process in SMA-2 if cleanup standards are not met following dredging in SMA-1. As discussed for Alternative M-2, it is anticipated that PCBs are the only IHS that may exceed its PCL following completion of remedial action in SMA-1.

Alternative M-3 includes demolishing and removing the marine railway system, replacing the bulkhead within the dredging area, removing contaminated sediment from SMA-1 by dredging, and implementing a contingent EMNR remedy in SMA-2 if needed to achieve cleanup standards throughout the Marine Site Unit. Figure 36 provides a plan-view of the Marine Site Unit with a summary of the planned remedial activities; additional details are provided in the paragraphs below. The anticipated restoration timeframe for this alternative is immediately following cleanup action construction, including placement of the EMNR thin-layer cap, if required.

As discussed for Alternative M-2, this alternative includes dredging within SMA-1 and the thin-layer cap would be thin enough (6 inches) that it would not interfere with navigation depths. As a result, there is a higher degree of confidence that adequate channel depth would remain after construction to allow passage of large vessels and thus be consistent with current and future Site uses.

Temporary Removal of the Marine Railway System

This action would be the same as discussed for Alternative M-2, and would achieve RAO-2.

Replace Bulkhead in Dredging Area

This action would be the same as discussed for Alternative M-2 and would partially achieve RAO-2, RAO-3, and RAO-4.

Removal of Contaminated Sediment from within SMA-1 by Dredging

This action would be the same as discussed for Alternative M-2, and would achieve RAO-3 and contribute to the achievement of RAO-4.

Enhanced Monitored Natural Recovery in SMA-2

This action would include the placement of a thin-layer cap throughout a portion of SMA-2, if needed to achieve the cleanup standards for IHSs. As described above for Alternative M-2, although unlikely, it is possible that PCB concentrations in surface sediment in SMA-2 may be sufficiently elevated in a portion of SMA-2 following dredging in SMA-1 that the area-weighted average concentration could exceed the PCB PCL for protection of human health. However, post-dredging sediment compliance monitoring may indicate that the Best Management Practices employed during dredging were sufficient to protect SMA-2 so that cleanup standards are achieved without the thin-layer cap.

The purpose of the thin-layer cap is to accelerate and enhance natural recovery by providing a clean layer of sediment in the biologically active zone. Cap details including gradation specifications for the materials of construction and techniques for placement would be developed during the remedial design phase. For the purposes of FS cost estimation, it is assumed that 2,800 yd^3 of sand would be used to create a 6-inch-thick thin-layer cap across the area shown on Figure 36, which is approximately 152,000 ft^2 in area. This area is based on an assumption that dredging residuals within about 200 ft of SMA-1 would exhibit PCB concentrations sufficiently elevated to result in exceedance of the PCB PCL on an area-weighted average basis. The actual area requiring placement of a thin-layer cap to support EMNR would be determined based on post-dredging sediment compliance monitoring.

Bathymetric surveys would be conducted prior to and after construction to ensure that the thin-layer cap is constructed in accordance with plans and specifications, and that adequate depth is maintained within the capping area to accommodate vessel draft. After installation of the thin-layer cap, natural recovery would be monitored in the same manner described for Alternative M-2, until RAO-4 is achieved. For cost estimating purposes, it is assumed that two rounds of compliance monitoring would be required to confirm cleanup standards are achieved.

Although this action would assist in achieving RAO-4 and expedite the natural recovery process, it would result in covering a large area of the sediment surface, and could potentially have detrimental impacts on the existing aquatic environment in the capping area. The benefit of enhancing the natural recovery process in SMA-2 is considered in conjunction with the potentially adverse impacts of covering such a large area in the detailed evaluation of alternatives in Section 11.6. Additionally, the capping area lies within an active marina subject to periodic maintenance dredging, so the thin-layer cap could be disturbed or removed during future maintenance dredging activities, which could make it less effective in the long term.

Alternative M-3 Cost

The estimated cost to implement Marine Site Unit Cleanup Alternative M-3 is $5,400,000. A summary of the cost components included with Alternative M-3 is provided in Table I-5 in Appendix I.

11.5.3.4 Alternative M-4: Harbor-Wide Removal and Offsite Disposal of Contaminated Sediment

Sediment cleanup Alternative M-4 was developed to represent the most permanent cleanup alternative that could be developed for the Marine Site Unit that would be potentially implementable. Alternative M-4 generally consists of temporary removal and replacement of the marine railway system (achieving RAO-2) and replacing the bulkhead within the dredging area, then removing contaminated sediment from a large portion of the harbor (SMA-1 and a portion of SMA-2) by dredging to achieve RAO-3 and RAO-4. Figure 37 provides a plan-view of the Marine Site Unit with a summary of the planned remedial activities; additional details are provided in the paragraphs below. The anticipated restoration timeframe for this alternative is 1 year following construction.

The proposed dredging area shown on Figure 37 is based on achieving marine sediment SCOs for all IHSs except cPAHs, including the PCB SCO on an area-weighted average basis. Although this large-scale dredging would achieve RAO-3 and RAO-4, it would result in potentially adverse impacts to the existing aquatic environment through elevated turbidity and disturbance of the predominantly biologically active zone, as well as face significant technical and administrative implementability issues.

Alternative M-4 Cost

The estimated cost to implement Marine Site Unit Cleanup Alternative M-4 is $11,300,000. A summary of the cost components included with Alternative M-4 is provided in Table I-6 in Appendix I.

11.6 Detailed Evaluation of Alternatives

This section evaluates and compares the adequacy of each alternative relative to the evaluation criteria specified in MTCA and SMS, as applicable. Section 11.6.1 presents a description of the evaluation criteria against which the alternatives are evaluated. Section 11.6.2 presents an evaluation of the alternatives against these criteria and Section 11.6.3 presents the disproportionate cost analysis (DCA) conducted to determine which alternative for each Site Unit is permanent to the maximum extent practicable. Table 22 summarizes the elements for the cleanup alternatives evaluated for each Site Unit.

As previously discussed in Section 11.5, the cleanup action alternatives for each Site Unit achieve the applicable RAOs presented in Section 11.2.1. Additionally, each alternative meets the MTCA threshold requirements, as discussed in Section 116.1 below. As a result, each alternative is considered a viable cleanup alternative under MTCA.

11.6.1 Model Toxics Control Act and Sediment Management Standards Evaluation Criteria

MTCA specifies the evaluation criteria against which cleanup action alternatives are compared. However, additional evaluation criteria specified in SMS are applicable to sediment cleanup sites. As a result, the alternatives developed for the Upland Site Unit will be evaluated against MTCA criteria, and the alternatives developed for the Marine Site Unit will be evaluated against both MTCA and SMS criteria.

Both MTCA and SMS require that cleanup alternatives be compared to a number of criteria to evaluate the adequacy of each alternative in achieving the intent of the regulations, and as a basis for comparing the relative merits of the developed cleanup alternatives. Most of the evaluation criteria are identical between MTCA and SMS, although SMS identifies two evaluation criteria not specified in MTCA. SMS evaluation criteria that are not specifically addressed by MTCA criteria consist of net environmental benefit and environmental impacts, which are discussed further in Section 11.6.1.5.

11.6.1.1 Threshold Requirements

As specified in WAC 173-340-360(2)(a), cleanup actions are required to meet the following threshold requirements:

- Protection of human health and the environment
- Compliance with cleanup standards specified under MTCA
- Compliance with applicable state and federal laws
- Provisions for compliance monitoring.

These specific threshold requirements are evaluated specific to the cleanup alternatives under consideration for each Site Unit in Section 11.6.2.1.

11.6.1.2 Requirement for Permanent Solution to the Maximum Extent Practicable

WAC 173-340-200 defines a permanent solution as one in which cleanup standards can be met without further action being required at the Site or at any other site involved with the cleanup action, other than the approved disposal site of any residue from the treatment of hazardous substances. Ecology recognizes that permanent solutions may not be practicable for all sites and provides criteria for determining whether a cleanup action is permanent to the "maximum extent practicable" in WAC 173-340-360(3)(f). These criteria include:

- Overall protectiveness of human health and the environment, including the degree to which Site risks are reduced, the risks during implementation, and the improvement of overall environmental quality
- Permanent reduction in toxicity, mobility, and volume of hazardous substances, including the reduction or elimination of hazardous substance releases and sources of releases
- Cleanup costs, including capital costs and operation and maintenance costs
- Long-term effectiveness, including the degree of certainty that the alternative will be successful, the long-term reliability, the magnitude of residual risk, and the effectiveness of controls required to manage treatment residues and remaining waste

- Management of short-term risks, including the protection of human health and the environment during construction and implementation
- Implementability, including consideration of whether the alternative is technically possible; the availability of necessary offsite facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity of construction; monitoring requirements; access for construction, operations, and monitoring; and integration with existing facility operations
- Consideration of public concerns, which will be addressed through public comment on this RI/FS report and the cleanup action plan (CAP) that will be subsequently developed by Ecology.

Ecology provides guidance for a DCA procedure [WAC 173-340-360(3)(e)] to determine whether a cleanup action is permanent to the maximum extent practicable. The purpose of the DCA is to determine if the incremental increase in cost of a cleanup alternative over that of a lower-cost alternative is justified by the incremental increase in benefits to human health and the environment. If the incremental increase in costs is determined to be disproportionate to the benefits, the more expensive alternative is considered impracticable and the lower-cost alternative is determined to be permanent to the maximum extent practicable. This process provides a mechanism for balancing the permanence of the cleanup action with its costs, while ensuring that human health and the environment are adequately protected.

11.6.1.3 Requirement for a Reasonable Restoration Timeframe

WAC 173-340-360(6)(a) specifies that the following factors be considered in establishing a reasonable timeframe:

- Potential risks to human health and the environment
- Practicability of achieving a shorter restoration timeframe
- Current use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site
- Potential future use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site
- Availability of alternate water supplies
- Likely effectiveness and reliability of institutional controls
- Ability to control and monitor migration of hazardous substances from the Site
- Toxicity of the hazardous substances at the Site
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar Site conditions.

11.6.1.4 Requirement for Consideration of Public Concerns

Consideration of public concerns is an inherent part of the Site cleanup process under MTCA (refer to WAC 173-340-600). This RI/FS report will be issued for public review and comment, and Ecology will determine whether changes to the RI/FS report are needed in response to public comment. A similar process will occur for the CAP, prior to implementation of the final cleanup action, as specified in WAC 173-340-380. Consideration of public concerns will not be discussed further in this document (except as part of the DCA), in recognition of the public participation process that will be conducted for this RI/FS report and the CAP to comply with MTCA requirements.

11.6.1.5 Sediment Management Standards Evaluation Criteria

In addition to the MTCA evaluation criteria described above, SMS requires that sediment cleanup alternatives be evaluated for protection of human health and the improvement in overall environmental quality or net environmental benefit, and for environmental impacts. Net environmental benefit includes benefits to the environment such as restoration of water and sediment quality, habitat, and fisheries, and public benefits such as public access, recreation, aesthetics, and future land use. Environmental impacts include such factors as construction-related water and sediment quality impacts, loss of habitat value or acreage, and restrictions to land use or access. Net environmental benefit will be addressed by a separate evaluation criterion for the Marine Site Unit (see Section 11.6.2.4).

11.6.2 Evaluation of Alternatives

This section presents the results of the evaluation conducted to assess each potential cleanup alternative for both Site Units against the criteria specified in MTCA and SMS, as discussed in Section 11.6.1.

As discussed in Section 11.5.3.1, Alternative M-1 for the Marine Site Unit was substantively the same as Alternative M-2 because of the limitations on where EMNR could be implemented in SMA-1. As a result, this alternative is not carried forward into the evaluation of alternatives and will not be discussed further in this FS.

11.6.2.1 Threshold Requirements Evaluation

In order for a cleanup alternative to meet the threshold requirements, it must adequately protect human health and the environment, comply with cleanup standards, comply with state and federal laws, and provide for compliance monitoring. Compliance with the threshold requirements for a cleanup action under MTCA is presumed by definition to be protective of human health and the environment once the cleanup action meets the cleanup standards for all affected media. In addition, any cleanup action performed in accordance with the requirements of MTCA (and SMS) is assumed to be in compliance with cleanup standards and applicable state and federal laws. The following sections identify how the cleanup alternatives for each Site Unit comply with the threshold requirements.

Upland Site Unit

The potential exists for human health and the environment to be impacted under current Site conditions through direct contact with contaminated soil and the release of hazardous substances from the Site uplands to the aquatic environment. The four Upland Site Unit alternatives comply with the threshold requirements as follows:

- **Protection of human health and the environment** – Alternatives U-1 and U-2 protect human health and the environment through the removal and offsite disposal of the most highly contaminated and accessible soil and containment of residual contaminated soil. Alternative U-3 protects human health and the environment through complete removal and disposal of contaminated soil at an offsite licensed solid waste facility.
- **Compliance with cleanup standards** – Through the various cleanup technologies and administrative controls employed, each alternative would achieve the applicable RAOs and comply with the Site-specific soil cleanup standards.
- **Compliance with state and federal laws** – Through compliance with ARARs (Section 11.2.2) and the MTCA regulations, each alternative would comply with relevant state and federal laws.
- **Provisions for compliance monitoring** – Protection monitoring would be provided for by each alternative through health and safety protocols specified in a Site-specific health and safety plan. Alternatives U-1 and U-2 would provide confirmational monitoring through cap integrity monitoring. Alternative U-3 would include performance monitoring through soil quality monitoring to demonstrate that cleanup standards have been achieved, which would also serve as confirmational monitoring at the completion of the remedial excavation construction.

Marine Site Unit

The potential exists for both marine organisms and human health to be impacted under current conditions in the Marine Site Unit based on sediment quality. The three Marine Site Unit remedial alternatives retained for evaluation would comply with the threshold requirements as follows:

- **Protection of human health and the environment** – Alternatives M-2 and M-3 protect human health and the environment through a combination of contaminant removal and contingent MNR (Alternative M-2) or EMNR (Alternative M-3) in SMA-2. Alternative M-4 protects human health and the environment by removal of sufficient contaminated sediment to achieve all sediment SCOs throughout the Marine Site Unit.
- **Compliance with cleanup standards** – Through the various cleanup technologies and achievement of the applicable RAOs (Section 11.2.1), each alternative would comply with MTCA and SMS cleanup standards.
- **Compliance with state and federal laws** – Through compliance with ARARs (Section 11.2.2) and the MTCA and SMS regulations, each alternative would comply with relevant state and federal laws.
- **Provisions for compliance monitoring** – Protection monitoring would be provided for as part of each alternative through health and safety protocols specified in a Site-specific health and safety plan. Each sediment cleanup alternative would provide both performance and

confirmational monitoring to demonstrate cleanup standards are achieved and maintained in the Marine Site Unit.

11.6.2.2 Permanent Solutions to the Maximum Extent Practicable Criteria Evaluation

As described in Section 11.6.1.2 (Requirement for Permanent Solution to the Maximum Extent Practicable), MTCA requires that cleanup actions be permanent to the maximum extent practicable, and identifies a number of criteria to evaluate whether this requirement is achieved. Evaluation of the practicability of a given alternative is based on the comparative evaluation of whether the incremental increase in cost associated with increasingly protective cleanup actions is substantial and disproportionate to the incremental increase in environmental benefit. If the incremental cost is determined to be substantial and disproportionate to the incremental increase in environmental benefit, the cleanup alternative is considered impracticable and eliminated from further consideration. The remainder of this section provides a comparison of the cleanup alternatives for each Site Unit to the permanence criteria. Each criterion is summarized in Section 11.6.1.2. The evaluation of practicability is addressed in Section 11.6.3 (Disproportionate Cost Analysis).

Upland Site Unit – Overall Protectiveness

As indicated previously, overall protectiveness is a measure of the degree to which Site risks are reduced, the risks during implementation, and the improvement of overall environmental quality.

The overall protectiveness of Alternatives U-1 and U-2 is high because the mass of contamination is reduced by more than 80 percent in both alternatives, and Site risks are reduced to a minimal level through the elimination of potential exposure to contaminated Site soil and the elimination of potential releases to the Marine Site Unit. Alternative U-1 removes a greater mass of contamination and creates a greater physical separation (2 ft vs 1 ft) between the ground surface and residual contamination than Alternative U-2, and therefore further reduces the potential for contaminated soil to be encountered during post-cleanup intrusive activities conducted for Site redevelopment or other purposes.

The overall protectiveness of Alternative U-3 is very high because it significantly reduces long-term risk and provides an improvement in overall environmental quality through the reduction in contaminant mass by excavation and offsite disposal. However, deeper soil contamination appears to be related to fill quality rather than Site releases, so deep soil removal would not address similar soil quality issues that may extend beyond the Site boundaries. Additionally, because groundwater quality is not substantively affected by soil contamination, and future intrusive activities will likely be limited to installation of utilities and building foundations, soil removal to depth will provide only a limited increase to overall protectiveness compared to alternatives that rely on containment to address deeper soil contamination.

Upland Site Unit – Permanent Reduction of Toxicity, Mobility, and Volume of Hazardous Substances

For the purpose of comparing cleanup technologies, the FS evaluation places a slightly higher value on treatment that results in a permanent reduction in toxicity, mobility, or volume of hazardous substances, over technologies that address contamination through containment or removal. Alternatives U-1, U-2, and U-3 permanently reduce the volume of hazardous substances at the Site. However, contaminated soil removed under these alternatives results in relocation of contaminated soil to a licensed and permitted disposal facility, but does not reduce the toxicity or volume of the hazardous substances in the affected media. Mobility may be decreased through containment in an offsite engineered landfill, although the lack of significant groundwater contamination indicates that hazardous substances in Site soil are not currently mobile, provided they are physically contained. Alternatives U-1 and U-2 each limit the mobility of hazardous substances through containing various volumes of contaminated soil through capping.

Upland Site Unit – Cost

Itemized cost estimates for each of the cleanup alternatives are provided in Appendix I (Tables I-1 through I-3) and are summarized in Table 22. Estimated present-worth costs are as follows:

- Alternative U-1: $1,100,000
- Alternative U-2: $1,200,000
- Alternative U-3: $2,100,000.

These estimated cleanup costs represent an order-of-magnitude cost estimate generally consistent with EPA guidance for preparing FS cost estimates (USACE and EPA 2000). These costs are used as the cost basis for the DCA presented in Section 11.6.3.3.

Upland Site Unit – Long-Term Effectiveness

All three Upland Site Unit cleanup alternatives would be effective in the long term. Alternative U-3 has a high degree of certainty for long-term effectiveness because most, if not all, contaminated soil would be removed and placed in an engineered, lined, and monitored facility, which is considered to have greater long-term effectiveness than onsite containment. Alternatives U-1 and U-2 are both considered to have a high degree of long-term effectiveness; Alternative U-1 because it removes a large volume of contaminated soil with capping and Alternative U-2 because it includes a pavement cap in conjunction with removing a lesser volume of contaminated soil. Alternatives U-1 and U-2 each have a high degree of certainty regarding long-term effectiveness because capping and institutional controls would effectively limit human contact with contaminants and prevent releases to the Marine Site Unit.

Residual risk will remain for Alternatives U-1 and U-2 because hazardous substances would remain on Site and both alternative require long-term maintenance of a containment cap and institutional controls to effectively manage the residual risk. Alternatives U-1 and U-2 both have low to moderate residual risk because they both remove a significant mass of contaminated soil and both have relatively robust containment systems. Alternative U-3 exhibits low residual risk because most if not all contaminated soil will be removed from the Site.

Upland Site Unit – Management of Short-Term Risks

The short-term risks associated with Alternatives U-1 and U-2 represent low to moderate short-term risk due to potential worker exposure to hazardous substances during excavation of contaminated soil, the potential of impacts to surface water and sediment when the excavation extends to the bulkhead, and the transport of contaminated soil for disposal. However, the short-term risks can be effectively managed through appropriate design and construction controls, including implementation of a Site-specific health and safety plan during construction.

Alternative U-3 has high short-term risks because the deeper excavation may require groundwater dewatering and a deep excavation immediately adjacent to the shoreline can create a significant risk of releases to surface water and sediment. Additionally, the deeper excavation results in higher risk to worker safety due to its greater complexity, a greater volume of contaminated soil being managed, and the potential for excavation/shoring failure. While all of these risks can be reduced through effective engineering and construction controls, they cannot be entirely eliminated.

Upland Site Unit – Technical and Administrative Implementability

Alternatives U-1 and U-2 would be implemented using common construction techniques and equipment employed for earthwork and do not present significant permitting or other administrative implementability issues. Therefore, these three alternatives have a high degree of technical and administrative implementability.

Although feasible, Alternative U-3 would be difficult to implement due to the large volume of soil that would be removed from below the water table and in close proximity to the shoreline. With groundwater likely in direct connection with the marine surface water in the shoreline vicinity, excavation shoring and dewatering would be very difficult (and costly) to implement. Alternative U-3 would also be subject to significant permitting difficulties due to the potential for water quality impacts to marine surface water during construction and the associated potential impacts to endangered species and other aquatic organisms.

Marine Site Unit – Protectiveness

The overall protectiveness of Alternatives M-2 through M-4 is high because they each include active cleanup measures within SMA-1, and effectively address any impacts to sediment quality in SMA-2 that might result from dredging in SMA-1. The contingent active measures for SMA-2 included in Alternatives M-2 through M-4 provide a high degree of certainty that cleanup standards throughout the Marine Site Unit would be achieved within a reasonable restoration timeframe.

Marine Site Unit – Permanent Reduction of Toxicity, Mobility, and Volume of Hazardous Substances

Alternatives M-2 through M-4 would all permanently reduce contaminant volume by dredging and disposing of most of the marine sediment contamination associated with Site releases. All three alternatives would significantly reduce the toxicity and mobility of hazardous substances in SMA-2 through MNR (Alternative M-2), EMNR (Alternative M-3), and additional dredging (Alternative M-4), if needed. However, the volume of hazardous substances requiring treatment in SMA-2 to achieve cleanup standards is anticipated to be quite low since it would be limited to the thin veneer of dredging residuals from SMA-1, and would likely be limited to PCBs.

Marine Site Unit – Cost

Itemized cost estimates for each of the cleanup alternatives are provided in Appendix I (Table I-4 through I-6) and are summarized in Table 22. Estimated present-worth costs are as follows:

- Alternative M-2: $5,000,000
- Alternative M-3: $5,400,000
- Alternative M-4: $11,300,000.

These estimated cleanup costs represent an order-of-magnitude cost estimate generally consistent with EPA guidance for preparing FS cost estimates (USACE and EPA 2000). These costs are used as the cost basis for the DCA presented in Section 11.6.3.4.

Marine Site Unit – Long-Term Effectiveness

The three Marine Site Unit cleanup alternatives are all anticipated to have a high degree of effectiveness in the long term. The long-term effectiveness of Alternatives M-2, M-3, and M-4 have high degrees of certainty based on active measures being implemented within SMA-1, and the anticipated effectiveness of contingent MNR (Alternative M-2), EMNR (Alternative M-3), and dredging (Alternative M-4) in SMA-2, if required to address dredging residuals from SMA-1.

The residual risk associated with Alternative M-2 is considered low because if dredging residuals from SMA-1 require MNR in SMA-2 to achieve cleanup standards, the risk would likely be limited to a single IHS (PCBs) for protection of human health, and MNR is anticipated to achieve cleanup standards in a relatively short timeframe. The residual risk associated with Alternatives M-3 and M-4 is low because any residual contamination that requires treatment in SMA-2 following dredging in SMA-1 would be immediately addressed through either EMNR (Alternative M-3) or dredging (Alternative M-4).

Marine Site Unit – Management of Short-Term Risks

Dredging SMA-1 would cause short-term risks to human health and the environment for all alternatives. These risks would be addressed through health and safety protocols to protect human health during construction, engineering controls to protect the environment during dredging, and contingent remedial activities in SMA-2 if dredging residuals adversely affect sediment quality outside of SMA-1.

The short-term risks associated with Alternative M-2 would be the low because dredging is the only construction disturbance to the aquatic environment. Alternative M-3 would pose a low to moderate short-term risk because of the greater level of construction activity and larger area over which marine sediment would be disturbed. Alternative M-4 poses a moderate degree of short-term risk due to the larger area of the Marine Site Unit that would be dredged to remove contamination and the associated impacts to benthic and epibenthic organisms.

Marine Site Unit – Technical and Administrative Implementability

The technical implementability of Alternative M-2 is high because there are few physical constraints to dredging in SMA-1, and MNR (if needed) would not require any additional construction. The technical implementability of Alternative M-3 is considered moderate because the contingent placement of a thin-layer cap would be difficult in the areas where wharfs, floats, or other marine structures are in place, and because placement of a thin-layer cap could interfere with, or be disturbed by, vessel drafts or other marina operations in some portions of the harbor. The technical implementability of Alternative M-4 is considered moderate to low because additional dredging would likely require the relocation of some floats and other marine structures, and dredging a thin layer of sediment using conventional dredging equipment is difficult.

Administrative implementability for all three alternatives is considered moderate based on the challenges associated with permitting in-water construction projects.

11.6.2.3 Requirement for a Reasonable Restoration Timeframe Criteria Evaluation

MTCA identifies a number of factors to be considered when establishing a reasonable restoration timeframe, as described in Section 11.5.1.3 (Requirement for a Reasonable Restoration Timeframe). A cleanup action is considered to have achieved restoration once cleanup standards have been met. However, the practicability of achieving a shorter restoration timeframe is addressed as part of the DCA evaluation presented in Section 11.6.3. In general, each of the cleanup alternatives evaluated achieve restoration in a reasonable timeframe.

Upland Unit

It is anticipated that the upland alternatives described in Section 11.5.2 would achieve each of the restoration timeframe criteria listed in Section 11.6.1.3. All three alternatives evaluated could be constructed/implemented in a single construction season, and would immediately achieve soil and groundwater cleanup standards.

Marine Site Unit

It is anticipated that each of the three sediment remedial alternatives would achieve the restoration timeframe criteria listed in Section 11.6.1.3 within a reasonable timeframe. The estimates are based on the cleanup elements included in the alternatives and the estimated natural sedimentation rates discussed in Section 5.1.2 (Topography and Bathymetry). The estimated timeframes are considered approximations that would be refined during compliance monitoring as part of any alternatives that rely to some degree on natural recovery processes.

Alternative M-4 would achieve cleanup standards at the completion of construction. It is anticipated for the purposes of this evaluation that the restoration timeframe for Alternative M-4 would be 1 year after completion of the remedial construction to allow time for post-construction sediment quality monitoring to confirm compliance with cleanup standards.

Alternative M-3 has an estimated restoration timeframe of 2 years from the completion of construction. The 2-year period provides for 2 years of post-construction monitoring to confirm that cleanup standards are achieved, assuming EMNR is required to achieve cleanup standards.

Alternative M-2 has an estimated restoration timeframe of 2 to 5 years following construction. The 2-year period provides for 2 years of post-construction monitoring to confirm that cleanup standards are achieved following dredging. The upper end of this timeframe (5 years) is the estimated restoration timeframe in the unlikely event that contingent MNR is required to achieve the area-weighted PCB PCL, and is the estimated time required to achieve at least a 10-cm accumulation of clean sediment through natural sedimentation processes at an assumed sediment accumulation rate of 2.5 cm (1 inch) per year, plus an additional year to account for uncertainty.

11.6.2.4 Net Environmental Benefit

As indicated in Section 11.6.1.5, SMS requires that sediment remedial alternatives be evaluated for improvements in overall environmental quality. Alternative M-2 would improve sediment quality by dredging within SMA-1, and MNR in SMA-2 if needed to achieve sediment cleanup standards. Alternative M-3 would improve sediment quality by dredging within SMA-1, and EMNR in SMA-2 if needed to achieve sediment cleanup standards. Alternative M-4 would improve sediment quality through the dredging in SMA-1 and a sufficient portion of SMA-2 to achieve sediment cleanup standards throughout the Marine Site Unit. Each of these alternatives would significantly improve the quality of aquatic habitat.

Although the construction activities implemented during the initial phases of each alternative would cause significant disruption of existing marine habitat, each would have a net positive environmental benefit after the cleanup is complete. Alternative M-2 is considered to have a moderately high net environmental benefit because it would cause the least disturbance to benthic and epibenthic organisms while achieving the SCOs for protection of benthic organisms throughout the Marine Site

Unit. Alternative M-3 is considered to have a slightly lower scoring (moderate) for environmental benefit because the placement of the thin-layer cap to support EMNR in SMA-2 would negatively affect existing benthic and epibenthic organisms without an appreciable decrease in risk to benthic organisms given that the SCOs for protection of benthic organisms would be achieved without EMNR. Similarly, Alternative M-4 is considered to have a moderately low net environmental benefit because dredging in SMA-2 would impact existing benthic and epibenthic organisms but would not appreciably reduce the risks to these biota.

11.6.3 Model Toxics Control Act Disproportionate Cost Analysis

As discussed in Section 11.6.2.2, MTCA requirements for remedy selection include the requirement to use permanent solutions to the maximum extent practicable. MTCA defines permanent cleanup actions as those in which cleanup standards are met without further action being required. MTCA specifies that the evaluation of whether a cleanup action uses permanent solutions to the maximum extent practicable be based on a DCA consistent with the requirements of WAC 173-340-360(3)(e).

In a DCA analysis, cleanup alternatives are arranged from most to least permanent based on the criteria specified in WAC 173-340-360(3)(f). The DCA then compares the relative environmental benefits of each alternative against those provided by the most permanent alternative evaluated. Costs are disproportionate to benefits if the incremental cost of the more permanent alternative exceeds the incremental benefits achieved by the lower-cost alternative [WAC 173-340-360(3)(e)(i)]. Alternatives that exhibit disproportionate costs are considered “impracticable.” Where the benefits of two alternatives are equivalent, MTCA specifies that Ecology select the least costly alternative [WAC 173-340-360(e)(ii)(c)].

The DCA is evaluated in the following sections, using the information presented in Section 11.6.2. The alternatives are first compared to the most permanent cleanup alternative for each Site Unit, and the benefits of each alternative are ranked under the criteria of the DCA [WAC 173-340-360(f)] in Sections 11.6.3.1 and 11.6.3.2. The costs are then compared to these benefits and the relationship between the costs and benefits is determined in Sections 11.6.3.3 and 11.6.3.4. These analyses then define which alternative is permanent to the maximum extent practicable for each Site Unit.

Relative rankings for the alternatives within each Site Unit were determined by assigning a value on a scale from 1 to 10, where 10 is the highest benefit/value, for each criterion, multiplying each value by a weighting factor, and summing the weighted values to determine an overall alternative benefits ranking score. Weighting factors are based on Ecology input provided for other FSs conducted on Port sites. The six evaluation criteria and associated weighting factors are:

- Protectiveness: 30 percent
- Permanence: 20 percent
- Long-term effectiveness: 20 percent

- Short-term risk management: 10 percent
- Implementability: 10 percent
- Considerations of public concerns: 10 percent.

Net environmental benefit needs to be included as an evaluation criterion for the Marine Site Unit. To accommodate this additional criterion, net environmental benefit is given a weighting factor of 10 percent, and the weighting factor for long-term effectiveness is reduced to 10 percent (for the Marine Site Unit evaluation only).

The DCA is based on a comparative analysis of the alternatives for each Site Unit against the six evaluation criteria (or seven criteria in the case of the Marine Site Unit evaluation). For each Site Unit, relative rankings of each alternative for the relevant criteria are discussed below and summarized in Tables 23 and 24.

11.6.3.1 Comparative Evaluation of Alternatives – Upland Site Unit

The following sections evaluate each Upland Site Unit alternative in regards to addressing protectiveness, permanence, long-term effectiveness, management of short-term risks, implementability, and consideration of public concerns.

Protectiveness of Human Health and the Environment

All three alternatives for the Upland Site Unit are protective of human health and the environment. However, there are relative degrees of protectiveness based on the technologies used to achieve that protectiveness. Alternatives U-1 and U-2 achieve protection through removal of contaminated soil, containment, stormwater management, and institutional controls. Alternative U-3 achieves protection through the removal of contaminated soil only. Although removal is not inherently more protective than the other technologies, it does provide a higher level of certainty that protectiveness will be maintained in the long term.

Based on these factors, Alternative U-3 was ranked the highest for protectiveness (10) based on the complete removal of contaminated soil. Although placement of impermeable caps provides a high degree of certainty for protectiveness, Alternatives U-1 and U-2 are ranked slightly lower (8 and 7, respectively) because they rely on containment and institutional controls to achieve cleanup standards. These ranking scores reflect the slightly higher level of contaminant mass and volume reduction under Alternative U-1.

Permanence

Although none of the cleanup alternatives provides a permanent reduction in the toxicity or volume of hazardous substances, all four alternatives provide a permanent reduction in mobility. Alternative U-3 is considered the most permanent alternative because it removes the source material from the

Site and contains it in an offsite engineered landfill. Alternatives U-1 and U-2 each provide a permanent reduction in mobility through contaminated soil removal and containment.

The integrity of the capping and containment systems associated with Alternatives U-1 and U-2 can be effectively maintained under the future land use options being considered for the Site. The permanence of cleanup actions using containment will rely on institutional controls that establish Site use restrictions to protect the remedy for perpetuity.

Alternative U-3 was ranked highest with the highest permanence score (9). Alternatives U-1 and U-2, receive somewhat lower rankings (7 and 6, respectively) because they will achieve comparatively decreasing levels of permanence. The rankings for all three of these alternatives take into consideration that none provides a permanent reduction in the toxicity or volume of hazardous substances.

Effectiveness Over the Long Term

The three upland cleanup alternatives have varying degrees of certainty regarding long-term effectiveness. Alternative U-3 has the highest certainty for long-term effectiveness and the residual risk would be eliminated because all contaminated soil would be removed from the Site.

Alternatives U-1 and U-2 will prevent direct human contact with contaminated soil and prevent future release of contaminated soil to the aquatic environment. Current risks are due primarily to worker exposure during onsite excavations and release of contaminated soil into the aquatic environment, so the residual risk following cleanup would be minimal as long as effective containment is maintained.

Based on these factors, Alternative U-3 is ranked the highest (9) for long-term effectiveness because removal of contaminated soil will eliminate any potential for a release to the environment in the future. Alternatives U-1 and U-2 each receive a ranking of 7 for long-term effectiveness because onsite containment is not a high-preference technology, but both provide for removal of a significant mass of contamination.

Management of Short-Term Risks

Alternatives U-1 and U-2 have the lowest short-term risks (ranked 8 each) because they involve the removal of relatively small volumes of contaminated soil from shallow depths. Alternative U-3 is ranked with a lower score (5) for short-term risk because of the high volume of contaminated soil to be excavated and the greater depths of excavation under this alternative, and the correspondingly high potential for environmental releases during implementation.

Implementability

Alternatives U-1 and U-2 would be implemented using common construction techniques employed for earthwork. These alternatives are roughly equivalent with the only exception being the slightly greater depth of excavation for Alternative U-1.

Alternative U-3 will likely require extensive groundwater management, extensive shoring adjacent to the shoreline, and extensive dewatering and groundwater management. Additionally, Alternative U-3 may be subject to permitting difficulties due to the significant potential for surface water quality impacts and the potential for release of hazardous substances to the marine environment.

Alternatives U-1 and U-2 are each ranked high (9) for implementability based on the use of relatively simple construction techniques, and no significant administrative implementation issues. Alternative U-3 is ranked moderate (5) for implementability; although considered possible, Alternative U-3 would be difficult to implement due to the location/depth of contaminated soil adjacent to the marine shoreline.

Consideration of Public Concerns

Each alternative considers public concerns by responding to public comments received on the RI/FS and CAP documents as part of the cleanup process under MTCA. As a result, all alternatives are given a ranking of 10 for consideration of public concerns.

Comparison of Overall Benefits (Relative Benefit Scores)

Each alternative provides an environmental benefit by eliminating potential exposure pathways. The alternatives provide increasingly greater overall environmental benefit with each incremental step moving from Alternative U-1 to U-3. The rank and relative benefit score for each alternative under this scenario are presented in Table 23, and are as follows:

- Alternative U-1 Relative Benefit Score: 7.9
- Alternative U-2 Relative Benefit Score: 7.4
- Alternative U-3 Relative Benefit Score: 8.6.

11.6.3.2 Comparative Evaluation of Alternatives – Marine Site Unit

The following provides the comparative evaluation of the alternatives for the Marine Site Unit, and compares each cleanup alternative to the most permanent alternative considered in this evaluation, Alternative M-4. As discussed in Section 11.5.3.1, Alternative M-1 was developed as the lowest-cost alternative that would potentially meet the threshold requirements under both MTCA and SMS. Alternative M-1’s EMNR component would be effective in only a limited area of SMA-1 (as a result of hydrodynamic forces affecting the stability of the thin-layer cap), which would greatly reduce the alternative’s applicability at the Site and make it functionally equivalent to Alternative M-2.

Although Alternative M-1 would be technically possible to implement, its lack of substantive difference from Alternative 2 eliminates its usefulness in evaluating a range of alternatives. Given these considerations, and the steps for initial screening of alternatives outlined in SCUM (Ecology 2017), Alternative M-1 was eliminated as a potential viable alternative for the Marine Site Unit and is not considered in the evaluation provided in this section.

Protectiveness of Human Health and the Environment

Each of the alternatives for the Marine Site Unit is protective of human health and the environment. Alternatives M-2 and M-3 receive moderately high scores (7 and 8, respectively) based on the incorporation of dredging within SMA-1 (both alternatives), and the thin-layer cap (contingent EMNR) planned as part of Alternative M-3. Alternative M-4 was ranked the highest for protectiveness (9) based on the removal and offsite disposal of the largest mass of contaminated sediment of all the alternatives.

Permanence

Each of the three alternatives provides a permanent reduction in the release of hazardous substances over the long term. Alternative M-4 is considered the most permanent alternative and receives the highest ranking score (9) because it includes the removal of sediment from throughout the Marine Site Unit that exceeds the sediment cleanup standards established for the Site, and achieves the marine sediment SCOs for all IHSs except for the cPAH SCO based on the protection of human health. Alternative M-2 receives a moderately high permanence ranking score (8) based on the expectation that once cleanup standards are achieved through MNR, contaminant concentrations in sediment are likely to remain below cleanup standards because natural recovery biotic processes that reduce concentrations in the affected sediment, such as bioturbation, are occurring in addition to the creation of a clean sediment surface through sedimentation.

Alternative M-3 receives a moderately high permanence score (7) that is slightly lower than for Alternative M-2 because while cleanup standards would be achieved immediately following construction, the thin-layer cap could impede biotic processes such as bioturbation, potentially resulting in limited reduction of IHS concentrations in contaminated sediment. Because of its location within an active harbor, there is a potential that the EMNR thin-layer cap would be disturbed by vessel prop wash or future maintenance dredging that could expose and potentially recontaminate sediment underlying the thin-layer cap if biotic processes do not extend through the thin-layer cap into the underlying contaminated sediment.

Effectiveness Over the Long Term

Each of the three alternatives would be effective in the long-term, through permanent reduction in the mass or concentrations of hazardous substances in marine sediment. Alternative M-4 is considered the most effective alternative over the long term and receives the highest ranking score (9) because it includes the removal of sediment from the Marine Site Unit that exceeds the sediment cleanup standards established for the Site and all but the cPAH SCO. Alternative M-2 receives a slightly lower ranking score (8) than Alternative M-4, and Alternative M-3 receives a slightly lower effectiveness score (7) than Alternative M-2.

Alternative M-3 receives a slightly lower long-term effectiveness score than Alternative M-2 for the same reasons presented in the Permanence section above. While Alternative M-2 may take longer to achieve cleanup standards than Alternative M-3, once achieved, it has a higher probability of maintaining cleanup standards if shallow sediment is disturbed by either vessel prop wash or maintenance dredging.

Management of Short-Term Risks

The short-term risks associated with implementation of Alternatives M-2 and M-3 have a moderate ranking scores (6 and 5, respectively) based on the dredging activities planned for SMA-1 with each alternative, which could result in potential releases of contaminated sediment during construction. Alternative M-3 is ranked slightly lower than Alternative M-2 due to the short-term impact on benthic and epibenthic biota of the thin layer cap placed for EMNR. Alternative M-4 has a lower ranking score (3) based on the more significant short-term risks associated with more extensive dredging and potential exposure to workers.

Implementability

Alternative M-2 has a moderately high score (8) because of the technical difficulty during construction (dredging), and necessary administrative implementation issues associated with permitting the in-water work. Alternative M-3 has a relatively lower implementability score (7) based on the considerations discussed for Alternative M-2, and the relatively large area that would require a thin-layer cap to enhance the natural recovery process in SMA-2.

Alternative M-4 would be implemented using common dredging techniques and equipment, but the magnitude and complexity of the alternative makes it subject to a number of implementability issues. Permitting for such a large-scale dredging project would be more complex because of the potential impacts to water quality and potential impacts to threatened or endangered species protected under the federal Endangered Species Act. Although feasible, the cost of Alternative M-4 is such that it may not be possible to obtain adequate funding to implement. As a result, Alternative M-4 receives a lower ranking score for implementability (4).

Consideration of Public Concerns

Each of the three alternatives considers public concerns by responding to public comments received on the RI/FS and CAP documents as part of the cleanup process under MTCA. As a result, all the three alternatives are given a ranking of 10 for consideration of public concerns.

Net Environmental Benefit

Each of the three alternatives provides a net environmental benefit through achieving sediment cleanup standards. Alternative M-4 receives the lowest net environmental benefit score (4) since it would have the greatest detrimental impacts to the existing marine biota, at least in the short term. Alternative M-3 receives a higher ranking score (6) since it may also have negative short-term effects on existing marine biota in a relatively large area based on application of the contingent thin-layer cap. Alternative M-2 receives the highest ranking score for net environmental benefit (7) based on removing the sediment with the highest concentrations of contaminants at the Site, thus significantly reducing the risk of exposure to human health or the environment, and since it does not have the potential negative impacts to the existing marine biology associated with Alternatives M-3 and M-4.

Comparison of Overall Benefits (Relative Benefit Scores)

Based on the discussion above, the alternatives and their respective relative benefit scores are listed below:

Alternative M-2:	7.6
Alternative M-3:	7.3
Alternative M-4:	7.5

11.6.3.3 Disproportionate Cost Analysis – Upland Site Unit

As required by MTCA for remedy selection, the costs and benefits associated with the evaluated remedial alternatives are compared using a DCA. The DCA compares the relative environmental benefits of each alternative to those provided by the most permanent alternative evaluated. Costs are disproportionate to benefits if the incremental cost of the most permanent alternative exceeds the incremental degree of benefits achieved over the lower-cost alternative [WAC 173-340-360(c)(i)]. Alternatives that exhibit such disproportionate costs are considered “impracticable.” Where the benefits of two alternatives are equivalent, MTCA specifies that Ecology select the lower-cost alternative [WAC 173-340-360(e)(ii)(c)].

The estimated costs and benefits presented in Section 11.6.3.1, are summarized for each alternative in Table 23. Figure 38 provides a graphical summary of the overall benefits and costs, and the benefit-to-cost ratio for each alternative using the relative benefit scores.

Consistent with MTCA requirements, the composite benefit and cost of each remedial alternative for the Upland Site Unit are compared to those for the most permanent alternative, Alternative U-3. Alternative U-3 makes the greatest use of high-preference technologies and represents the most permanent remedial alternative evaluated in this FS. As such, Alternative U-3 represents the benchmark against which the incremental costs and benefits of the other alternatives are evaluated.

Alternative U-3 receives a composite benefit ranking of 8.6 (out of 10.0) and a benefit/cost ratio of 4.1 based on its estimated cost of $2,100,000. Because this remedy uses the most permanent remedial technologies of those evaluated for this FS, it receives high benefit rankings for overall protectiveness, permanence, and long-term effectiveness. However, Alternative U-3 receives a moderate benefit ranking for short-term risk management and a low ranking for implementability, due to the difficulty and risk associated with the removal of large volumes of contaminated soil, much of which is below the water table and adjacent to marine surface water.

The composite benefit ranking for Alternative U-3 (8.6) is about 16 percent greater than Alternative U-2 (7.4), but costs about 75 percent more, resulting in Alternative U-2 having a benefit/cost ratio (6.2) that is more than 50 percent greater than Alternative U-3. Based on the benefit/cost ratio for Alternative U-2 being more than 50 percent greater than for Alternative U-3 and the cost for Alternative U-3 being 75 percent greater, the incremental additional cost for Alternative U-3 is considered substantial and disproportionate to the incremental benefit provided relative to Alternative U-2. Consistent with WAC 173-340-360(3)(e), Alternative U-3 is considered impracticable and was eliminated from further consideration for cleanup of the Upland Site Unit and the remaining upland alternatives were compared to Alternative U-3.

Alternative U-1 received an overall weighted benefit score of 7.9 and a benefit/cost ratio of 7.2 based on its estimated cost of $1,100,000. The overall weighted benefit score for Alternative U-1 is about 5 percent higher than Alternative U-2 (7.9 and 7.4, respectively). Alternative U-1 received slightly higher scores for overall protectiveness and permanence because it removes a slightly greater mass of contamination and provides greater separation between contaminated soil and the ground surface. The estimated cost for Alternative U-2 is approximately 9 percent higher than for Alternative U-1. Based on Alternative U-2 having a lower weighted benefit score and a higher cost than Alternative U-1, the incremental cost for Alternative U-2 is clearly substantial and disproportionate to the (lack of) incremental benefit provided relative to Alternative U-1 and is eliminated from further consideration. As a result, Alternative U-1 is considered permanent to the maximum extent practicable.

11.6.3.4 Disproportionate Cost Analysis – Marine Site Unit

Similar to the evaluation conducted for the Upland Site Unit alternatives, the three proposed Marine Site Unit alternatives were evaluated, based on relative costs and benefits, using a DCA. The estimated costs and benefits presented in Section 11.6.3.2, are summarized for each alternative in Table 24. Figure 39 provides a graphical summary of the overall benefits and costs, and the benefit-to-cost ratio for each alternative using the relative benefit scores.

Consistent with MTCA requirements, the composite benefit and cost of each remedial alternative for the Marine Site Unit are compared to those for Alternative M-4, the most permanent alternative for the Marine Site Unit. Alternative M-4 makes the greatest use of high-preference technologies and represents the most permanent remedial alternative evaluated in this FS. As such, Alternative M-4 provides the benchmark against which the incremental costs and benefits of the other alternatives are evaluated.

Alternative M-4 receives an overall weighted benefit score of 7.5. Because this remedy uses the most permanent remedial technologies of those evaluated for this FS, it receives high benefit rankings for overall protectiveness, permanence, and long-term effectiveness. However, this alternative receives low benefit rankings for short-term risk management, implementability, and net environmental benefit due to the difficulty and risk associated with the removal of large volumes of sediment.

Although Alternative M-4 is considered the most permanent, based on its cost ($11,300,000) it has a low benefit/cost ratio of 0.66. The weighted benefit score for Alternative M-3 (7.3) is slightly lower than Alternative M-4, but because its cost is so much lower ($5,400,000), its benefit/cost ratio (1.4) is more than twice that of Alternative M-4. Based on the much lower benefit/cost ratio and the substantively greater cost, the additional cost to implement Alternative M-4 is substantial and disproportionate when compared to Alternative M-3. As a result, Alternative M-4 was determined to be impracticable and was eliminated from further consideration.

Alternative M-3 receives an overall weighted benefit score of 7.3, which is lower than the score for Alternative M-2 (7.6). The cost for Alternative M-3 is also about 8 percent higher than Alternative M-2. Based on Alternative M-3 having a lower overall weighted benefit score and a higher cost than Alternative M-2, the relative benefit-to-cost ratio is about 7 percent higher for Alternative M-2 than for Alternative M-3. Based on the higher cost of M-3, the lower overall benefit score, and the lower benefit-to-cost ratio, the cost to implement Alternative M-3 is considered substantial and disproportionate to the (lack of) incremental benefit. As a result, Alternative M-3 was determined to be impracticable and was eliminated from further consideration. Therefore, Alternative M-2 is considered permanent to the maximum extent practicable.

12.0 SUMMARY AND CONCLUSIONS

The RI defined the Site physical characteristics, land utilization, COPCs, contamination sources and areas, the nature and extent of impacted media, and the migration pathways for contaminants. Data from the RI are used in the FS process to develop and evaluate remedial alternatives for the Site. The FS is developed based on the evaluation of various remedial alternatives, and the criteria defined in MTCA and SMS to determine a preferred alternative with the most permanent remedy for the Site, to the maximum extent practicable.

This section presents the preferred alternative based on these evaluations, discusses how the preferred alternative will be compatible with planned development strategies for the Site, and discusses implementation of Site cleanup.

12.1 Preferred Alternative

This section describes a preferred cleanup alternative for the Site. The final cleanup action will be determined by Ecology and presented in the Site CAP, and could vary from the preferred cleanup action described herein.

In the DCA (Section 11.6.3), Upland Site Unit Alternative U-1, and Marine Site Unit Alternative M-2 were determined to be permanent to the maximum extent practicable. These alternatives are combined together as the preferred remedy for addressing contamination at the Site.

As discussed in Section 11.5.2, Upland Site Unit Alternative U-1 (Shallow Soil Removal and Containment) consists of demolishing and removing the upland component of the marine railway system (i.e., side rails and concrete foundations), excavating and disposing of the upper 2 ft of contaminated soil, capping the upland area with clean soil, and implementing institutional controls. The primary components included as part of the Upland Site Unit Alternative U-1 design are shown on Figure 40.

As discussed in Section 11.5.3, Marine Unit Alternative M-2 (Sediment Dredging in SMA-1 and MNR in SMA-2) includes temporarily removing the marine railway system, including removal of the steel rails, rail ties, concrete, and piles; replacing the existing bulkhead within the sediment dredging area; removing contaminated marine sediment from SMA-1 by dredging, and; implementing a contingent MNR program in SMA-2 until cleanup standards are achieved throughout the Marine Site Unit. Sediment dredging within SMA-1 will remove contaminated sediment exceeding the SCO based on protection of benthic organisms. Dredging in SMA-1 would also address the exceedances of the CSL based on protection of human health. Dredging in SMA-1 is likely to achieve all sediment cleanup standards, including those established for PBTs based on reducing the harbor-wide area-weighted average of PBTs. However, MNR could be required as a contingent action after completing construction to attain cleanup standards throughout the Marine Site Unit. The primary components included as part of the Marine Site Unit Alternative M-2 design are shown on Figure 40.

12.2 Implementation of Site Cleanup

After considering public comment, the RI/FS will be finalized and a cleanup action for the Site will be selected by Ecology. The selected cleanup action will be presented in the Site CAP, which will describe the cleanup action and specify cleanup standards and compliance monitoring requirements. Following public review of the CAP, the cleanup will be implemented into a series of implementation phases, pre-design investigations, engineering and design, permitting, construction, and long-term compliance monitoring (as applicable). The pre-design and design phases will provide additional information by which the logistics of cleanup implementation will proceed, following finalization of the CAP.

It is assumed that the Marine Site Unit remedy would be implemented concurrent with, or following, the Upland Site Unit remedy. It is anticipated that temporary removal of the marine railway system and installation of the new bulkhead at the shoreline would be sequenced to occur in advance of implementing the components included with Upland Site Unit Alternative U-1. The remaining components of both the Marine Site and Upland Site Units could then be implemented concurrently or independently.

For the Upland Site Unit, the soil cap would be designed to support current Site uses. The implementation would also address stormwater management since the existing grades would be modified to direct stormwater away from the marine railway well. Because soil contamination will remain in-place and prevention of exposure will rely on a containment technology, a restrictive covenant would be applied to the upland portion of the Site.

13.0 USE OF THIS REPORT

This document has been prepared for the use of the Port of Bellingham and the Washington State Department of Ecology for specific application to the Westman Marine Site. The reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by LAI, shall be at the user's sole risk. LAI warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the Pacific Northwest under similar conditions as this project. LAI makes no other warranty, either express or implied.

14.0 REFERENCES

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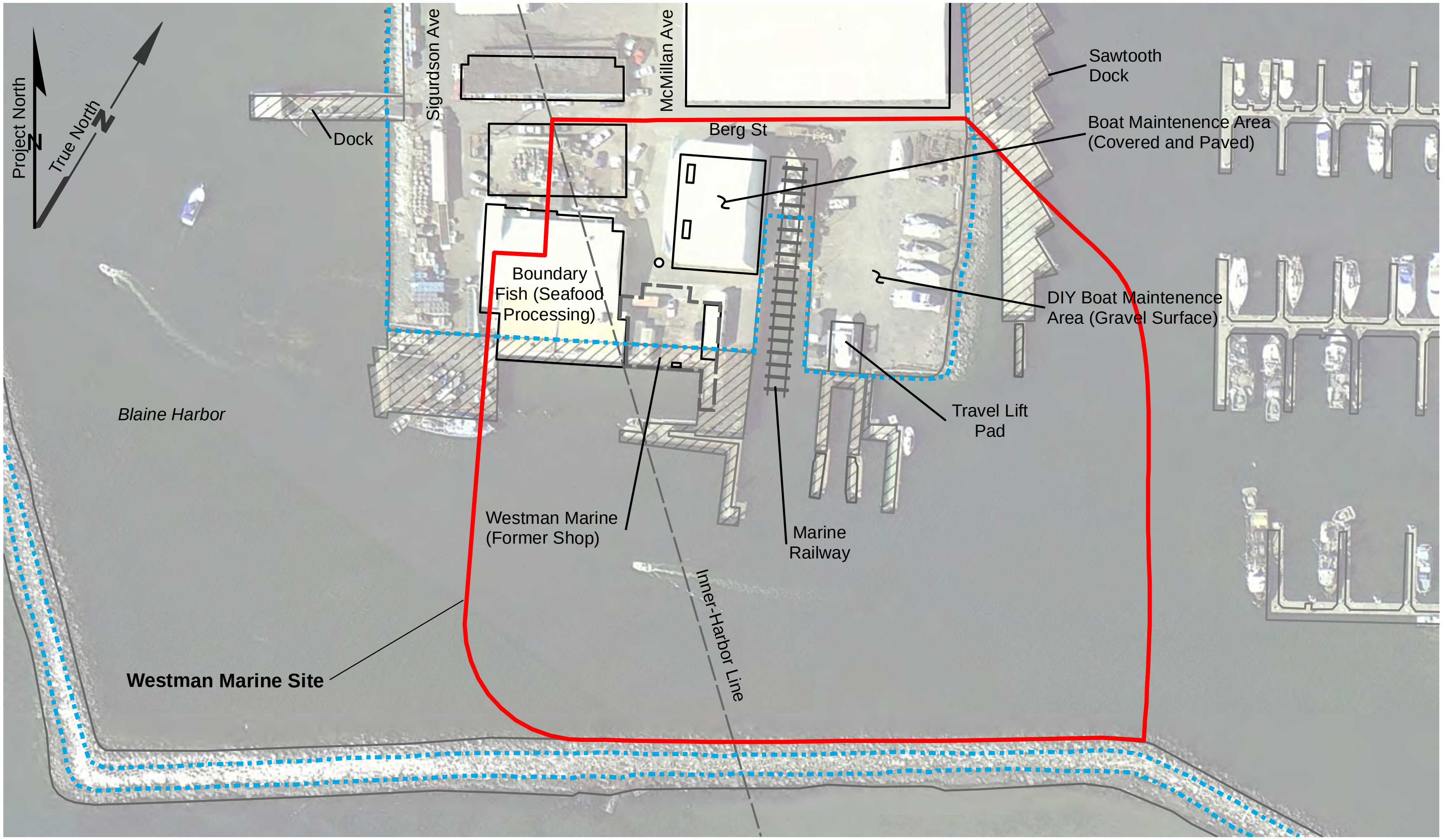
Data Source: Esri 2012

G:\Projects\001\035\010\018\RI Report\F01VicinityMap.mxd 2/9/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Landau Associates

Westman Marine Blaine Harbor Blaine, Washington	**Vicinity Map**	Figure 1

G:\Projects\001\035\010\018\RI Report\F02SitePlan.mxd 3/12/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

🟥 Preliminary Westman Marine Site Boundary

▨ Structure Over Water

— Existing Building Location

┈ MHHW = 9.5 ft

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Wilson Engineering 2011; Port of Blaine 2011; Walker and Associates, Inc.; Google Earth Professional 2011

0 120 240

Scale in Feet

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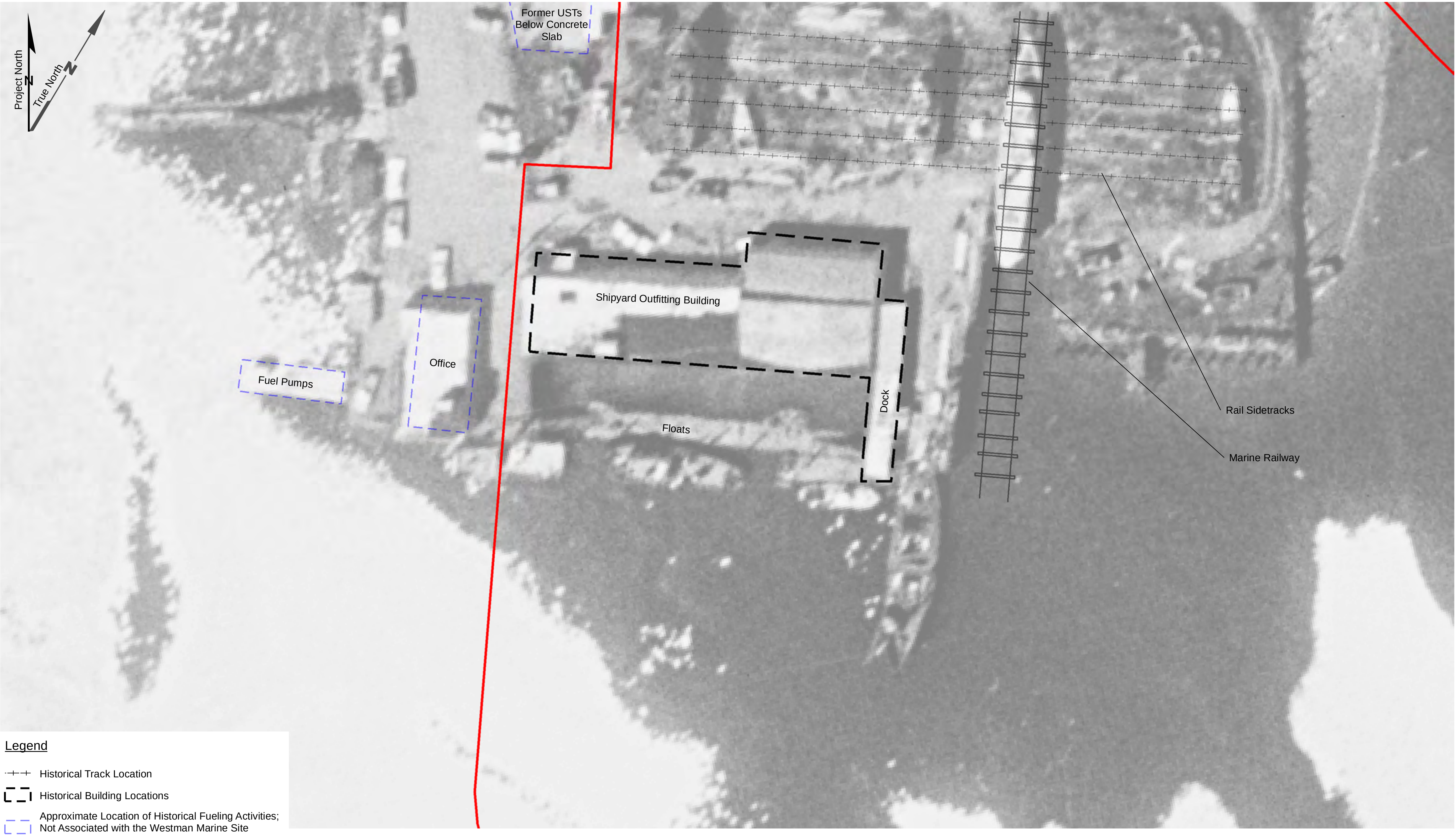
Westman Marine
Blaine Harbor
Blaine, Washington

Site Plan

Figure
2



Legend

- -+-+ Historical Track Location
- ⬚ Historical Building Locations
- ⬚ Approximate Location of Historical Fueling Activities; Not Associated with the Westman Marine Site
- 🟥 Preliminary Westman Marine Site Boundary

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 40 80

Scale in Feet

Source: Blaine Small Boat Harbor Large Scale Plan Drawing No. 04-0104-8 Oct 1966; Aerial Photo Source: Historical 1966

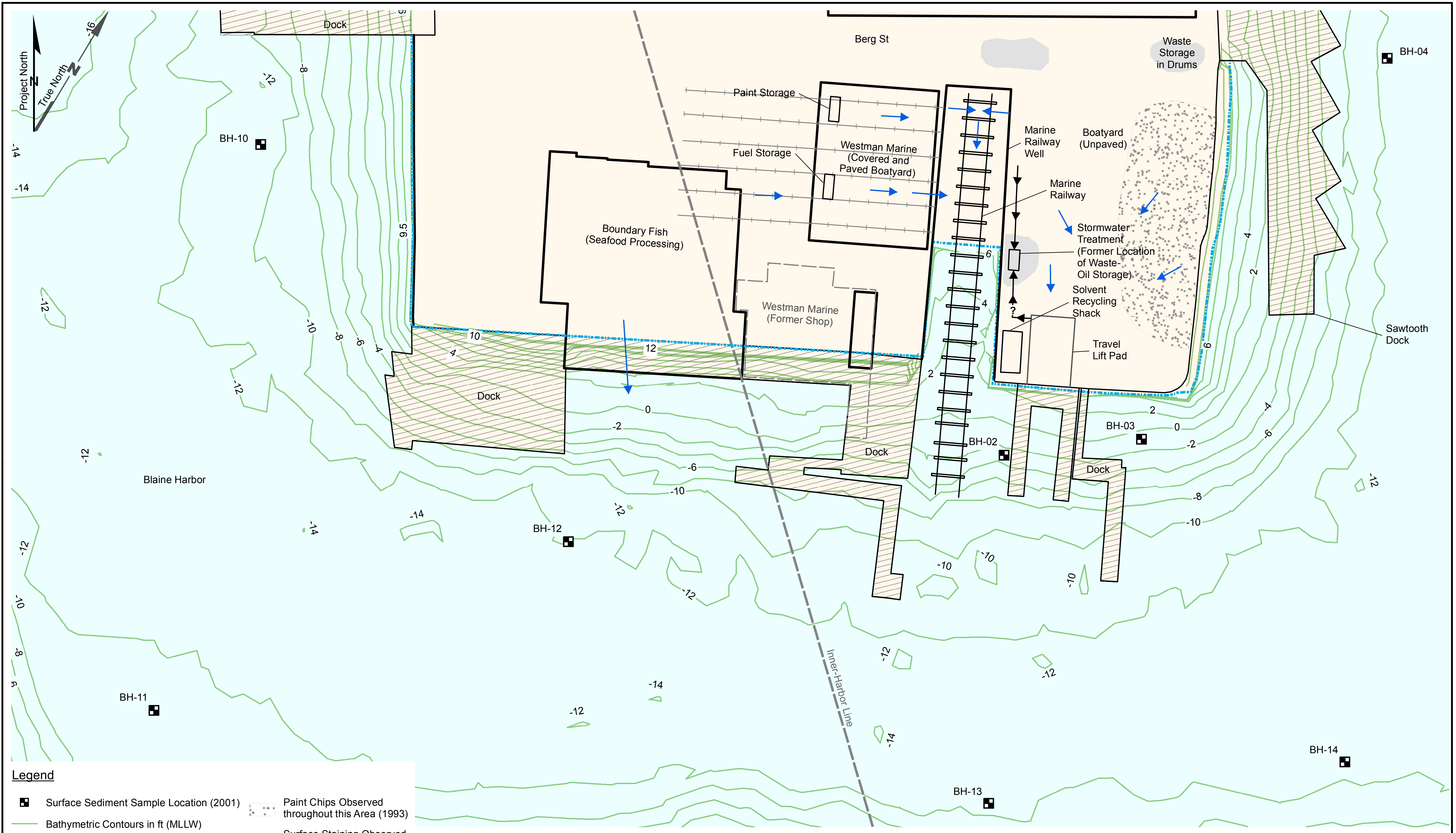
Westman Marine Site
Blaine Harbor
Blaine, Washington

Site Historical Features

Figure
3

LANDAU ASSOCIATES

G:\Projects\001\035\010\018\RI Report\F03HistoricalSiteLayout.mxd 3/12/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

■	Surface Sediment Sample Location (2001)
—	Bathymetric Contours in ft (MLLW)
→	Stormwater Drain Pipe
→	Stormwater Runoff Pathways Observed in 2001 and 2013
⁘	Paint Chips Observed throughout this Area (1993)
▭	Surface Staining Observed in these Areas (1993)
▨	Structure Over Water

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 50 100

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Westman Marine
Blaine Harbor
Blaine, Washington

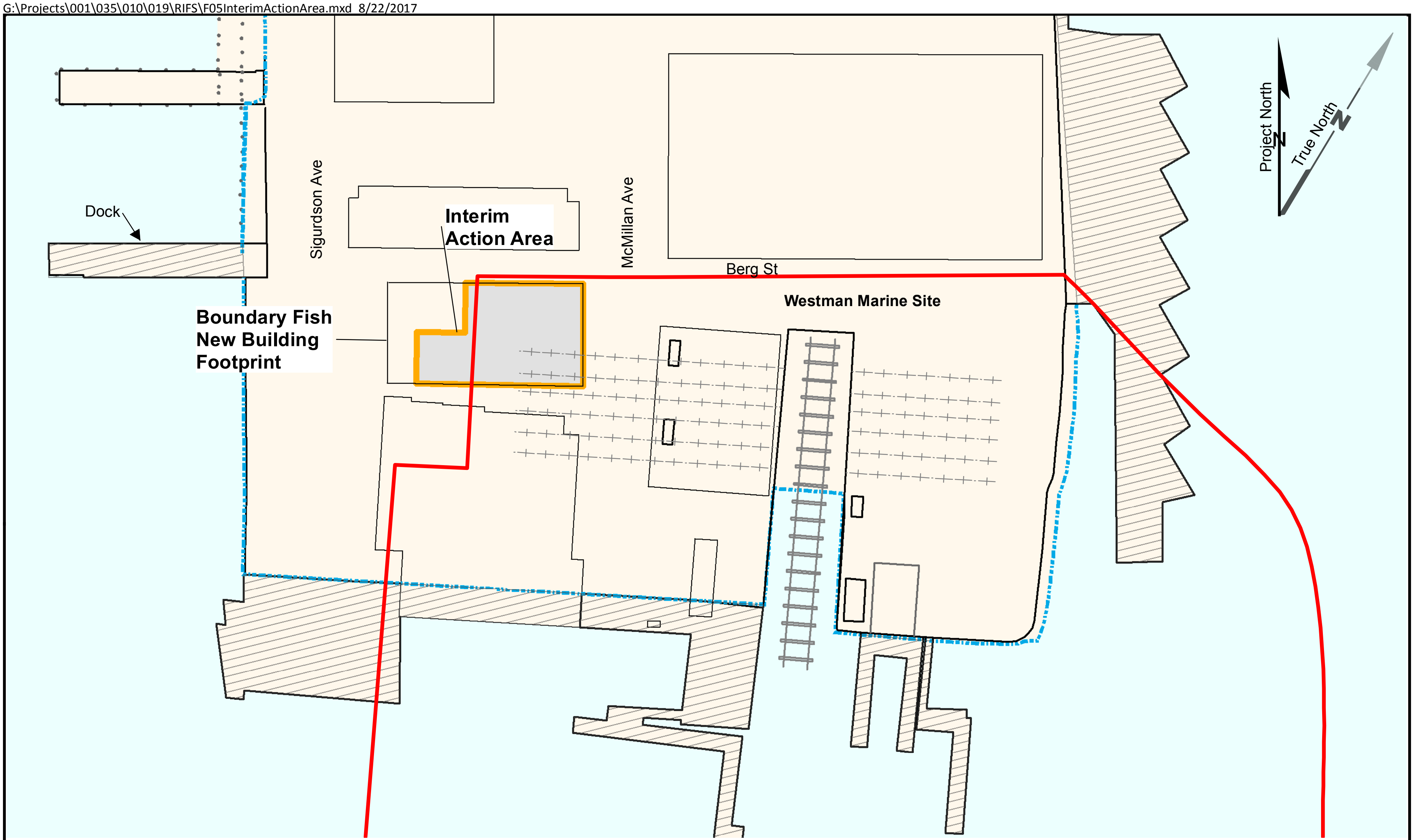
Previous Site Observations and Investigations

Figure
4

LANDAU ASSOCIATES

G:\Projects\001\035\010\018\RI Report\F04PreviousSiteInvestigations.mxd 3/12/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

G:\Projects\001\035\010\019\RIFS\F05InterimActionArea.mxd 8/22/2017



Legend

-+- Historical Track Location (1966)

🟥 Preliminary Westman Marine Site Boundary

🟧 Interim Action Area

☐ Existing Buildings

0 75 150

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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Westman Marine
Blaine Harbor
Blaine, Washington

Interim Action Area

Figure
5

G:\Projects\001\035\010\018\RI Report\F06InterimActionSoilRemovalSamples.mxd 3/12/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

- ⊕ Soil Sample Location
- ▭ Concrete Vault
- 🟥 Preliminary Westman Marine Boundary

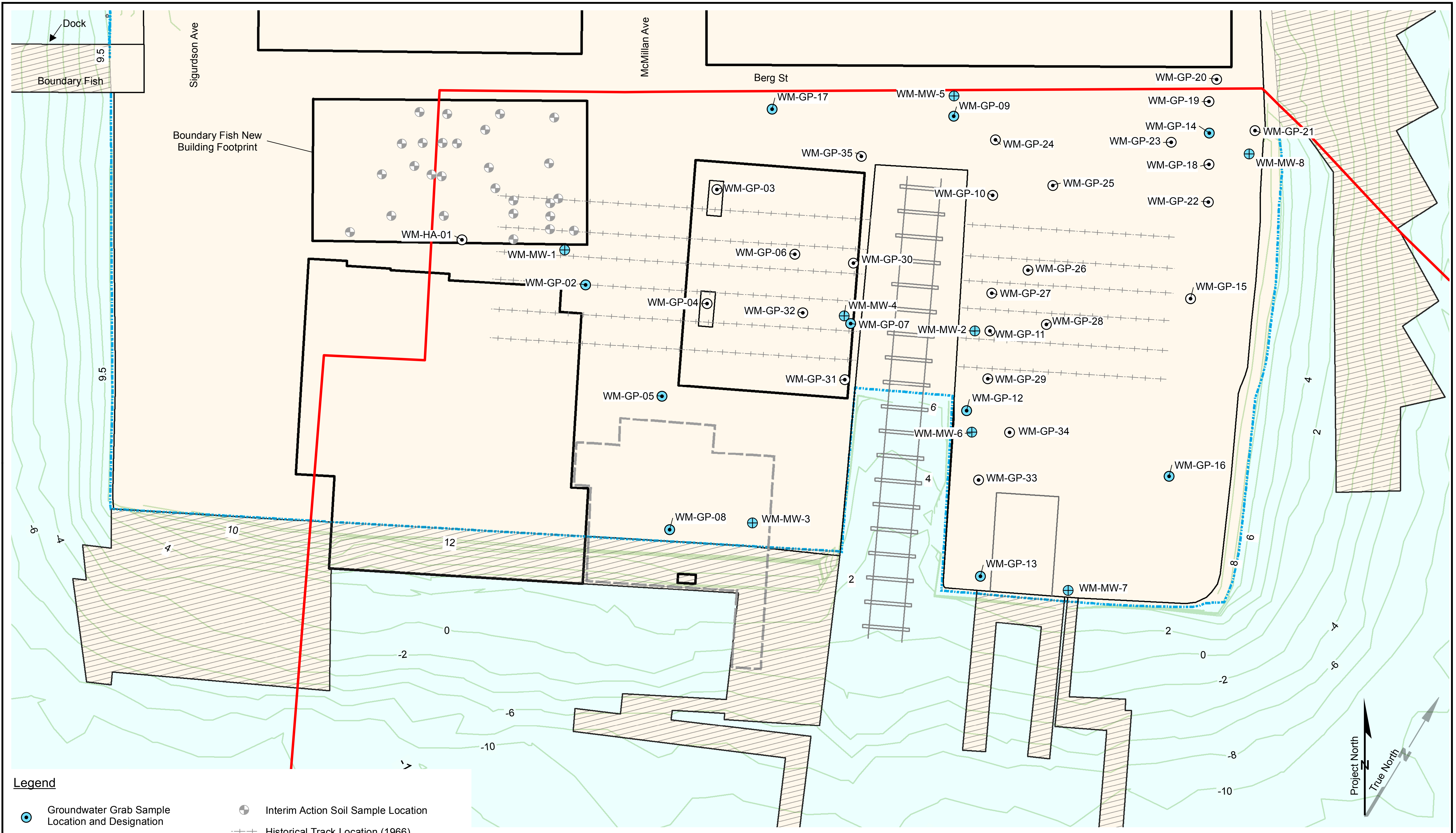
Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Wilson Engineering 2011; Port of Blaine 2011; Walker and Associates, Inc.

LANDAU ASSOCIATES

Westman Marine Blaine Harbor Blaine, Washington	**Interim Action Soil Removal Boundaries and Final Confirmation Sample Locations**	Figure 6



G:\Projects\001\035\010\018\RI Report\F07UplandSampleLocations.mxd 3/12/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

- ● Groundwater Grab Sample Location and Designation
- ⊙ Soil Sample Location and Designation
- ⊕ Groundwater Monitoring Well Location
- ◐ Interim Action Soil Sample Location
- -+-+- Historical Track Location (1966)
- — Bathymetric Contours (MLLW)
- 🟥 Preliminary Westman Marine Site Boundary
- ▨ Structure Over Water

LANDAU ASSOCIATES

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60

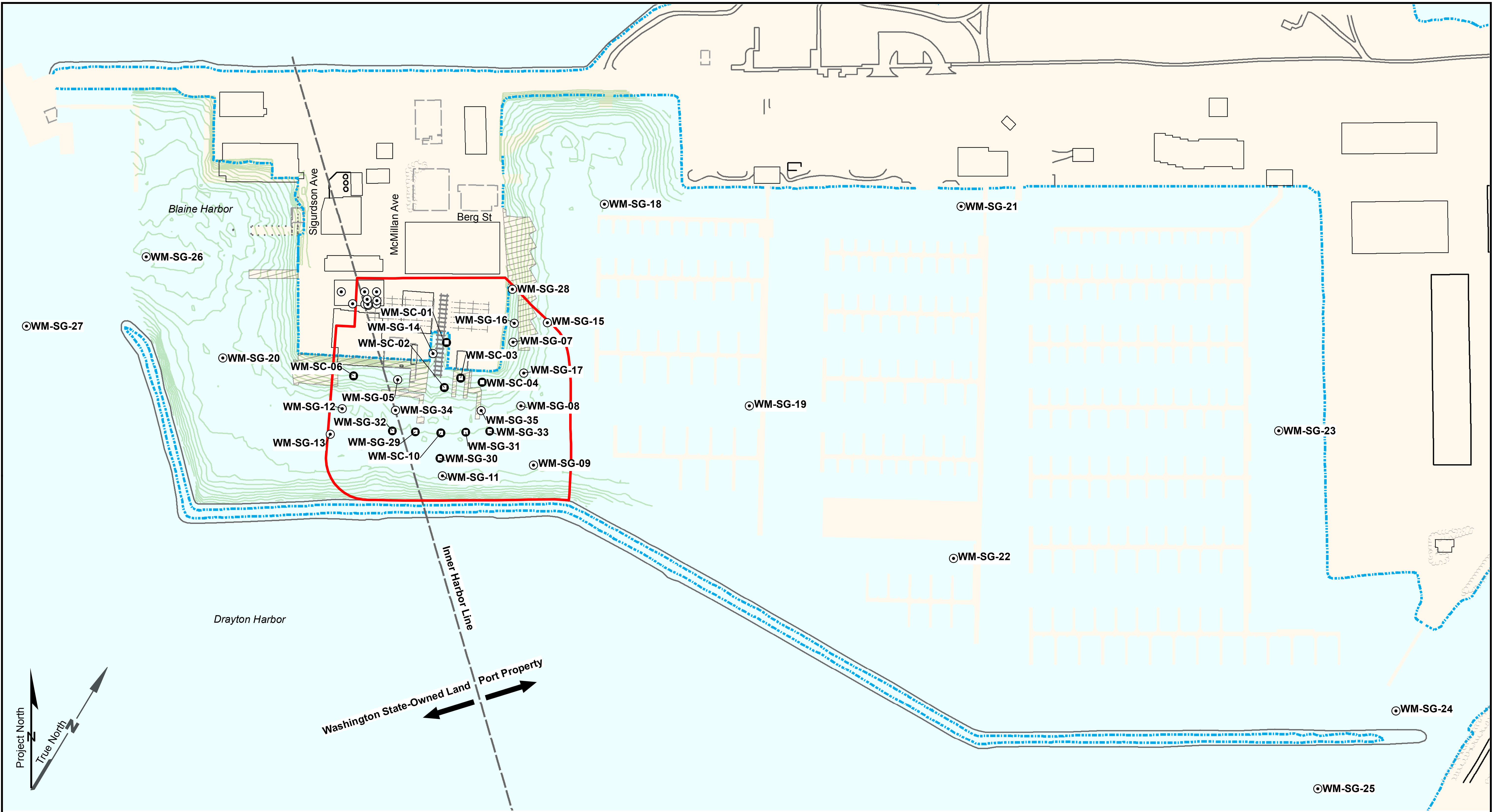
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Westman Marine
Blaine Harbor
Blaine, Washington

Upland Area - Sample Locations

Figure
7



G:\Projects\001\035\010\019\RIFS\F08SedimentSampleLocations.mxd 4/17/2019

Legend

- ◘ Sediment Core Sample Location (Surface Sample Also Collected at this Location)
- ⊙ Surface Sediment Sample Location
- ▭ Preliminary Westman Marine Site Boundary
- -+- Historical Track Location (1966)
- — Bathymetric Contours (MLLW)
- ▨ Structure Over Water
- ---- MHHW = 9.5 ft

Abbreviations

MHHW = Mean Higher High Water
MLLW = Mean Lower Low Water

0 200 400
Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

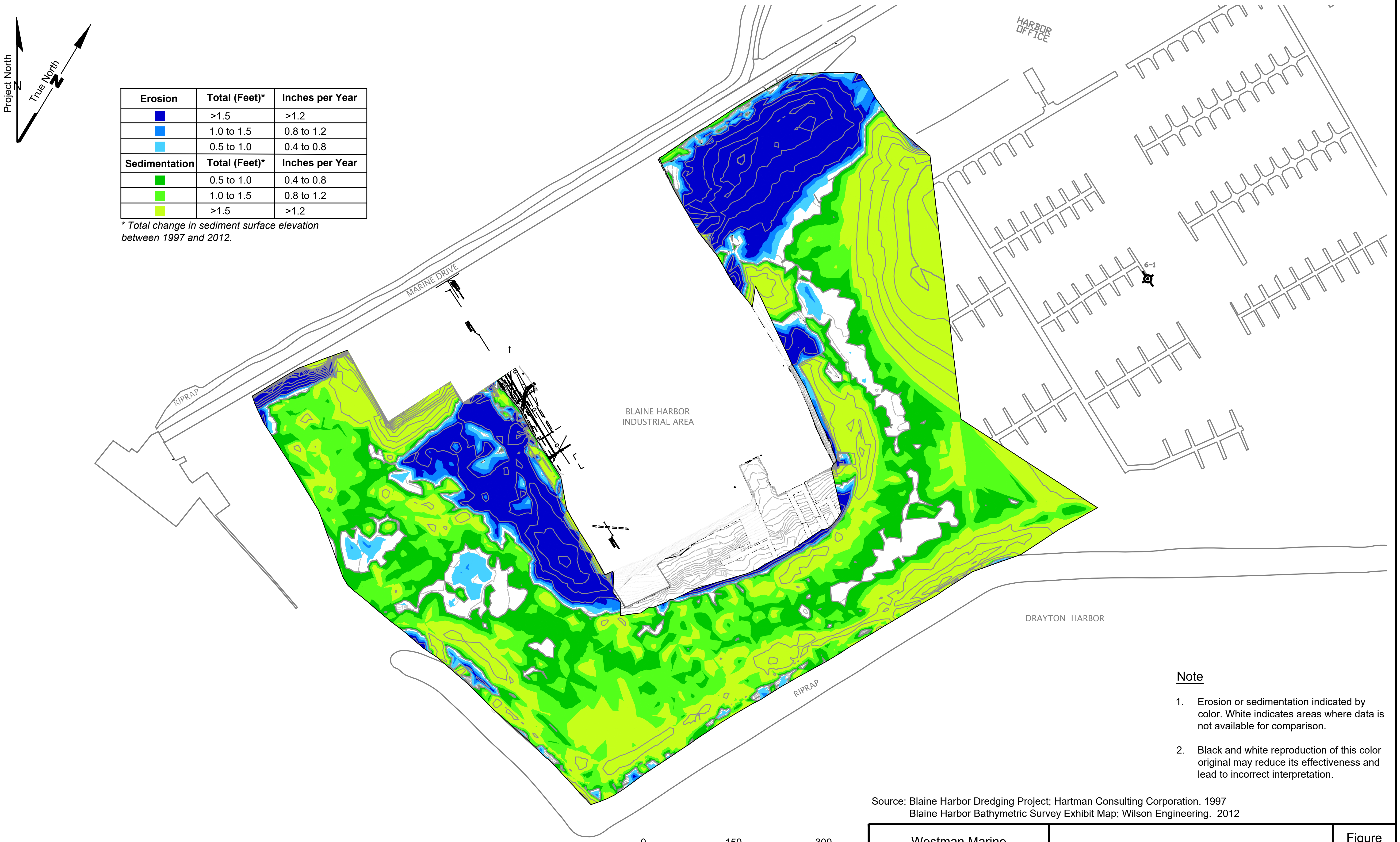
Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Sediment Sample Locations

Figure
8



Erosion	Total (Feet)*	Inches per Year
🟦	>1.5	>1.2
🟦	1.0 to 1.5	0.8 to 1.2
🟦	0.5 to 1.0	0.4 to 0.8
Sedimentation	**Total (Feet)***	**Inches per Year**
🟩	0.5 to 1.0	0.4 to 0.8
🟩	1.0 to 1.5	0.8 to 1.2
🟩	>1.5	>1.2

** Total change in sediment surface elevation between 1997 and 2012.*

Note

1. Erosion or sedimentation indicated by color. White indicates areas where data is not available for comparison.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Blaine Harbor Dredging Project; Hartman Consulting Corporation. 1997
Blaine Harbor Bathymetric Survey Exhibit Map; Wilson Engineering. 2012

0 150 300
Scale in Feet

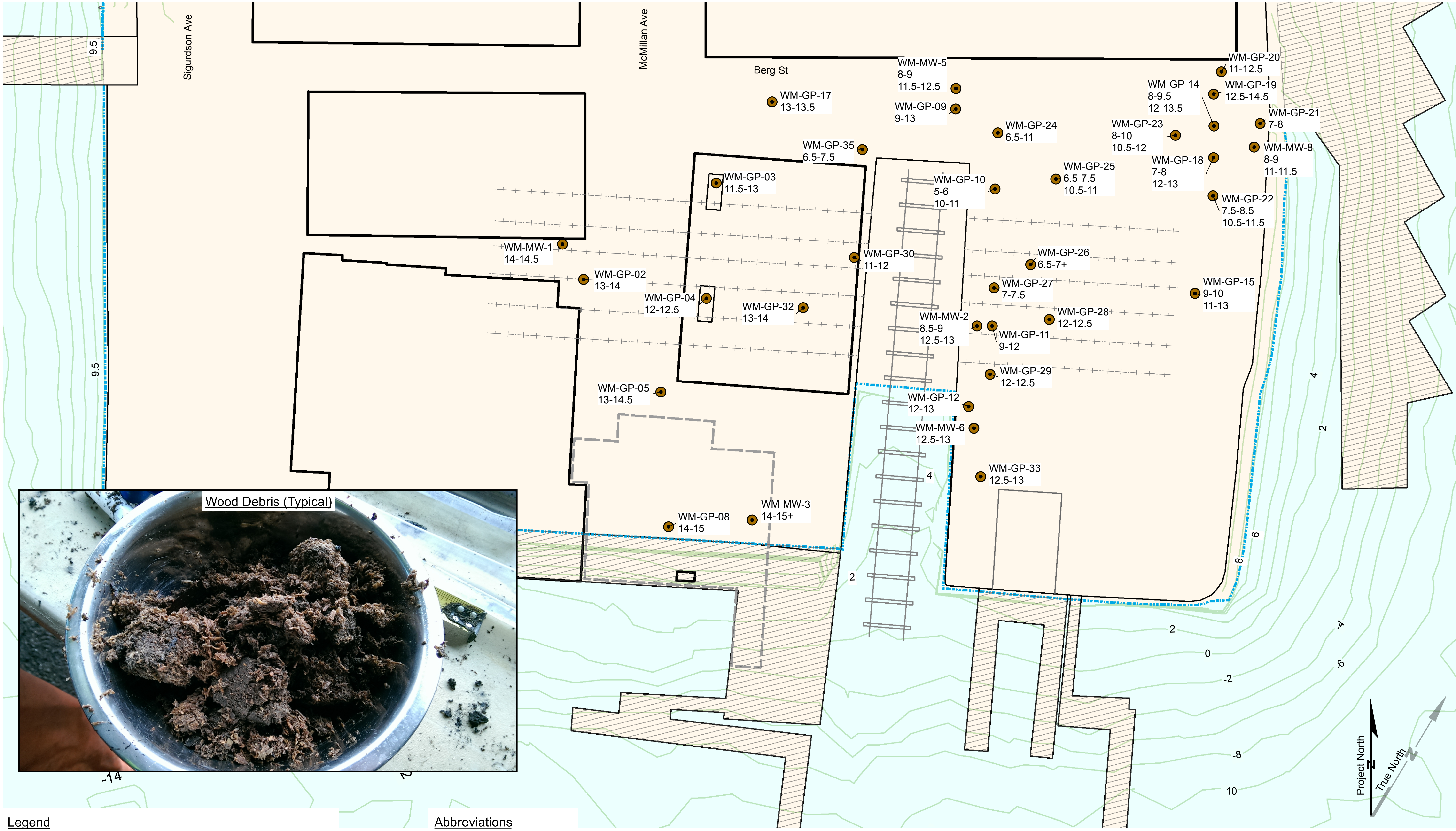
Landau
Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Sedimentation Evaluation

Figure
9

LANDAU ASSOCIATES, INC. | G:\Projects\001\035\010\018\RI Report\F09Volume.dwg (A) "Figure 9" 8/22/2017



Legend

● Wood Debris Present
8-9 Depth Interval (ft BGS)
-+-+ Historical Track Location (1966)
Bathymetric Contours (MLLW)
▨ Structure Over Water

Abbreviations

BGS = Below Ground Surface
ft = Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

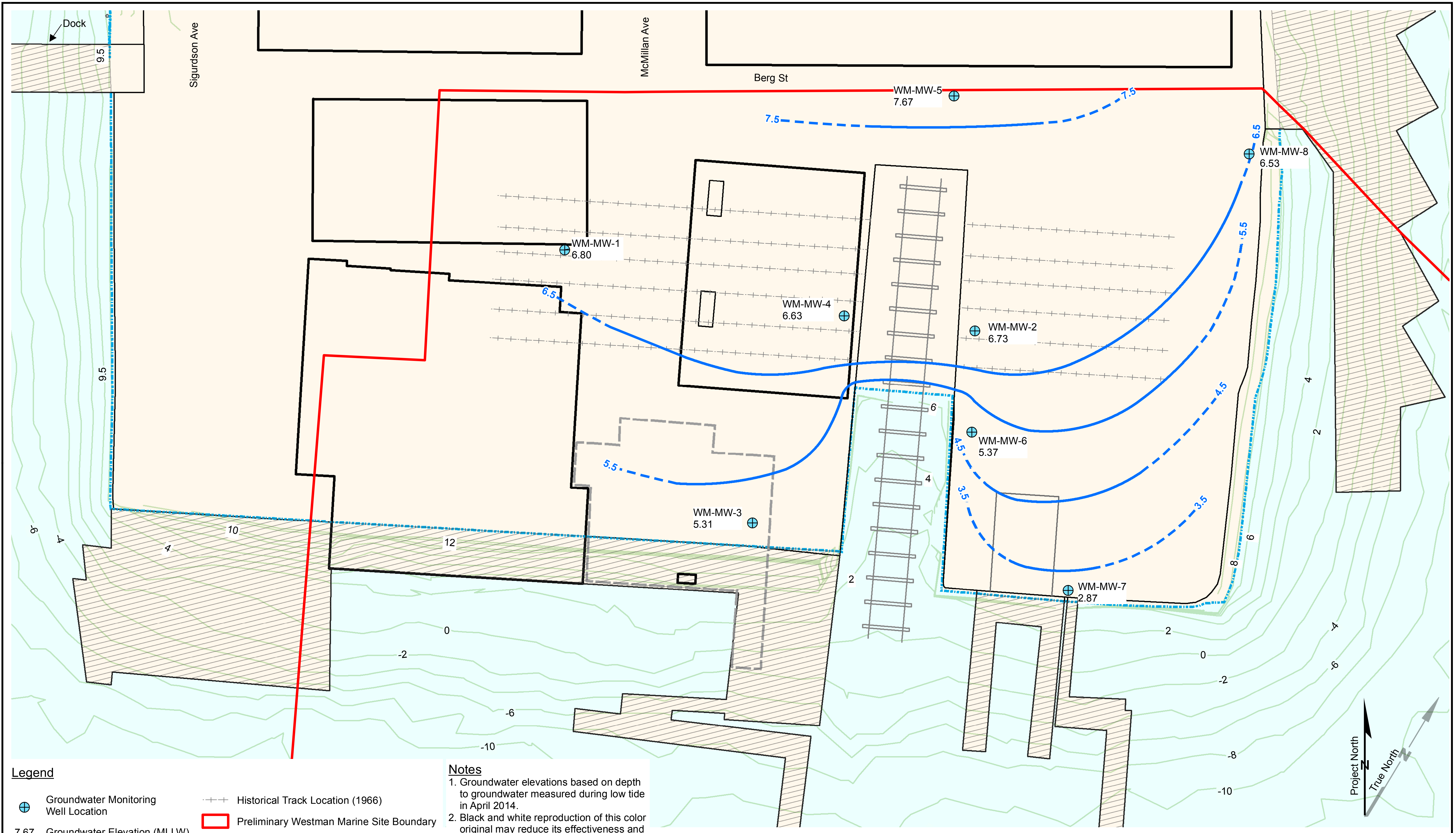
G:\Projects\001\035\010\018\RI Report\F10WoodDebris.mxd 4/10/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Wood Debris in Soil

Figure
10



G:\Projects\001\035\010\018\RI Report\F11GWContoursApril.mxd 4/10/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Legend

⊕	Groundwater Monitoring Well Location
7.67	Groundwater Elevation (MLLW)
━	Groundwater Elevation Contours
─	Bathymetric Contours (MLLW)
-+-+-	Historical Track Location (1966)
🟥	Preliminary Westman Marine Site Boundary
▨	Structure Over Water
-··-	MHHW = 9.5 ft

Notes

1. Groundwater elevations based on depth to groundwater measured during low tide in April 2014.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

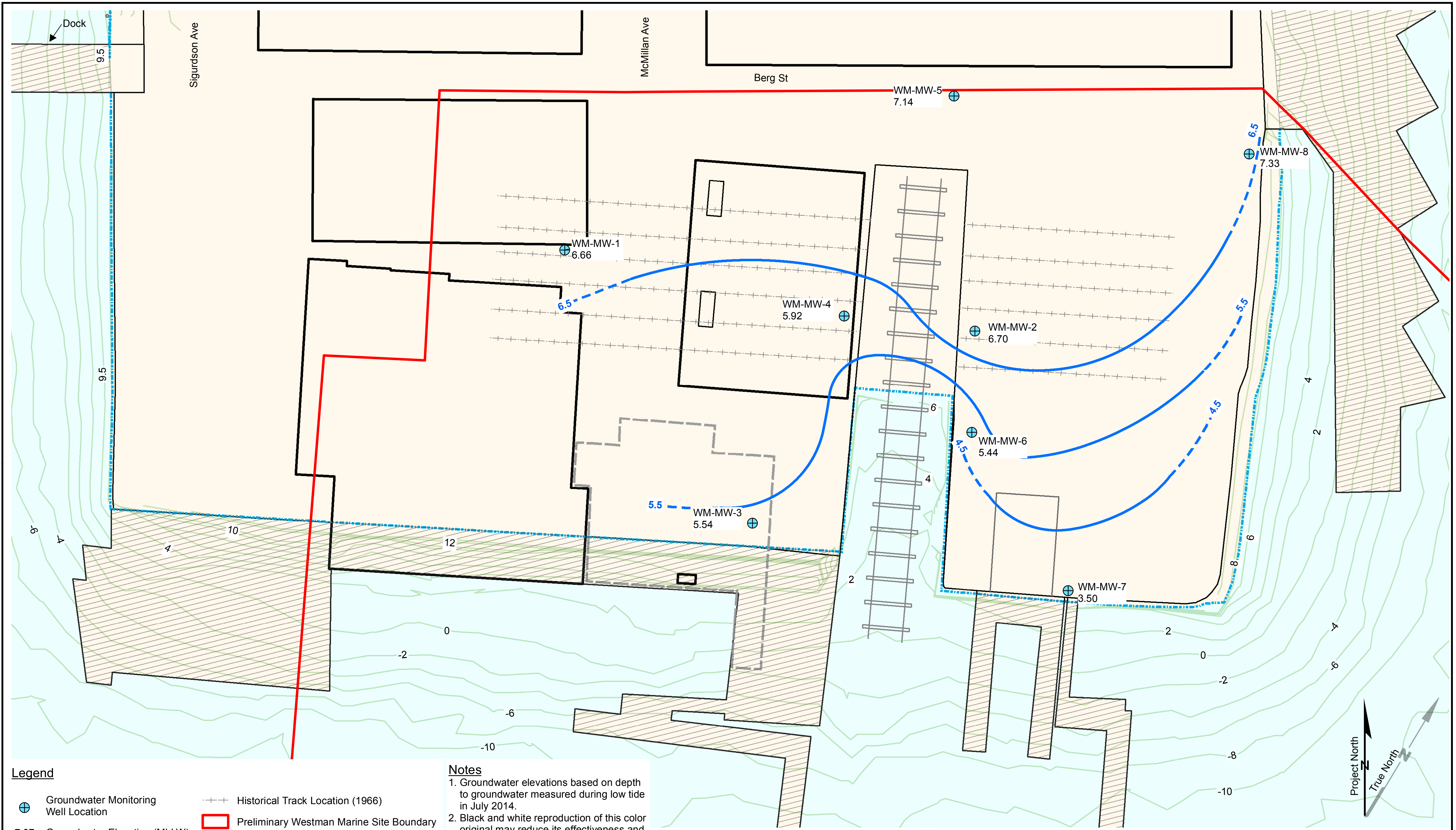
0 30 60
Scale in Feet

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Groundwater Contours -
April 2014

Figure
11



Legend

⊕ Groundwater Monitoring Well Location

7.67 Groundwater Elevation (MLLW)

Groundwater Elevation Contours

Bathymetric Contours (MLLW)

Historical Track Location (1966)

🟥 Preliminary Westman Marine Site Boundary

▨ Structure Over Water

MHHW = 9.5 ft

Notes

1. Groundwater elevations based on depth to groundwater measured during low tide in July 2014.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

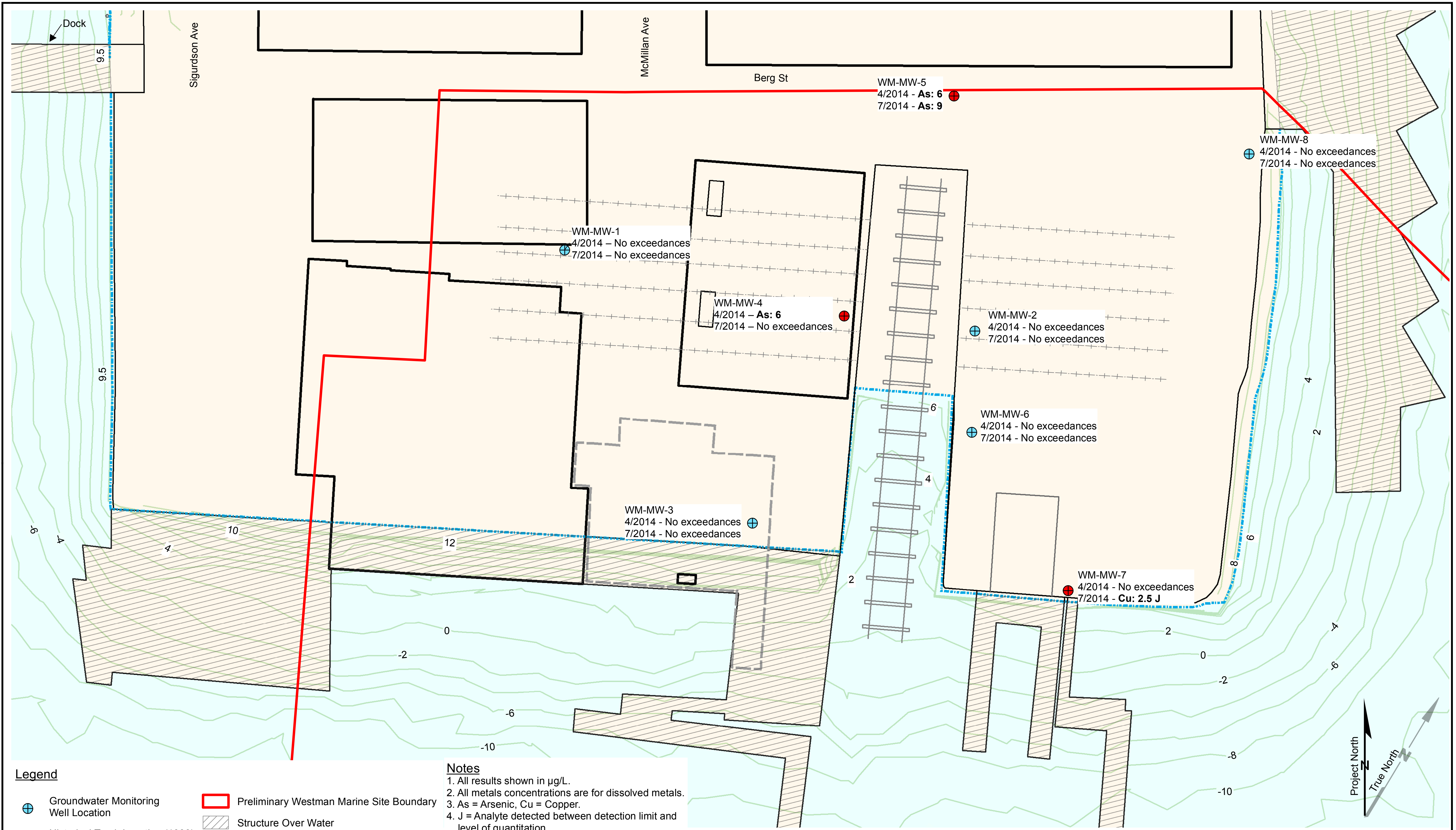
0 30 60
Scale in Feet

Westman Marine
Blaine Harbor
Blaine, Washington

Groundwater Contours - July 2014

Figure
12

G:\Projects\001\035\010\018\RI Report\F12GWContoursJuly.mxd 4/10/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

⊕	Groundwater Monitoring Well Location
-+-+-	Historical Track Location (1966)
—	Bathymetric Contours (MLLW)
▭	Preliminary Westman Marine Site Boundary
▨	Structure Over Water

Notes

1. All results shown in µg/L.
2. All metals concentrations are for dissolved metals.
3. As = Arsenic, Cu = Copper.
4. J = Analyte detected between detection limit and level of quantitation.
5. Locations shown in red indicate concentrations were above the screening level.
6. The screening level for Cu = 2.4 µg/L
7. The screening level for As = 5 µg/L
8. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Westman Marine
Blaine Harbor
Blaine, Washington

Groundwater COPCs Detected Above Screening Levels

Figure
13

G:\Projects\001\035\010\018\RI Report\F13GWCOPCs.mxd 4/10/2015 NAD 1983 StatePlane Washington North FIPS 4601 Feet

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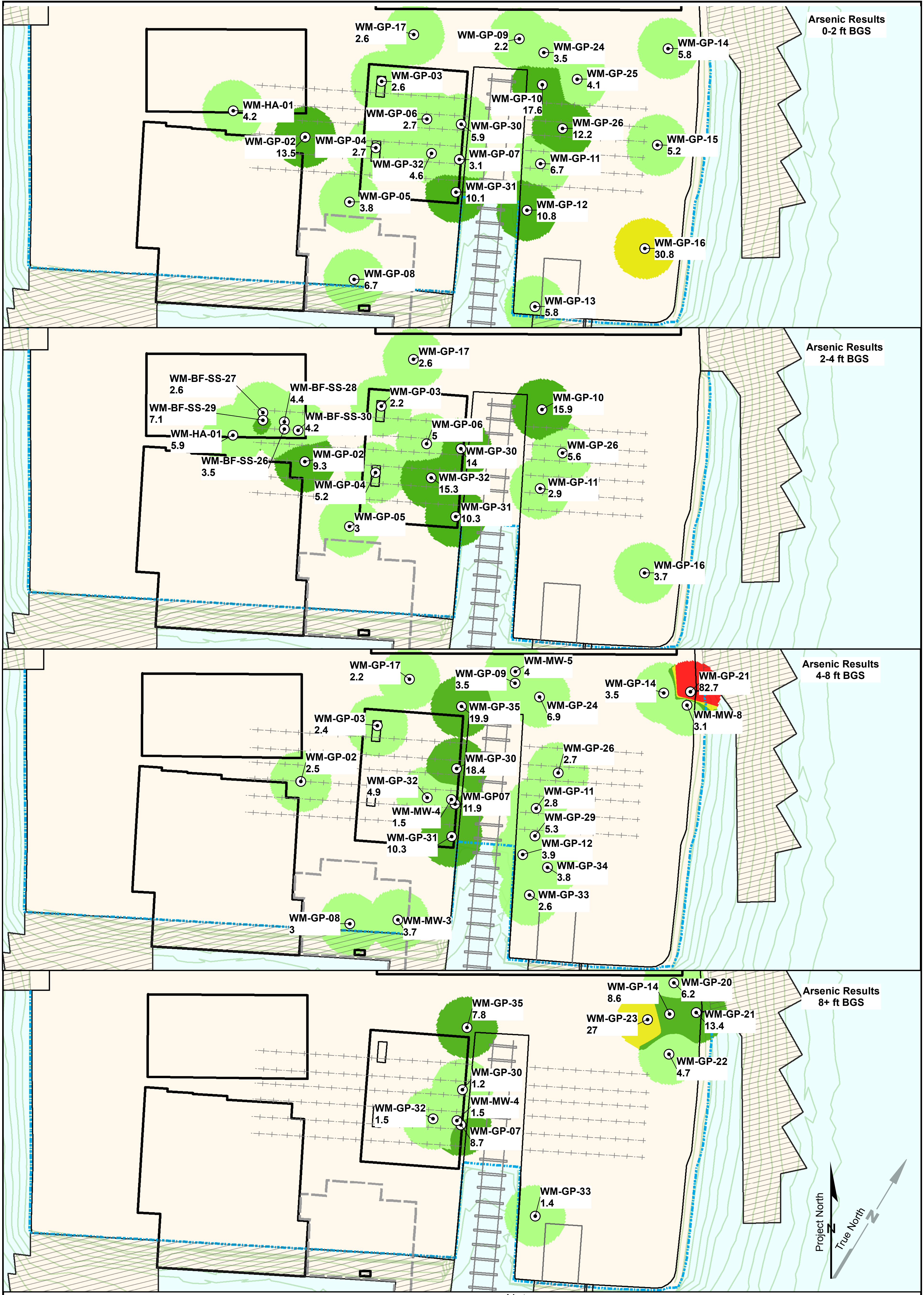


Legend

⊙ Soil Sample Location

Arsenic Concentrations (mg/kg)

🟩 0 - 7
🟩 7 - 20
🟨 20 - 40
🟥 40+

Notes
1. All results shown are reported in mg/kg.
2. The screening level for arsenic in soil is 20 mg/kg.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 60 120
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

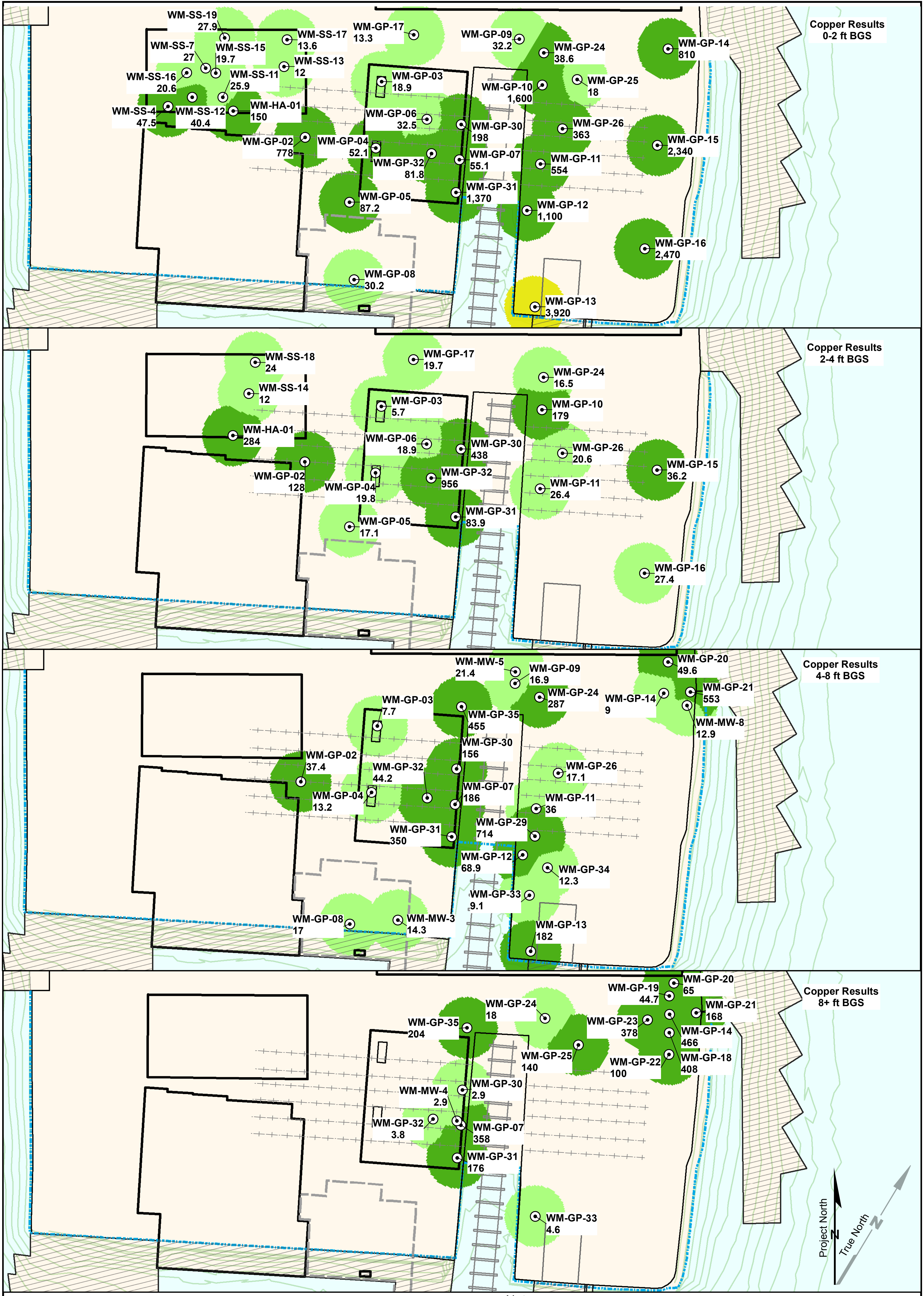
Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Arsenic in Soil

Figure
14

G:\Projects\001\035\010\019\RIFS\F15SoilCuConcentrations.mxd 8/22/2017



Legend

⊙ Soil Sample Location

Copper Concentrations (mg/kg)

🟩	0 - 36
🟩	36-3,200
🟨	3,200 - 6,400
🟥	6,400+

Notes
1. All results shown are reported in mg/kg.
2. The screening level for copper in soil is 3,200 mg/kg.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 60 120

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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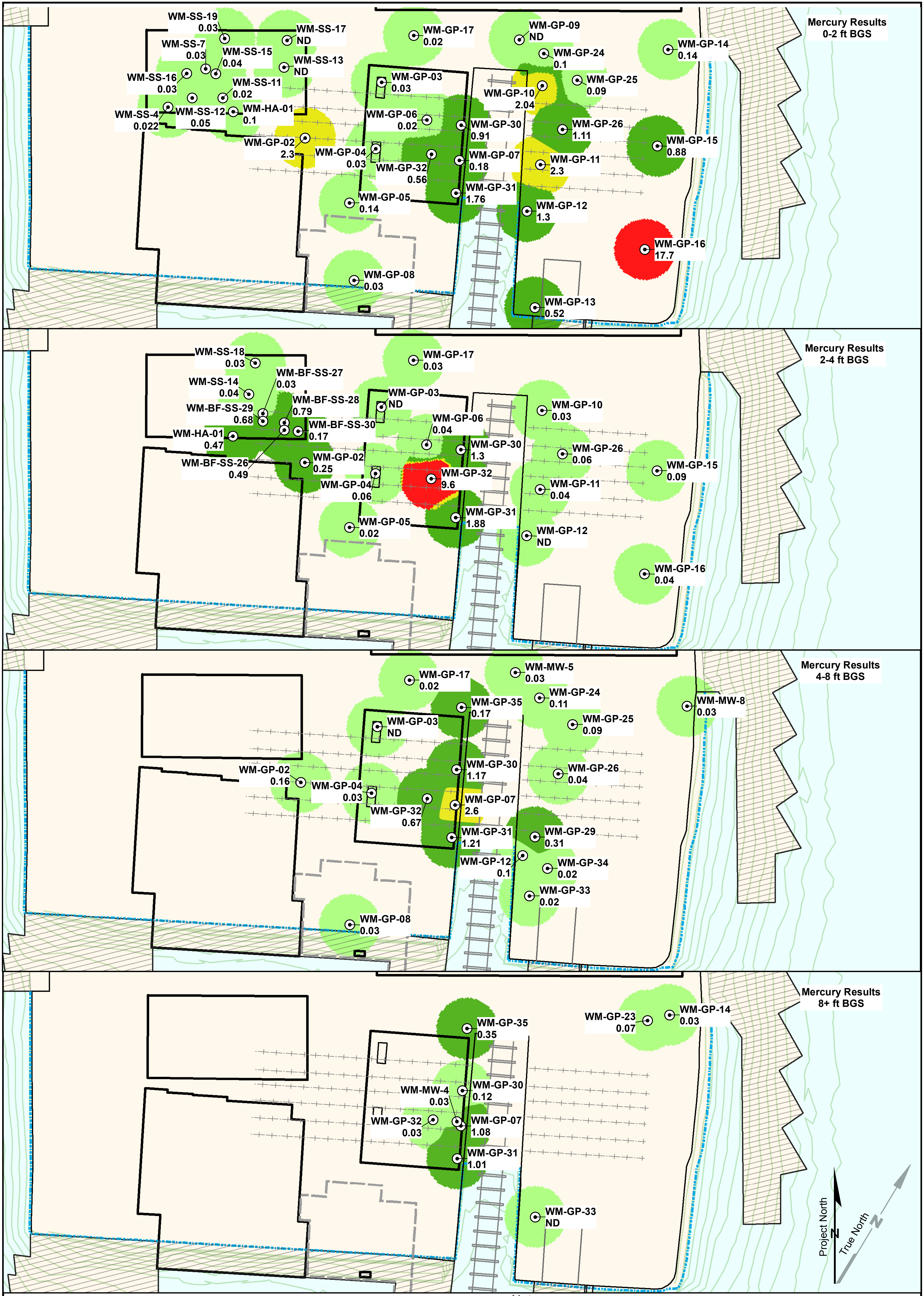
Westman Marine
Blaine Harbor
Blaine, Washington

Copper in Soil

Figure
15



Legend

⊙ Soil Sample Location

ND = Not Detected

Mercury Concentrations (mg/kg)

🟩 0 - 0.16
🟩 0.16 - 2
🟨 2 - 4
🟥 4+

Notes
1. All results shown are reported in mg/kg.
2. The screening level for Mercury in soil is 2 mg/kg.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 60 120
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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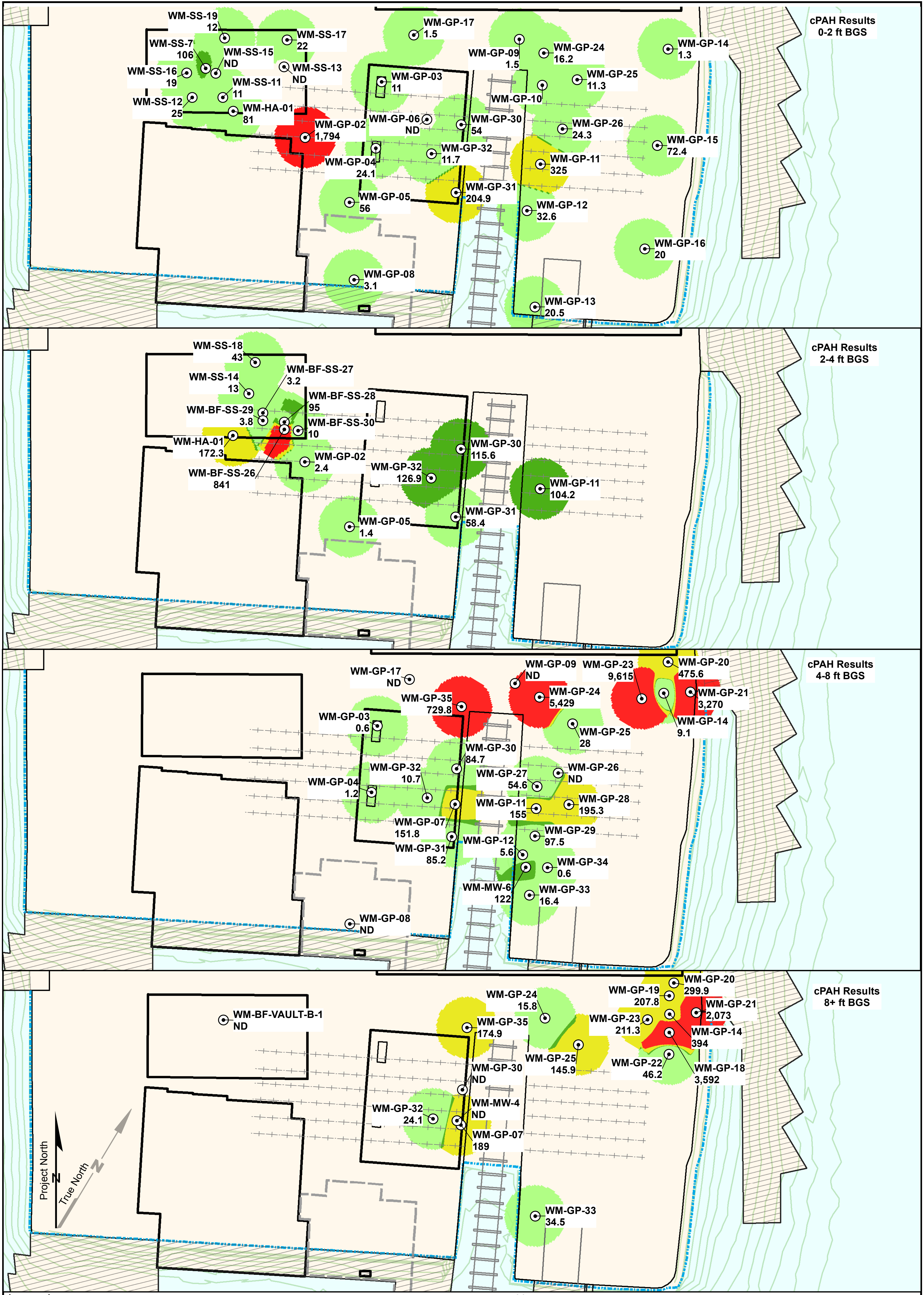
Westman Marine
Blaine Harbor
Blaine, Washington

Mercury in Soil

Figure
16

G:\Projects\001\035\010\019\RIFS\F17SoilcPAHConcentrations.mxd 11/19/2015



Legend

⊙ Soil Sample Location

ND = Not Detected

cPAH Concentrations (µg/kg)

🟩	0 - 100
🟩	100 - 140
🟨	140 - 500
🟥	500+

Notes
1. All results shown are reported in µg/kg.
2. The screening level for cPAHs in soil is 140 µg/kg.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 60 120
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

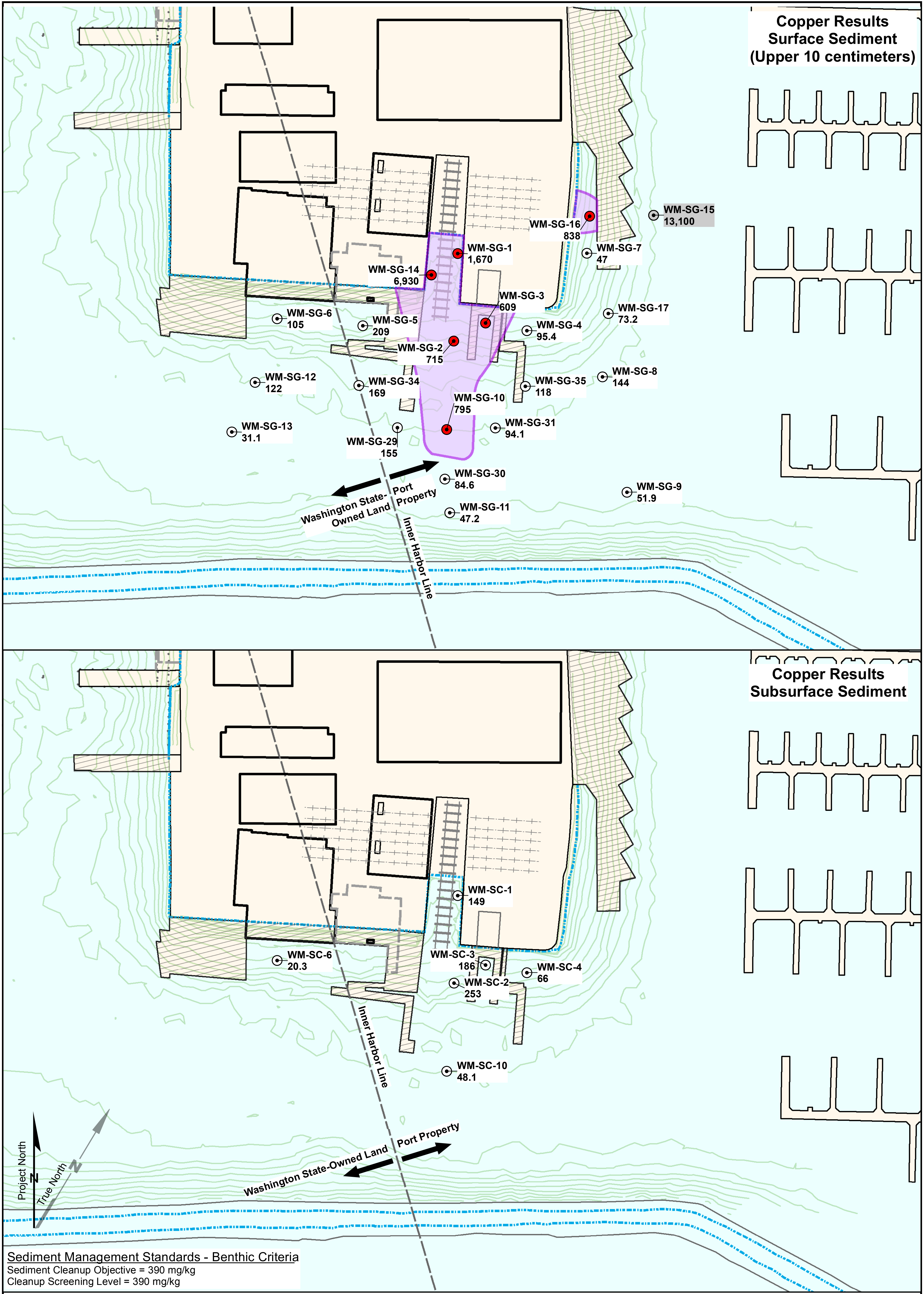
LANDAU ASSOCIATES

Westman Marine
Blaine Harbor
Blaine, Washington

Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil

Figure
17

G:\Projects\001\035\010\019\RIFS\F18SedCuConcentrations.mxd 4/17/2019



Sediment Management Standards - Benthic Criteria
Sediment Cleanup Objective = 390 mg/kg
Cleanup Screening Level = 390 mg/kg

Legend

⊙ Sediment Sample Location

▨ Approximate Extent of SCO Exceedances

Abbreviations

mg/kg = milligrams per kilogram
CSL = Cleanup Screening Level
SCO = Sediment Cleanup Objective

Notes

1. All results shown are reported in mg/kg.
2. Locations shown in red exceed the CSL and the SCO.
3. Locations shown in yellow exceed the SCO.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 100 200
Scale in Feet

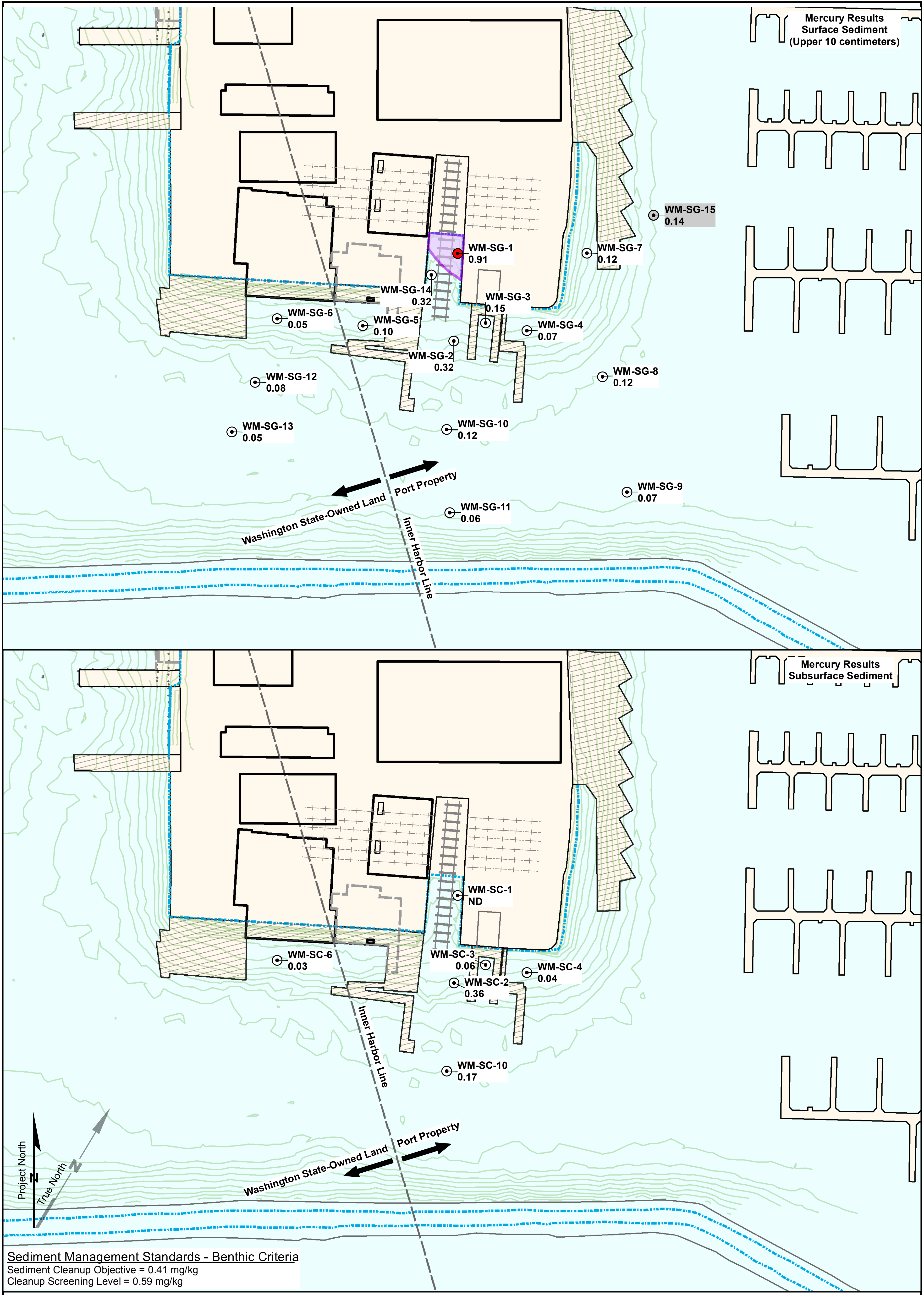
Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Copper in Sediment

Figure
18

G:\Projects\001\035\010\019\RIFS\F19SedHgConcentrations.mxd 4/17/2019



Sediment Management Standards - Benthic Criteria
Sediment Cleanup Objective = 0.41 mg/kg
Cleanup Screening Level = 0.59 mg/kg

Legend

⊙ Sediment Sample Location

▨ Approximate Extent of SCO Exceedances

ND = Not Detected

Abbreviations

mg/kg = milligrams per kilogram
CSL = Cleanup Screening Level
SCO = Sediment Cleanup Objective

Notes

1. All results shown are reported in mg/kg.
2. Locations shown in red exceed the CSL and the SCO.
3. Locations shown in yellow exceed the SCO.
4. Natural background = 0.2 mg/kg.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 100 200
Scale in Feet

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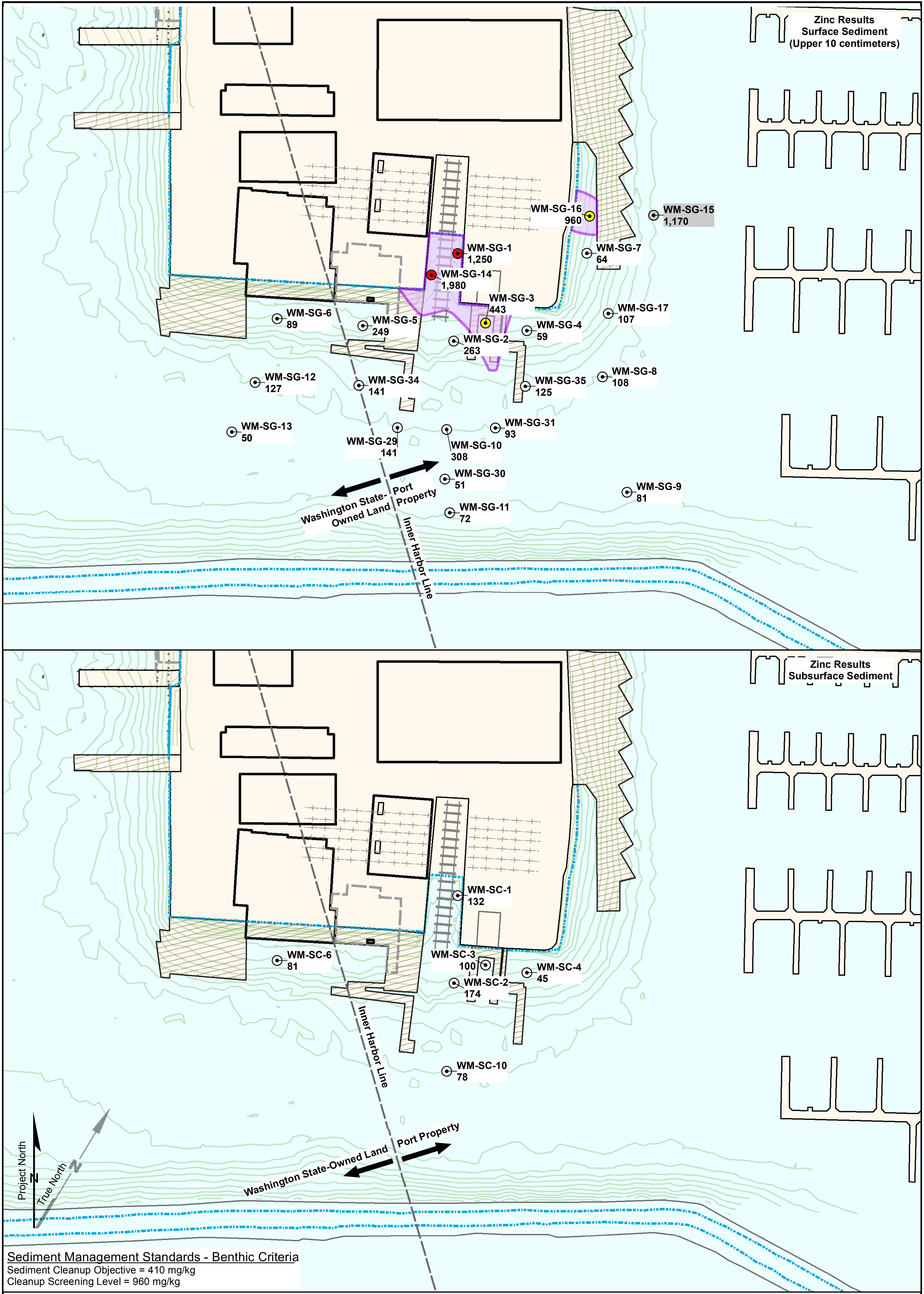
Westman Marine
Blaine Harbor
Blaine, Washington

Mercury in Sediment

Figure
19

G:\Projects\001\035\010\019\RIFS\F20SedZnConcentrations.mxd 4/17/2019



Sediment Management Standards - Benthic Criteria
Sediment Cleanup Objective = 410 mg/kg
Cleanup Screening Level = 960 mg/kg

Legend

⊙ Sediment Sample Location

🟪 Approximate Extent of SCO Exceedances

Abbreviations

mg/kg = milligrams per kilogram
CSL = Cleanup Screening Level
SCO = Sediment Cleanup Objective

Notes

1. All results shown are reported in mg/kg.
2. Locations shown in red exceed the CSL and the SCO.
3. Locations shown in yellow exceed the SCO.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 100 200
Scale in Feet

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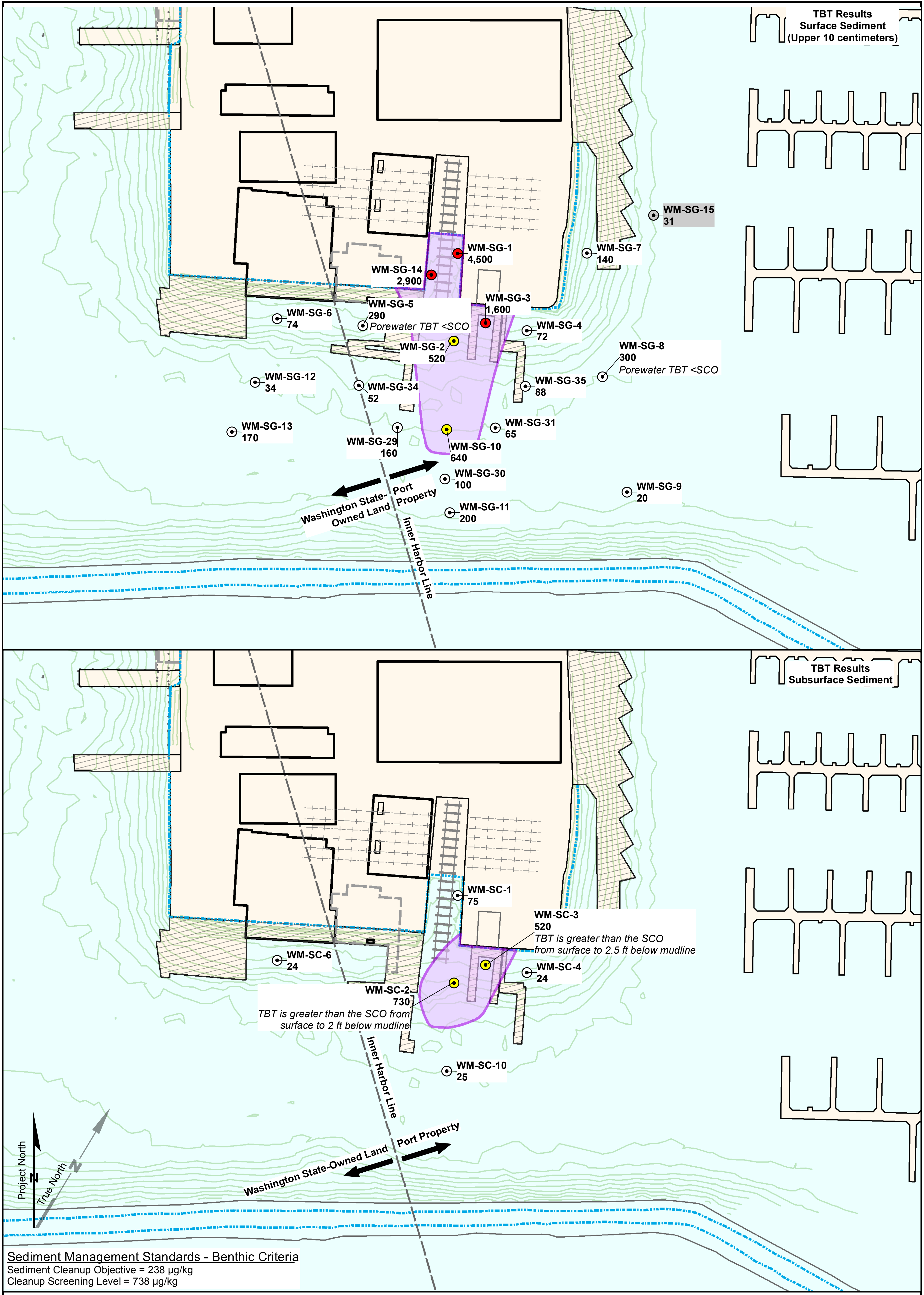
Blaine, Washington

Zinc in Sediment

Figure
20

G:\Projects\001\035\010\019\RIFS\F21SedTBTConcentrations.mxd 4/17/2019



Sediment Management Standards - Benthic Criteria
Sediment Cleanup Objective = 238 µg/kg
Cleanup Screening Level = 738 µg/kg

Legend

⊙ Sediment Sample Location

🟪 Approximate Extent of SCO Exceedances

Abbreviations

µg/kg = micrograms per kilogram
CSL = Cleanup Screening Level
SCO = Sediment Cleanup Objective

Notes

1. All results shown are reported in µg/kg.
2. Locations shown in red exceed the CSL and the SCO.
3. Locations shown in yellow exceed the SCO.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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0 100 200
Scale in Feet

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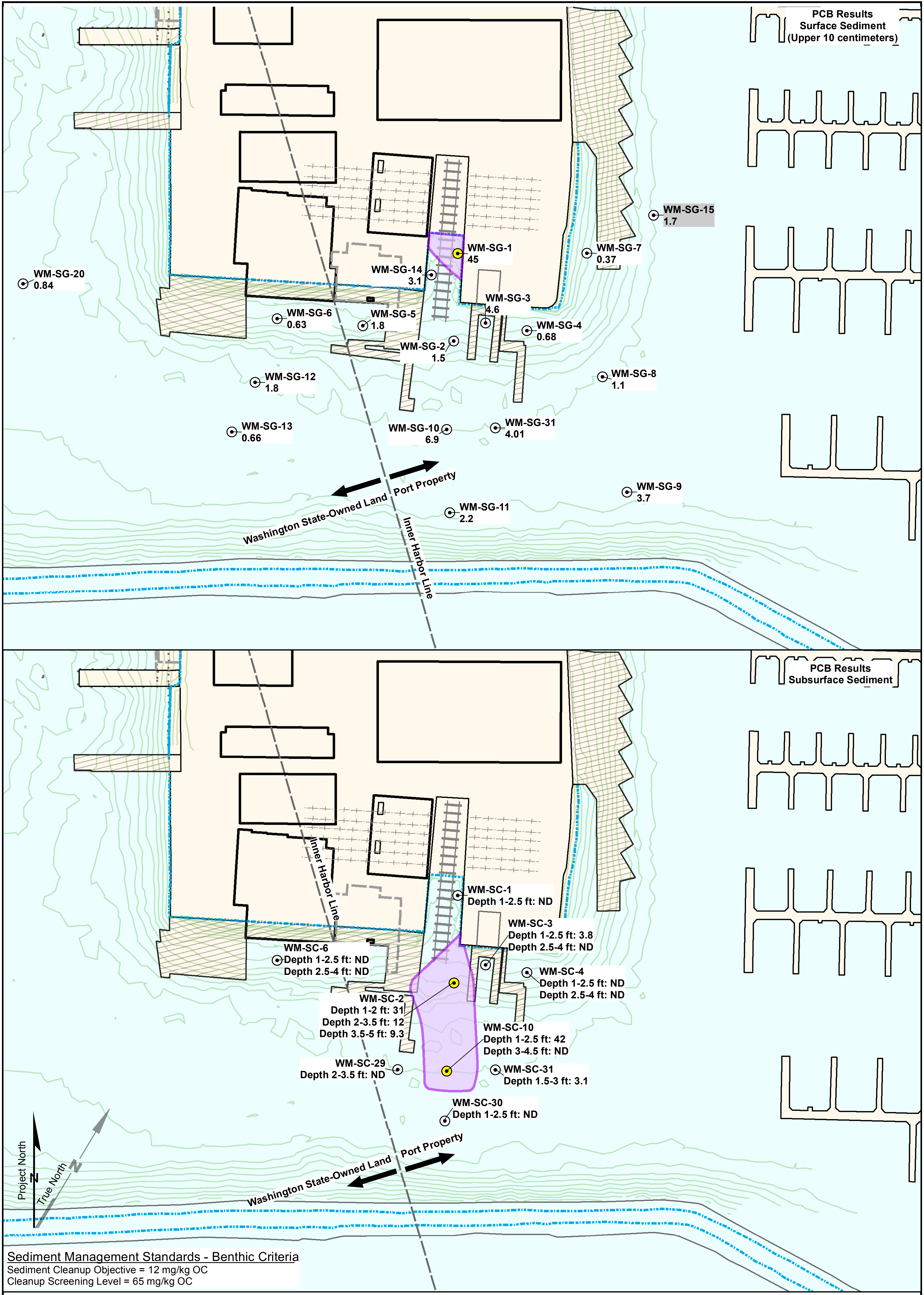
Blaine Harbor
Blaine, Washington

Tributyltin in Sediment

Figure
21

G:\Projects\001\035\010\019\RIFS\F22SedPCBConcentrations.mxd 4/17/2019



Sediment Management Standards - Benthic Criteria
Sediment Cleanup Objective = 12 mg/kg OC
Cleanup Screening Level = 65 mg/kg OC

Legend

⊙ Sediment Sample Location

▨ Approximate Extent of SCO Exceedances

Abbreviations

mg/kg = milligrams per kilogram
CSL = Cleanup Screening Level
ND = Not Detected
OC = Normalized to Organic Carbon
SCO = Sediment Cleanup Objective

Notes

1. All results shown are reported in mg/kg OC.
2. Locations shown in red exceed the CSL and the SCO.
3. Locations shown in yellow exceed the SCO.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 100 200
Scale in Feet

Landau Associates

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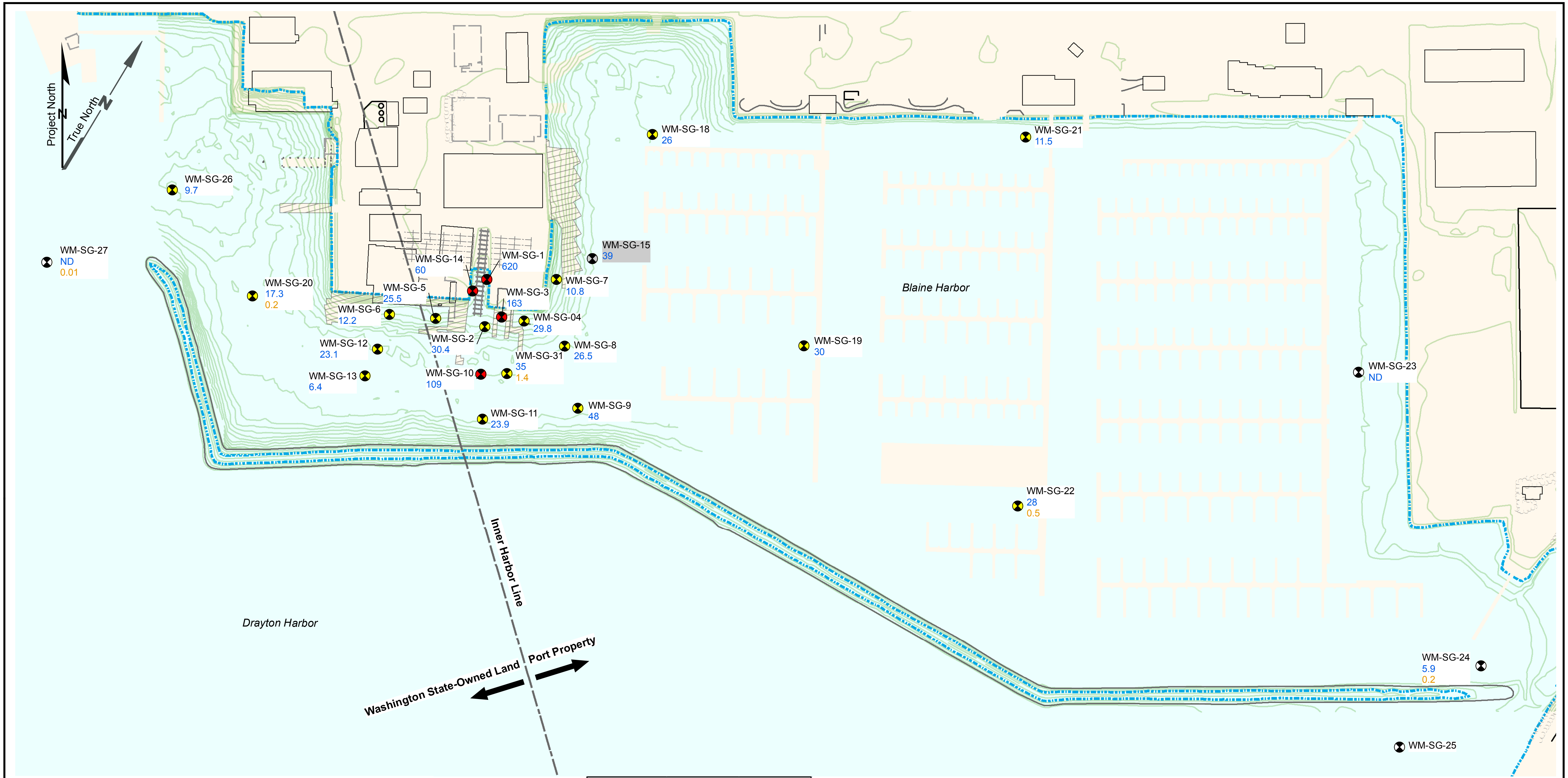
Blaine Harbor
Blaine, Washington

Polychlorinated Biphenyls in Sediment

Figure
22



Legend

⊗ Surface Sediment Sample Location

17.3 Total PCB Concentration (μg/kg)
0.2 Dioxin-Like PCB Congeners (PCB-TEQ) Concentration ppt

-+-+- Historical Track Location (1966)

— Bathymetric Contours (MLLW)

▨ Structure Over Water

Human Health Screening Levels for Polychlorinated Biphenyls

Constituent	SCO	CSL
Total PCBs	6 μg/kg	53 μg/kg
PCB-TEQ	0.2 ppt	2 ppt

Note

1. Locations shown in red exceed the CSL.
2. Locations shown in yellow exceed the SCO.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Abbreviations

PCBs = Polychlorinated Biphenyls
μg/kg = Micrograms per Kilogram
ND = Not Detected
ppt = Parts per Trillion
TEQ = Toxicity Equivalency

0 200 400
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

G:\Projects\001\035\010\019\RIFS\F23SedPBT.mxd 4/17/2019

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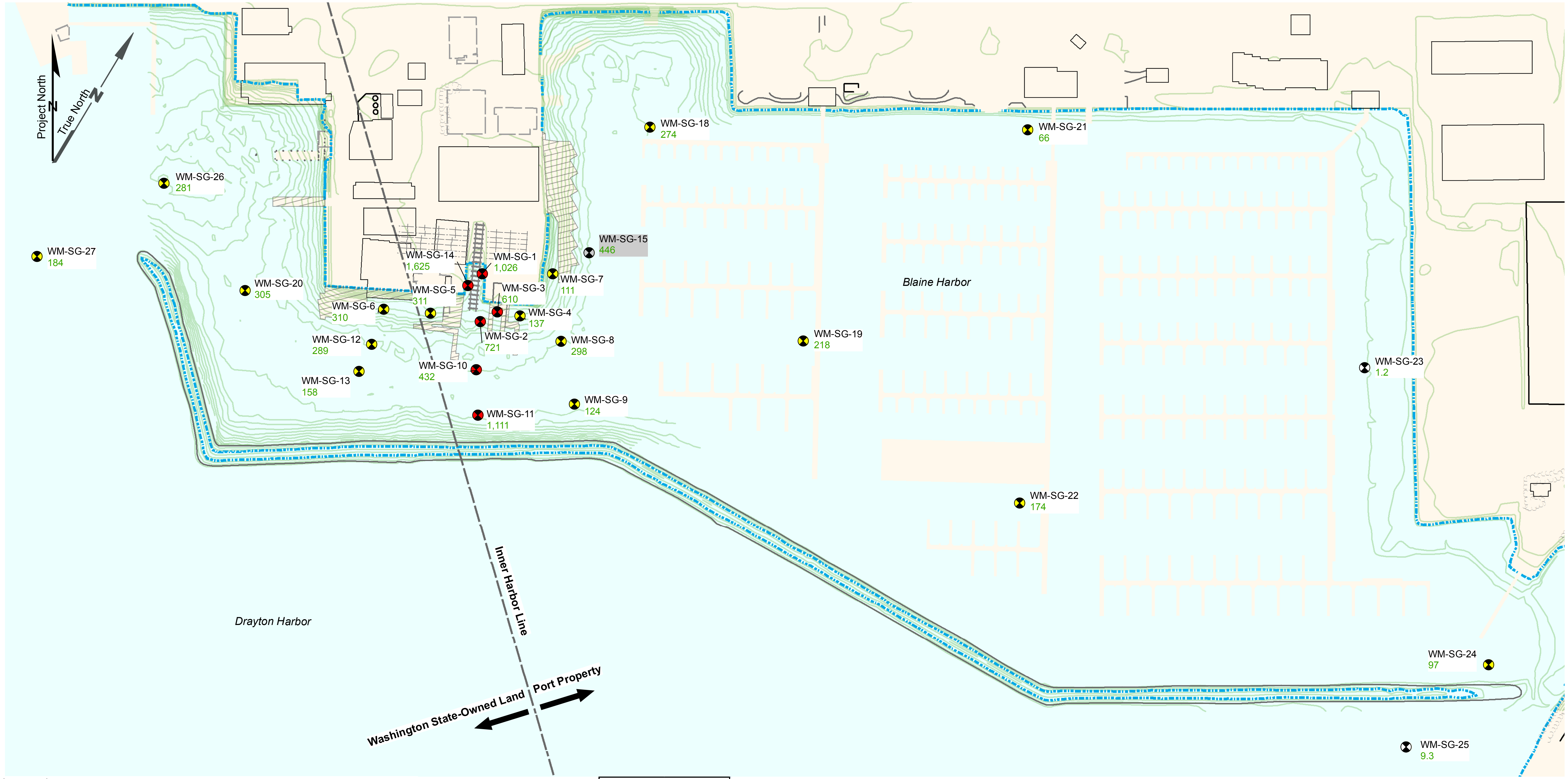
Blaine, Washington

Polychlorinated Biphenyls in Surface Sediment - Harbor-Wide

Figure
23



G:\Projects\001\035\010\019\RIFS\F24SedcPAH.mxd 4/17/2019

Legend

⊗ Surface Sediment Sample Location
305 cPAH Concentration (µg/kg)

Historical Track Location (1966)
Bathymetric Contours (MLLW)
▨ Structure Over Water

Human Health Screening Levels for cPAHs	
SCO	CSL
40 µg/kg	400 µg/kg

Note
1. Locations shown in red exceed the CSL.
2. Locations shown in yellow exceed the SCO.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Abbreviations
cPAHs = Carcinogenic Polycyclic Aromatic Hydrocarbons (TEQ)
µg/kg = Micrograms per Kilogram
TEQ = Toxicity Equivalency

0 200 400
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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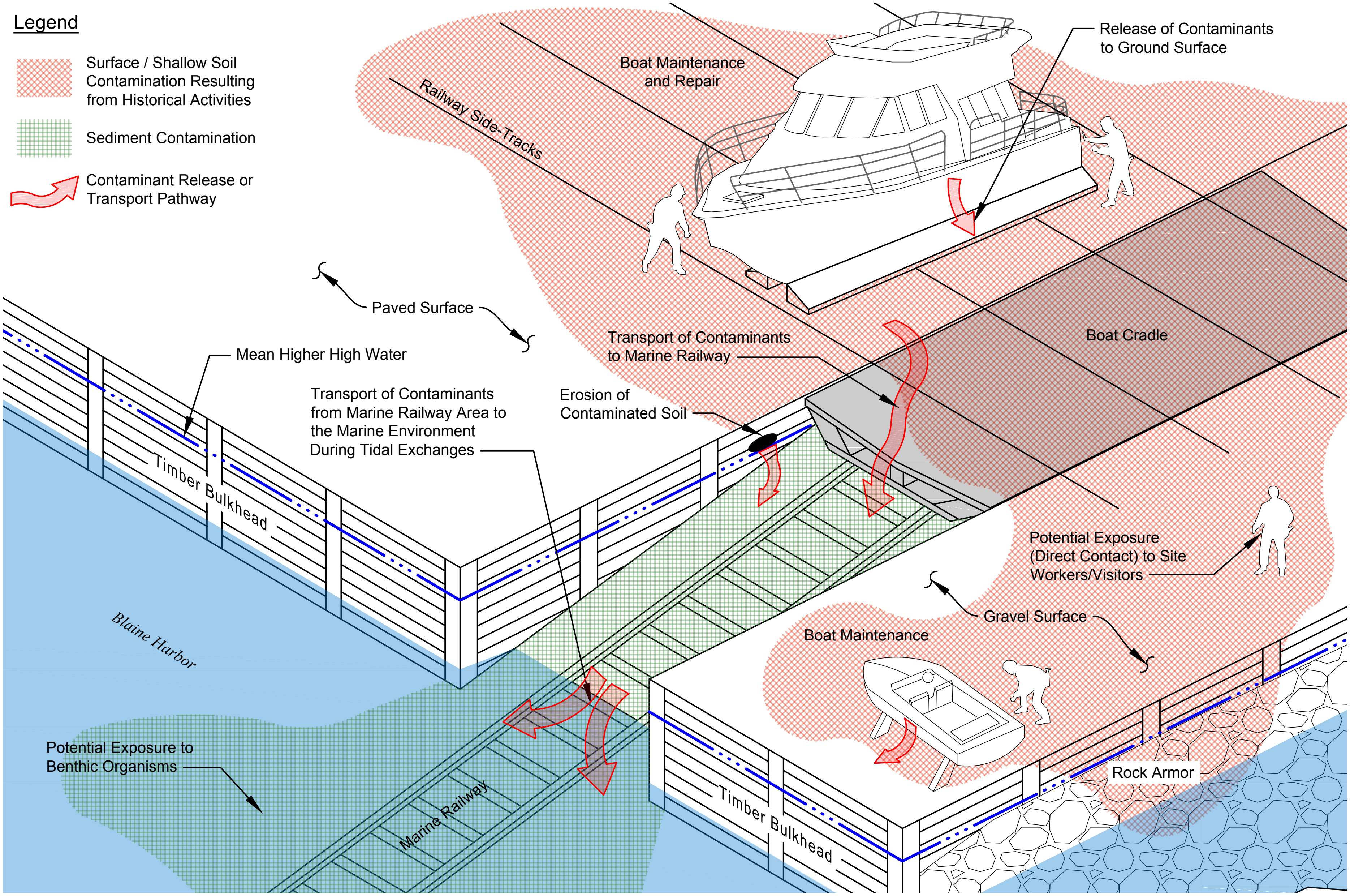
Blaine, Washington

Carcinogenic Polycyclic Aromatic Hydrocarbons in Surface Sediment

Figure
24

LANDAU ASSOCIATES, INC. | G:\Projects\001\035\010\018\RI Report\F025 CSM.dwg (A) "Figure 25" 12/19/2017



Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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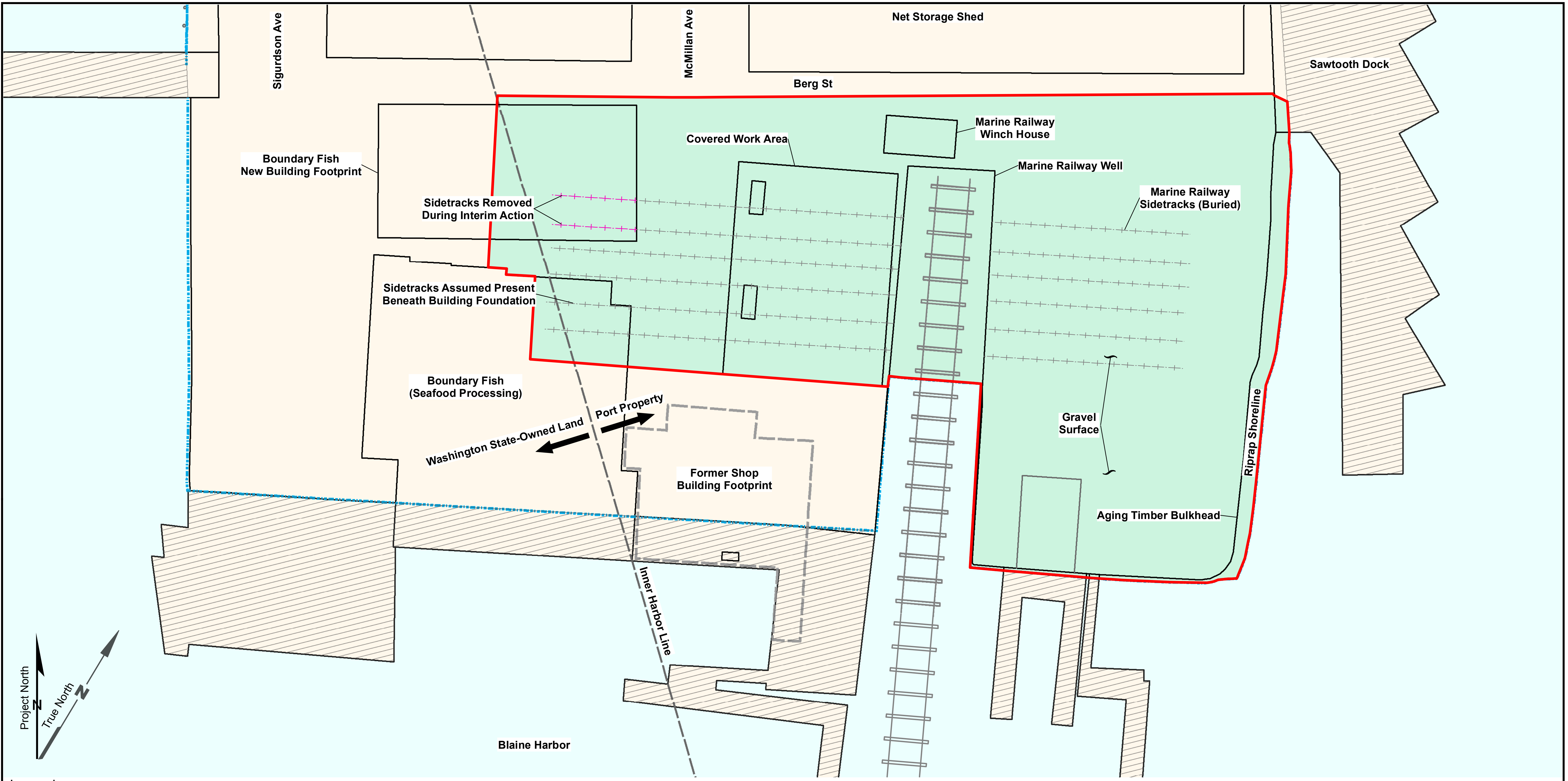
Blaine, Washington

Conceptual Site Model

Figure
25



Legend

-+- Historical Track Location (1966)

🟥 Upland Site Boundary

▨ Structure Over Water

🟩 Upland Site Unit

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 40 80
Scale in Feet

G:\Projects\001\035\010\019\RIFS\F26UplandSiteUnitDesignations.mxd 3/19/2019

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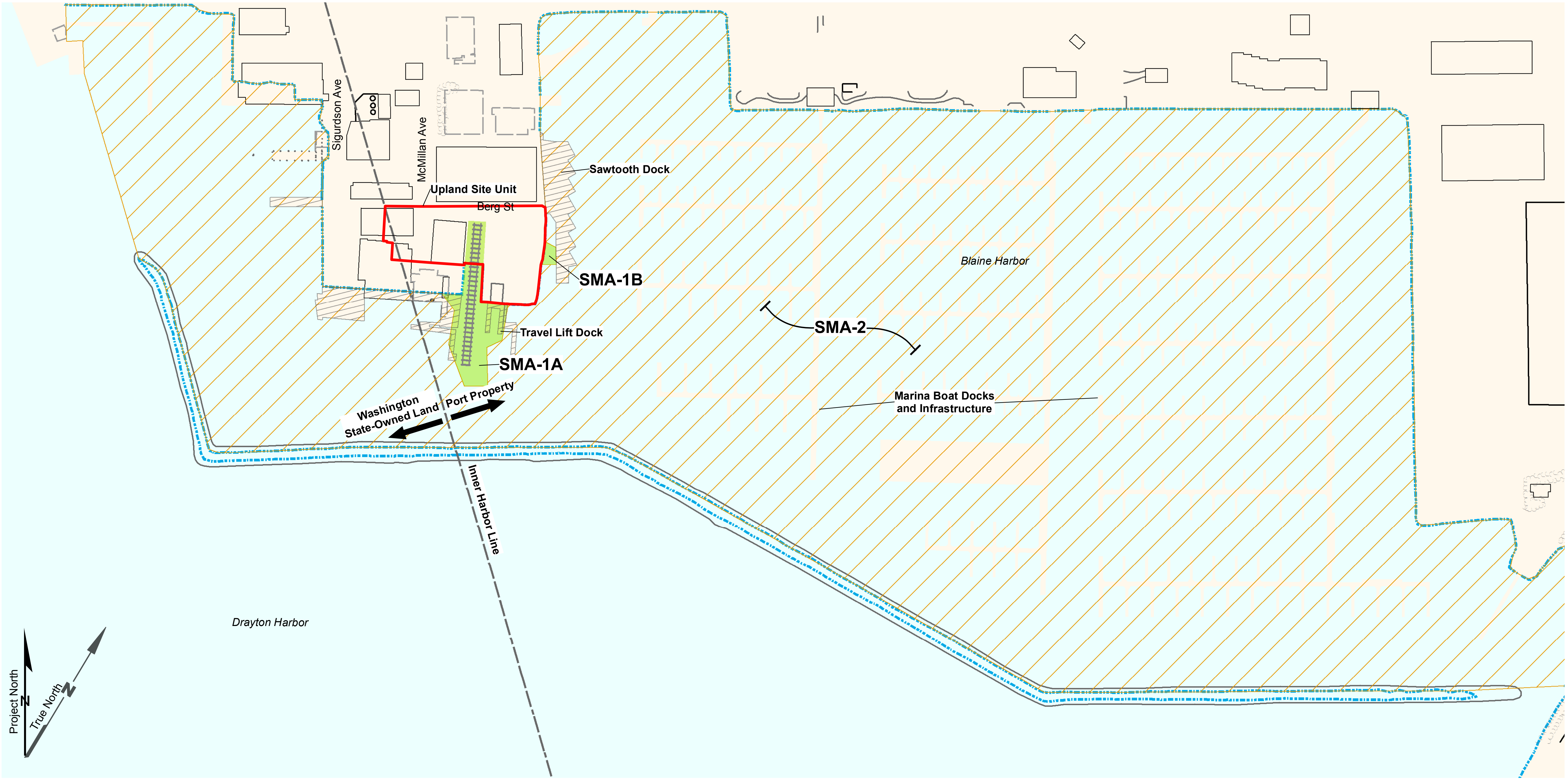
Blaine, Washington

Upland Site Unit Designations

Figure
26



Legend

🟥 Upland Site Unit

🟩 Sediment Management Area (SMA)-1

▨ SMA-2

▨ Structure Over Water

— Rock Breakwater

-·-· Mean Higher High Water

Notes
1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Marine Site Unit consists of SMA-1 and SMA-2.
3. Black and white reproduction of this
color original may reduce its effectiveness
and lead to incorrect interpretation.

0 200 400

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

G:\Projects\001035\010\019\RIFS\F27SiteUnitDesignations.mxd 3/20/2019

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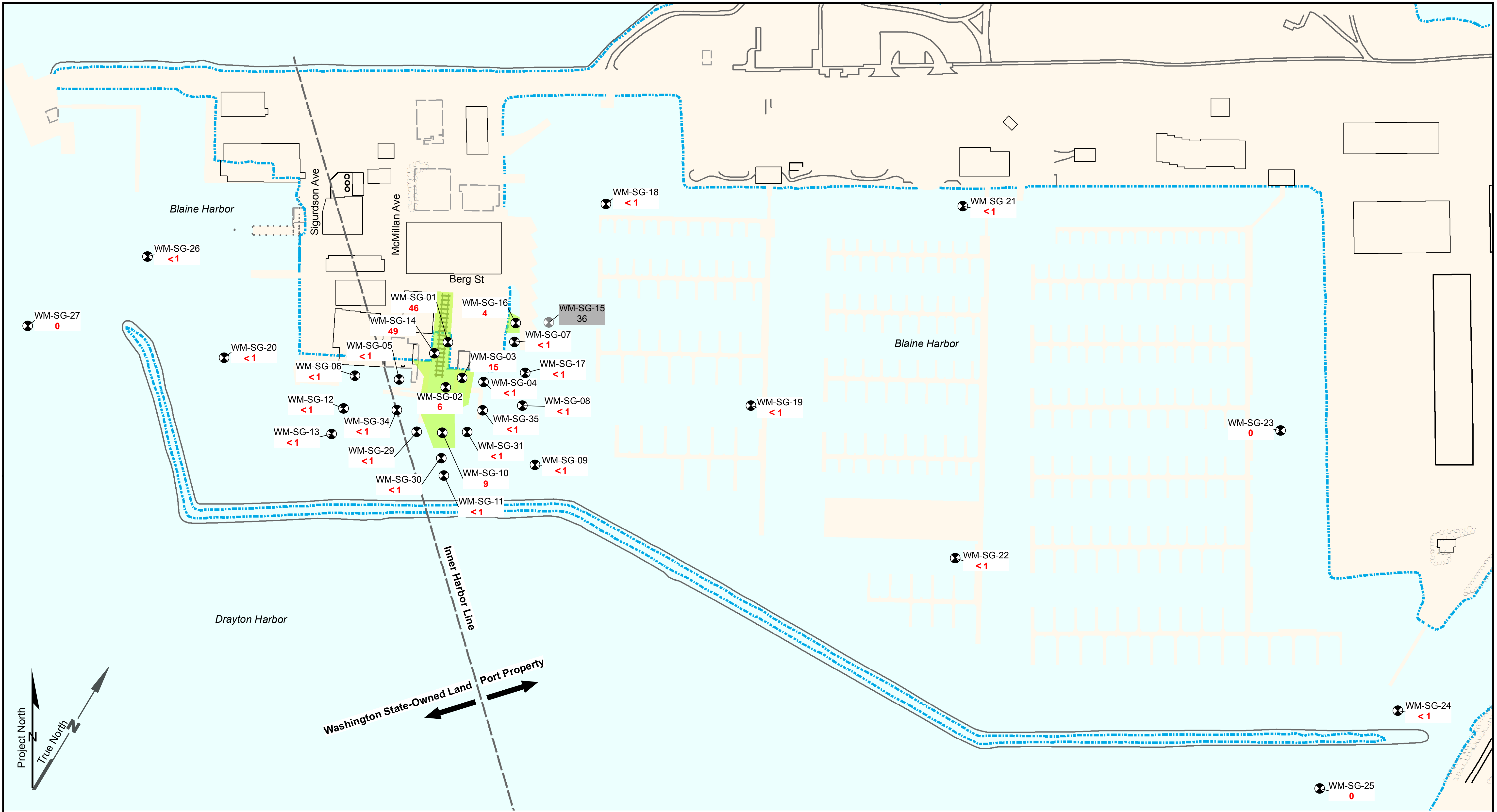
Blaine, Washington

Marine Site Unit Designations

Figure
27



G:\Projects\001\035\010\019\RIFS\F28BenthicExceedanceFactors.mxd 4/17/2019

Legend

⊗ WM-SG-15 - Location is not Considered as Part of the Site

🟩 SMA-1

⊗ Surface Sediment Sample Location

1 Sum of Exceedance Factors >1 for Each Benthic Criteria SCO Exceedance

Abbreviations

SMA = Sediment Management Area
SCO = Sediment Cleanup Objective

Notes

1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Exceedance factor equals concentration divided by the sediment cleanup objective.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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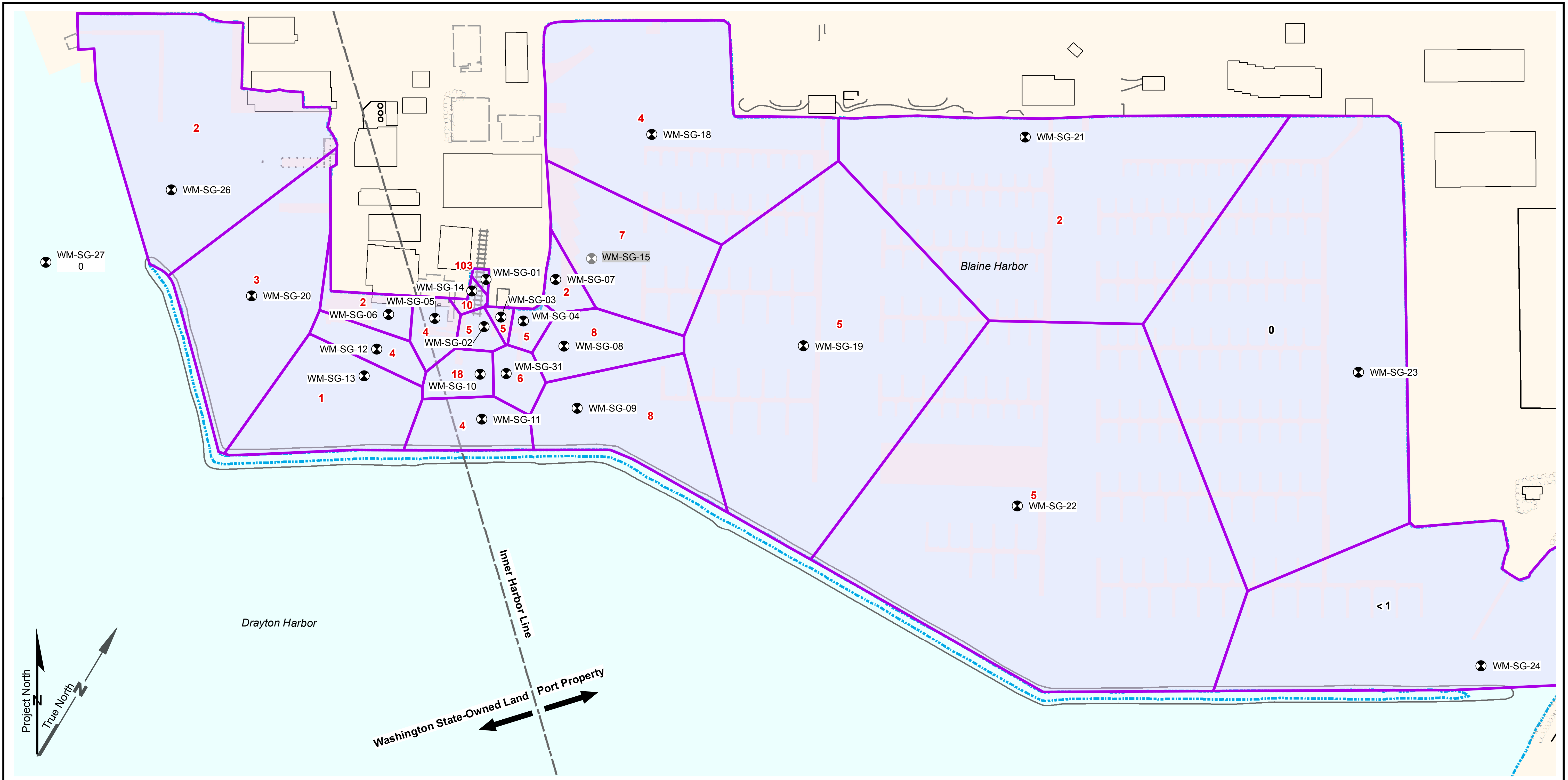
Blaine, Washington

Benthic SCO Exceedance Factors

Figure
28



Legend

◎ WM-SG-15 - Location is not Considered as Part of the Site

⊗ Surface Sediment Sample Location

▭ Thiessen Polygons

1 PCB SCO Exceedance Factor

Abbreviations

PBT = Persistent Bioaccumulative Toxin
SMA = Sediment Management Area
SCO = Sediment Cleanup Objective

Notes

1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Exceedance factor equals concentration divided by the sediment cleanup objective.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

G:\Projects\001035\010\019\RI\FS\F29PBTExceedanceFactors.mxd 4/17/2019

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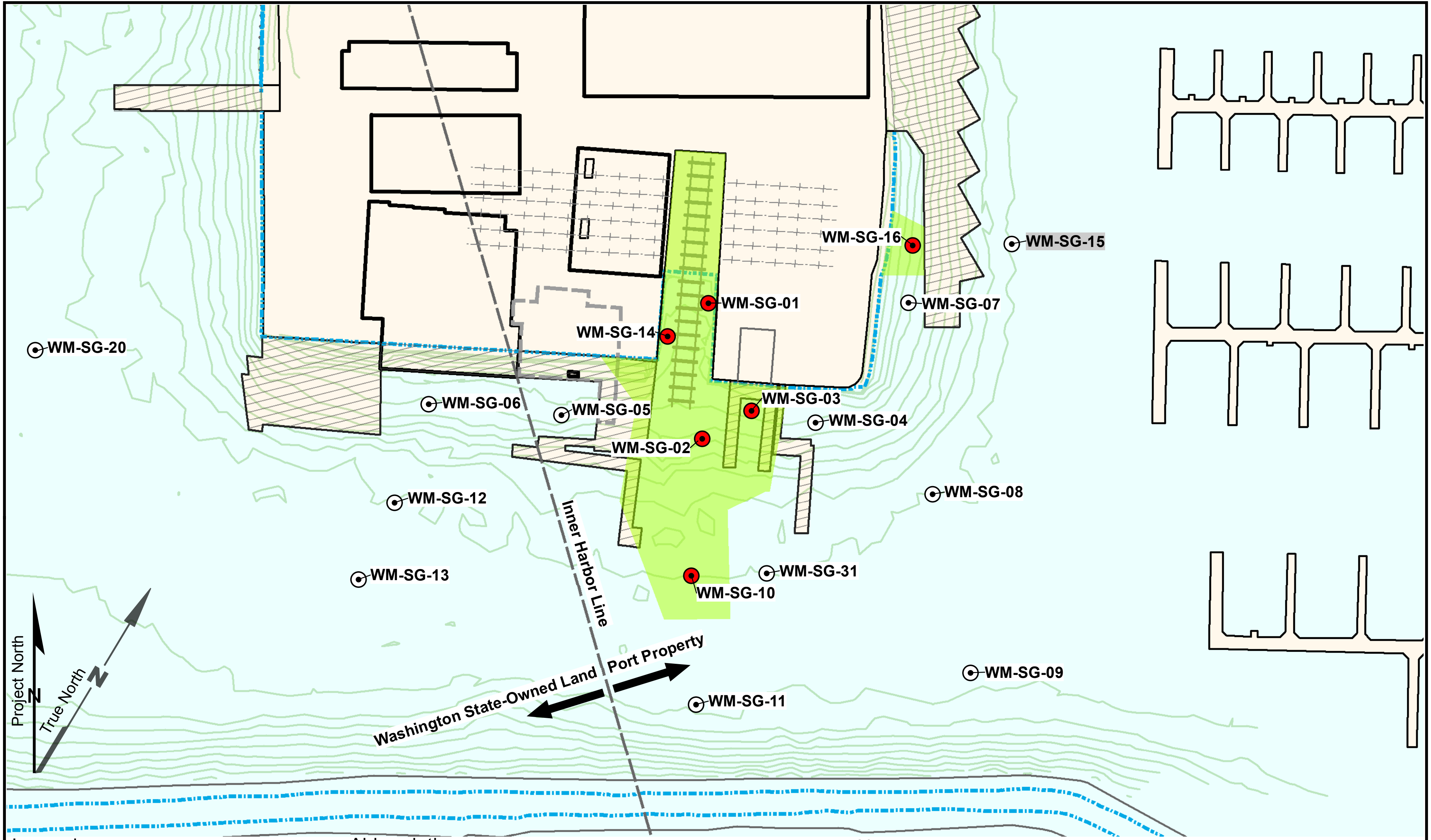
Blaine, Washington

PBT SCO Exceedance Factors for PCBs

Figure
29

G:\Projects\001\035\010\019\RIFS\F30SMA-1SCOCSLExceedances.mxd 4/17/2019



Legend

⦿ Sediment Sample Location

🟩 Shaded Area Contains IHS at Concentrations Exceeding the SCO or CSL for Benthic Criteria

Abbreviations

CSL = Cleanup Screening Level
SMA = Sediment Management Area
SCO = Sediment Cleanup Objective

Notes

1. Locations in red exceed the CSL and the SCO.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 100 200
Scale in Feet

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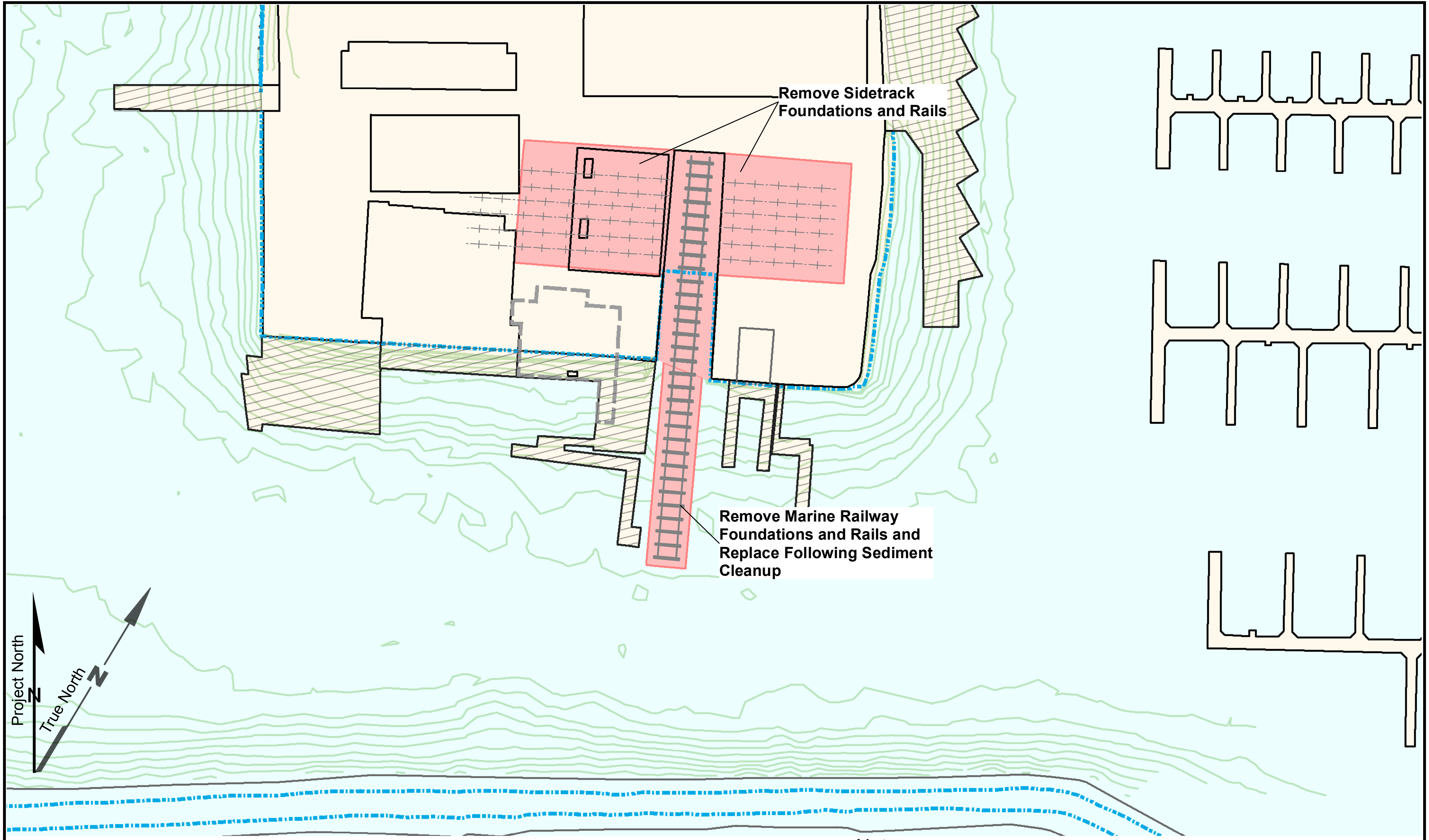
Blaine Harbor
Blaine, Washington

SMA-1 Benthic SCO and CSL Exceedance Locations

Figure
30

G:\Projects\001\035\010\019\August 2017 Draft\F31MarineRailwayDemolition.mxd 8/22/2017



Legend

-┼-┼- Historical Track Location (1966)
🟥 Railway Removal Areas
☐ Existing Buildings

Notes

1. Locations in red exceed the CSL and the SCO.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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0 100 200
Scale in Feet

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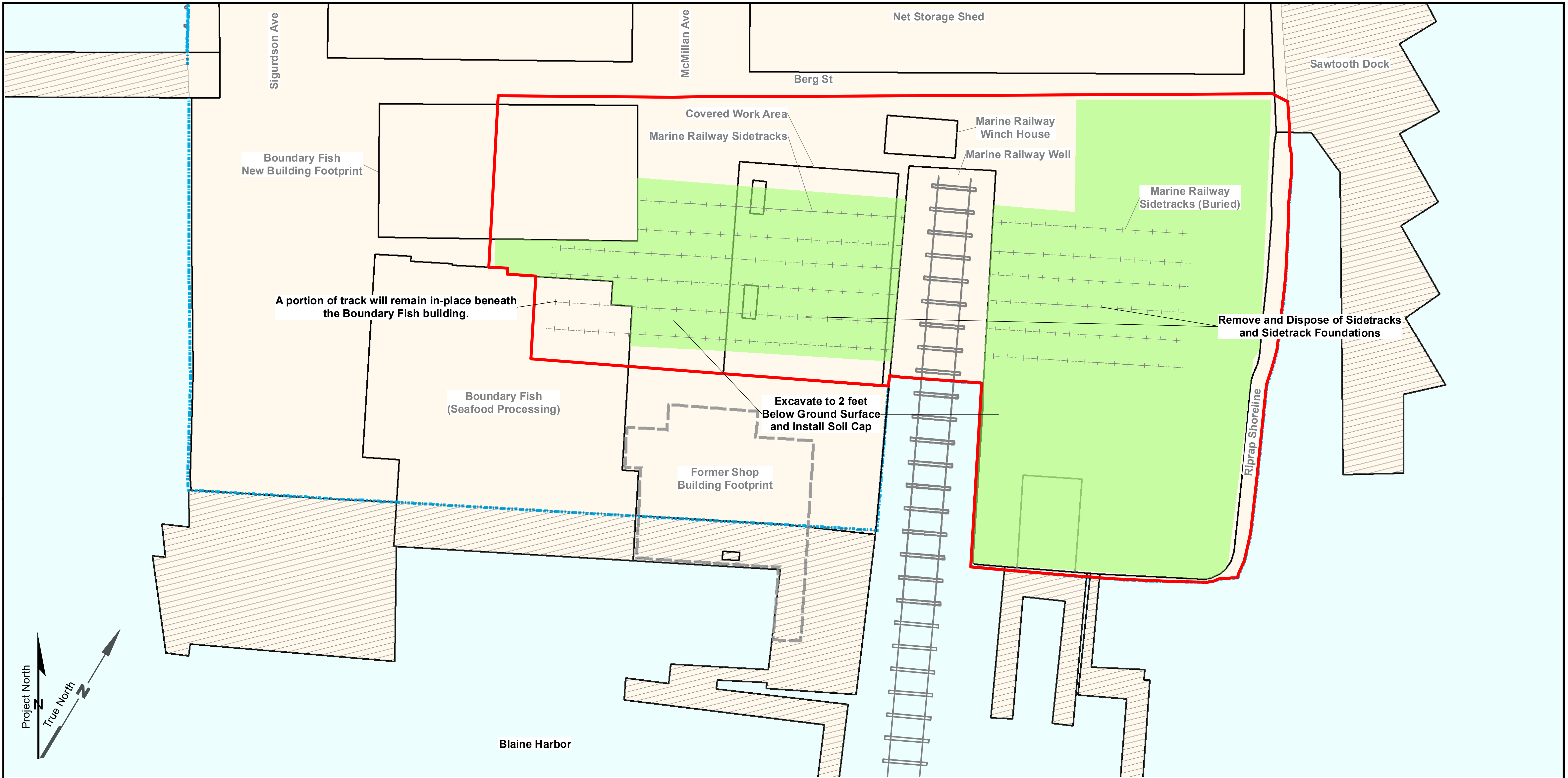
Blaine Harbor
Blaine, Washington

Marine Railway Demolition and Removal

Figure
31



Legend

-+- Historical Track Location (1966)

— Upland Site Boundary

▨ Structure Over Water

🟩 Excavate to 2 ft Below Ground Surface and Install Soil Cap

Upland Site Unit Remedial Alternative U-1 Includes the Following:

- Remove marine side rails and adjacent soil east and west of Marine Railway.
- Excavation and offsite disposal of top 2 feet of soil east of Marine Railway.
- Install a marker layer and a clean soil cap to prevent direct-contact with soil, returning the site to existing grades.
- Institutional controls (restrictive covenants); and long-term operation and maintenance (assume 30 years).

0 40 80

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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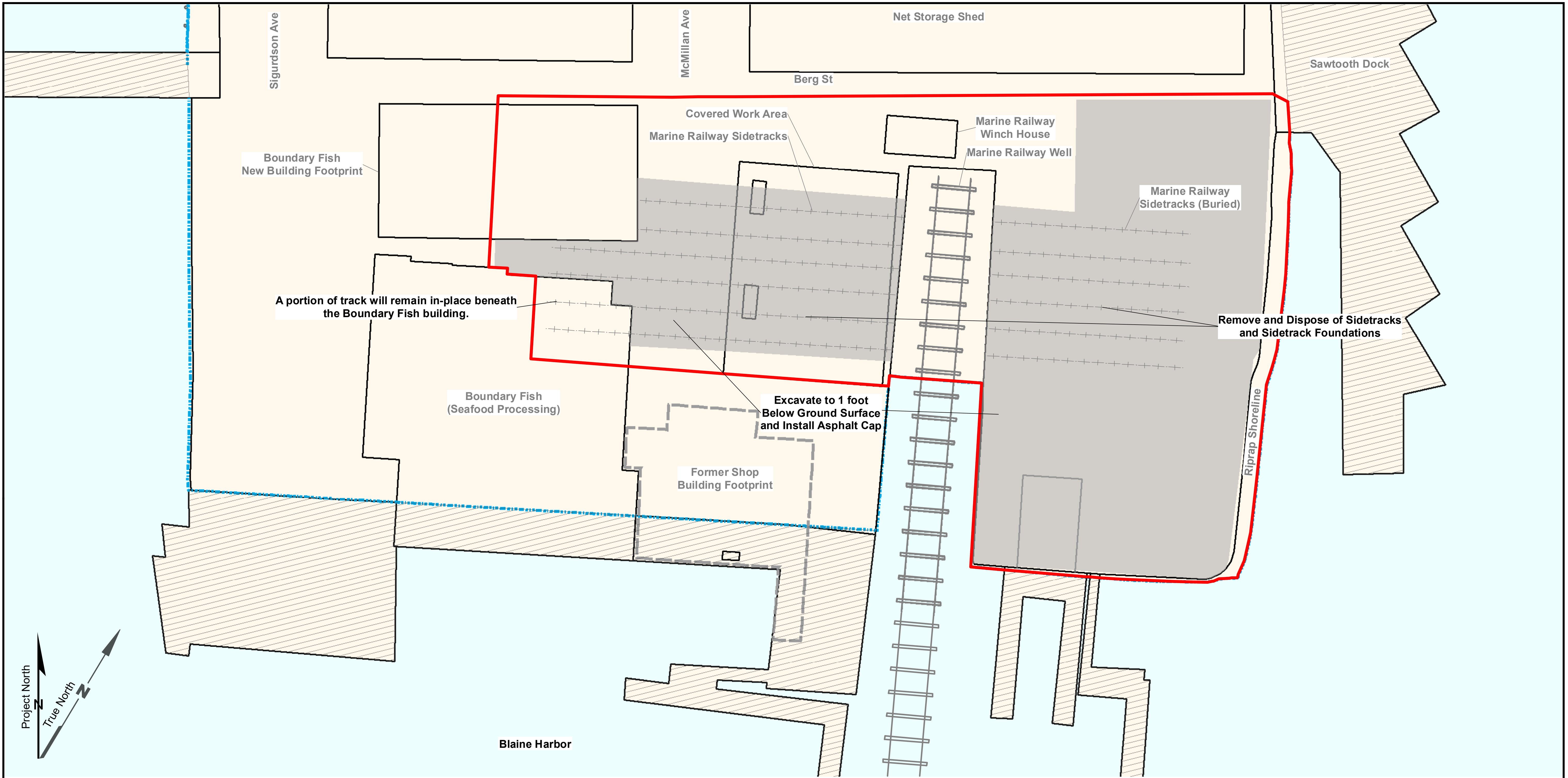
Blaine Harbor
Blaine, Washington

Upland Site Unit -
Remedial Alternative U-1

Figure
32



Legend

-+-	Historical Track Location (1966)
🟥	Upland Site Boundary
▨	Structure Over Water
▩	Excavate to 1 ft Below Ground Surface and Install Asphalt Cap

Upland Site Unit Remedial Alternative U-2 Includes the Following:

- Remove marine side rails and adjacent soil east and west of Marine Railway.
- Excavation and offsite disposal of top 1 foot of soil east of Marine Railway.
- Install pavement section including 4 inches of asphalt and associated stormwater controls in areas not currently paved.
- Institutional controls (restrictive covenants); and long-term operation and maintenance (assume 30 years).

0 40 80
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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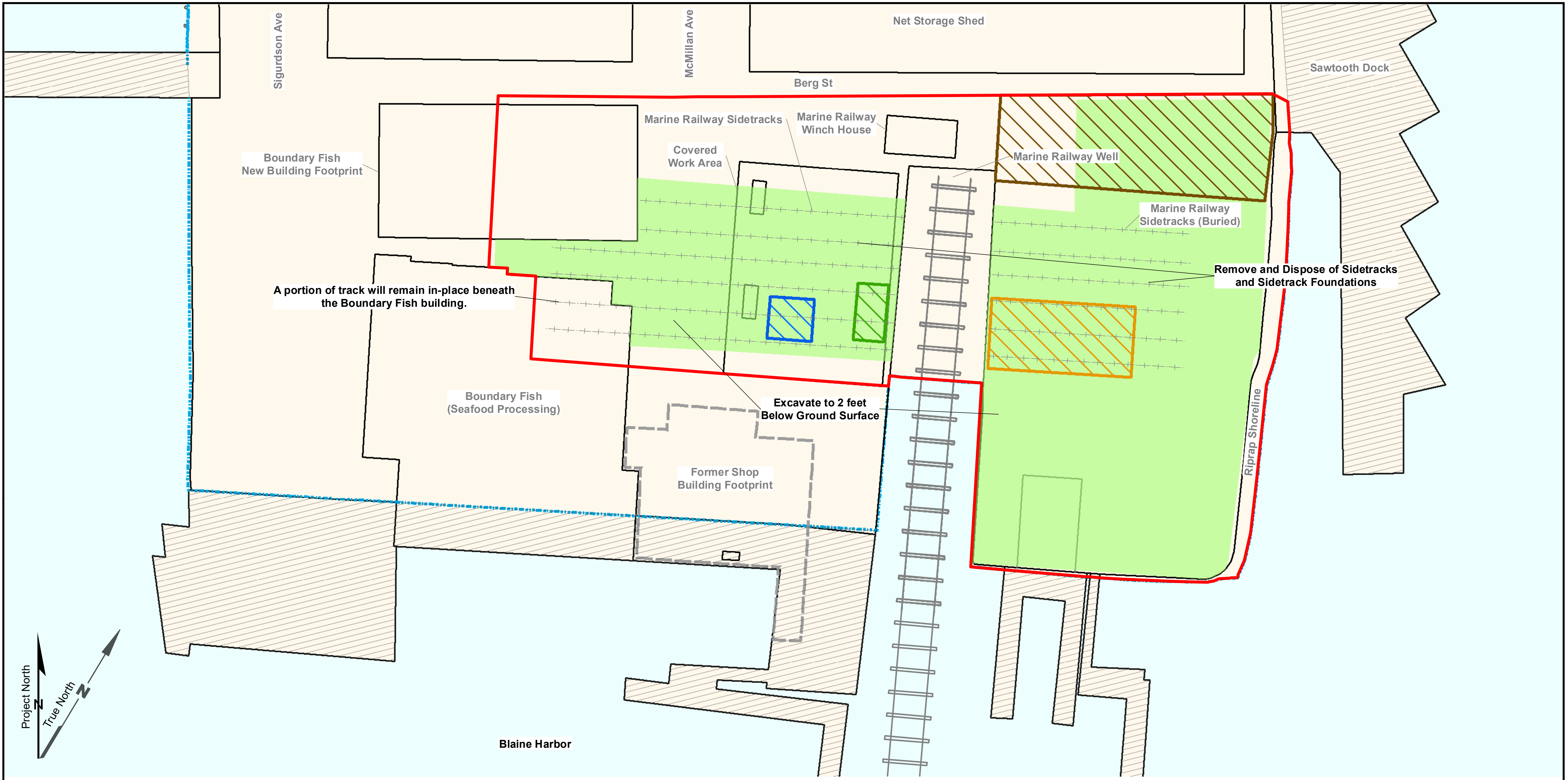
Blaine, Washington

Upland Site Unit - Remedial Alternative U-2

Figure
33



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Legend

- -+- Historical Track Location (1966)
- 🟥 Upland Site Boundary
- ▨ Structure Over Water
- 🟩 Excavate to 2 feet Below Ground Surface; Deeper where Noted
- ▨ Excavate to 3 feet Below Ground Surface
- ▨ Excavate to 6 feet Below Ground Surface
- ▨ Excavate to 9 feet Below Ground Surface
- ▨ Excavate to 12 feet Below Ground Surface

Upland Site Unit Remedial Alternative U-3 Includes the Following:

- Remove and dispose of contaminated soils (entire Upland Site Unit) and the marine side-rails (both sides of the marine railway).
- Site restoration, including returning site to existing grades using imported clean fill.

0 40 80
Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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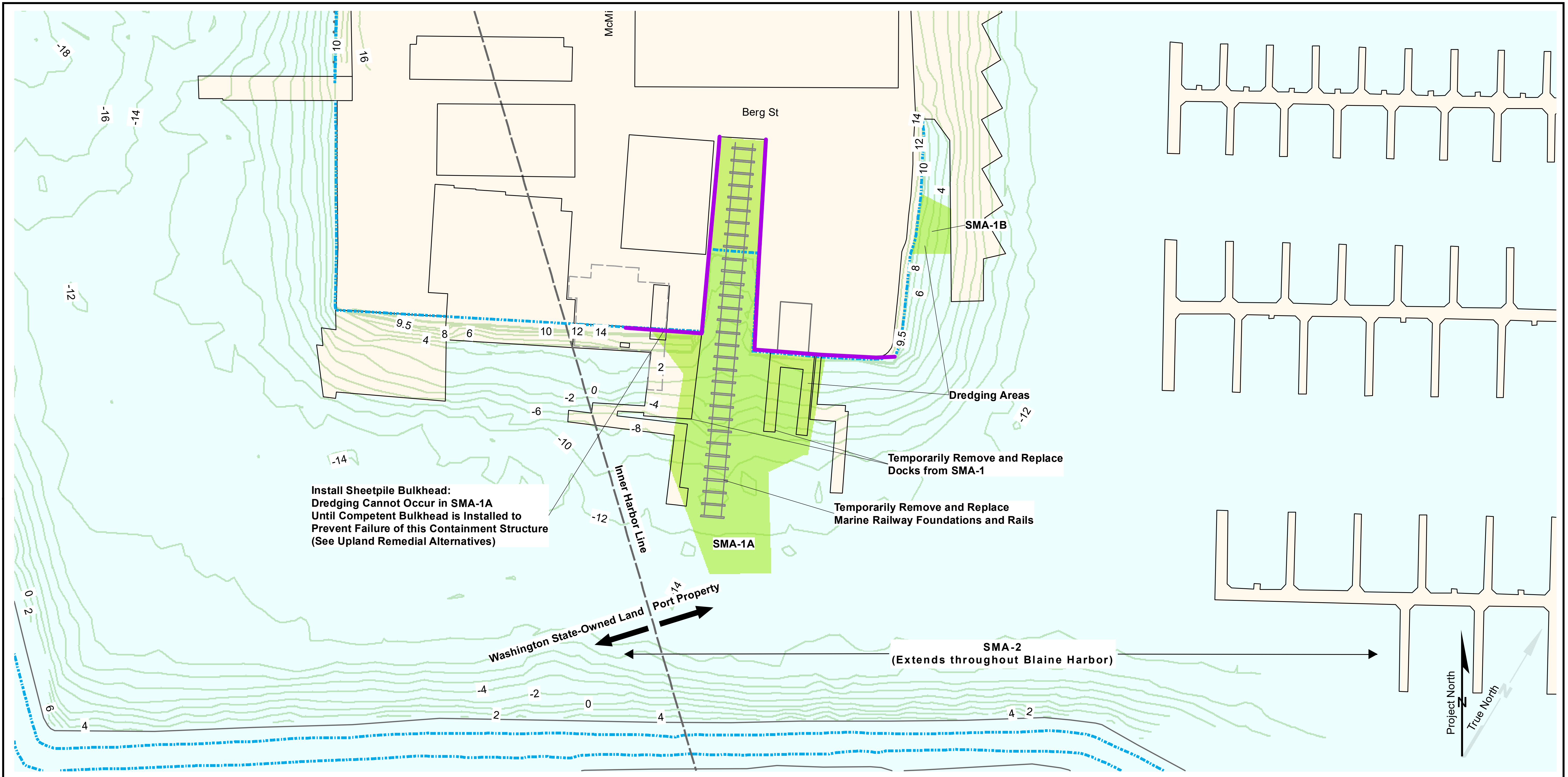
Blaine Harbor
Blaine, Washington

**Upland Site Unit -
Remedial Alternative U-3**

Figure
34



Install Sheetpile Bulkhead:
Dredging Cannot Occur in SMA-1A
Until Competent Bulkhead is Installed to
Prevent Failure of this Containment Structure
(See Upland Remedial Alternatives)

Temporarily Remove and Replace
Docks from SMA-1

Temporarily Remove and Replace
Marine Railway Foundations and Rails

Legend

🟩	SMA-1
━	Sheet Pile Bulkhead
┅	MHHW

Marine Site Unit Remedial Alternative M-2
Includes the Following:

- Install perimeter sheetpile bulkhead to facilitate dredging in the marine portion of the Site and to prevent erosion of upland contaminated soil to the marine environment.
- Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
- Remove contaminated sediment from throughout SMA-1 (including SMA-1a and SMA-1b) and dispose of the removed materials at an upland offsite disposal facility.
- Conduct compliance monitoring.
- Place residual cover layer if needed.

Abbreviations

IHS = Indicator Hazardous Substances
MHHW = Mean Higher High Water
MNR = Monitored Natural Recovery
SMA = Sediment Management Area
PCBs = Polychlorinated Biphenyls
PCB-TEQ = Dioxin-like PCB Congeners Toxicity Equivalence Quotient

Notes

1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 75 150
Scale in Feet

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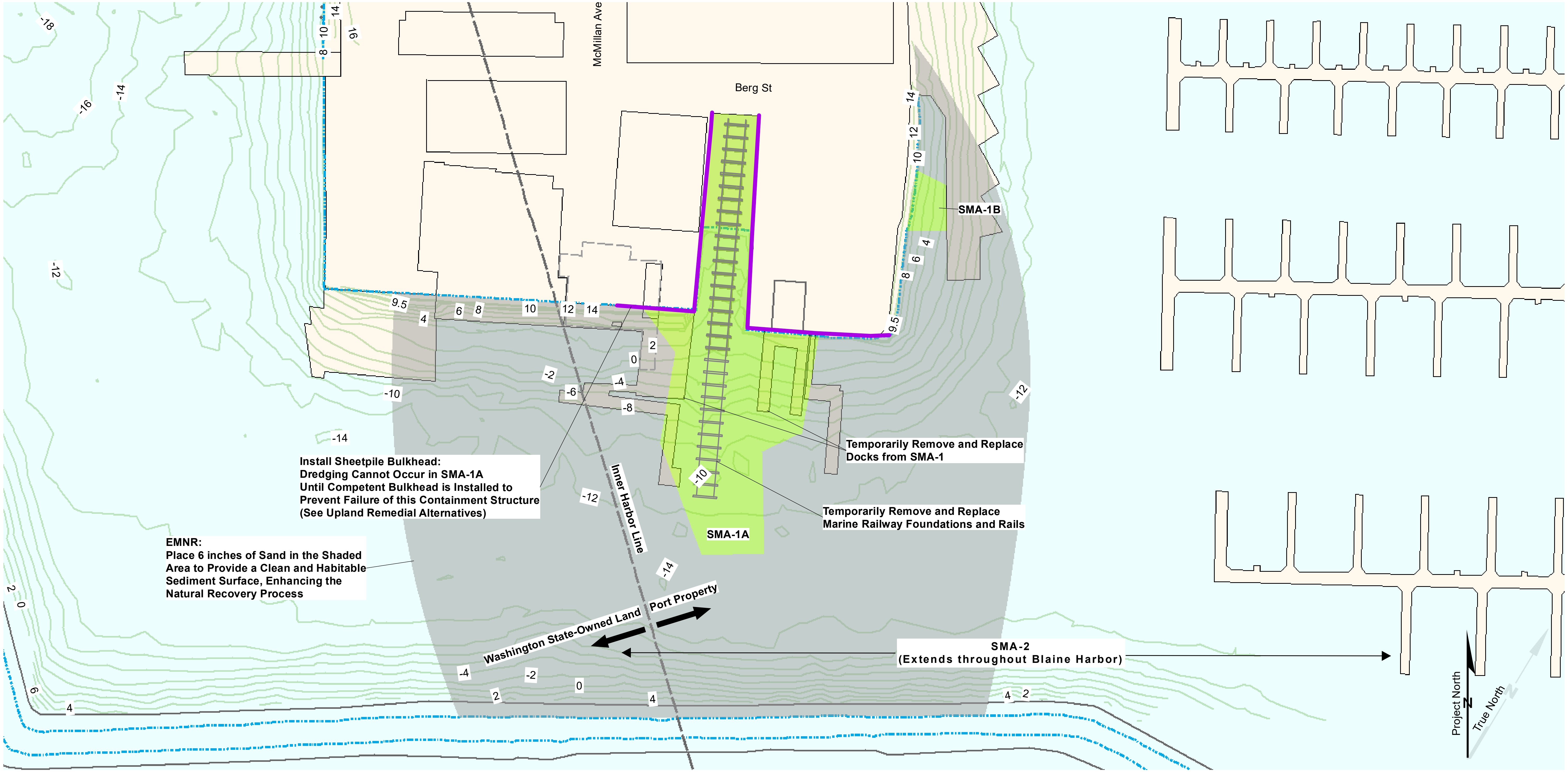
Blaine Harbor
Blaine, Washington

Marine Site Unit -
Remedial Alternative M-2

Figure
35



Legend

- 🟩 SMA-1
- ▨ EMNR Area
- Sheet Pile Bulkhead
- MHHW

Marine Site Unit Remedial Alternative M-3 Includes the Following:

- Install perimeter sheetpile bulkhead to facilitate dredging in the marine portion of the Site and to prevent erosion of upland contaminated soil to the marine environment.
- Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
- Remove contaminated sediment from throughout SMA-1 (including SMA-1a and SMA-1b) and dispose the removed materials at an upland offsite disposal facility.
- Place residual cover layer if needed.
- EMNR in SMA-2 (6 inches of sand to reduce area-weighted average PCB concentration to below the SCO).
- Conduct compliance monitoring to confirm cleanup standards are achieved and maintained.

0 75 150
Scale in Feet

Abbreviations

IHS = Indicator Hazardous Substances
MHHW = Mean Higher High Water
EMNR = Enhanced Monitored Natural Recovery
MNR = Monitored Natural Recovery
SMA = Sediment Management Area
PCBs = Polychlorinated Biphenyls
PCB-TEQ = Dioxin-like PCB Congeners
Toxicity Equivalence Quotient

Notes

SMA-2 = All of Blaine Harbor outside of SMA-1.

1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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Blaine Harbor
Blaine, Washington

Marine Site Unit - Remedial Alternative M-3

Figure
36

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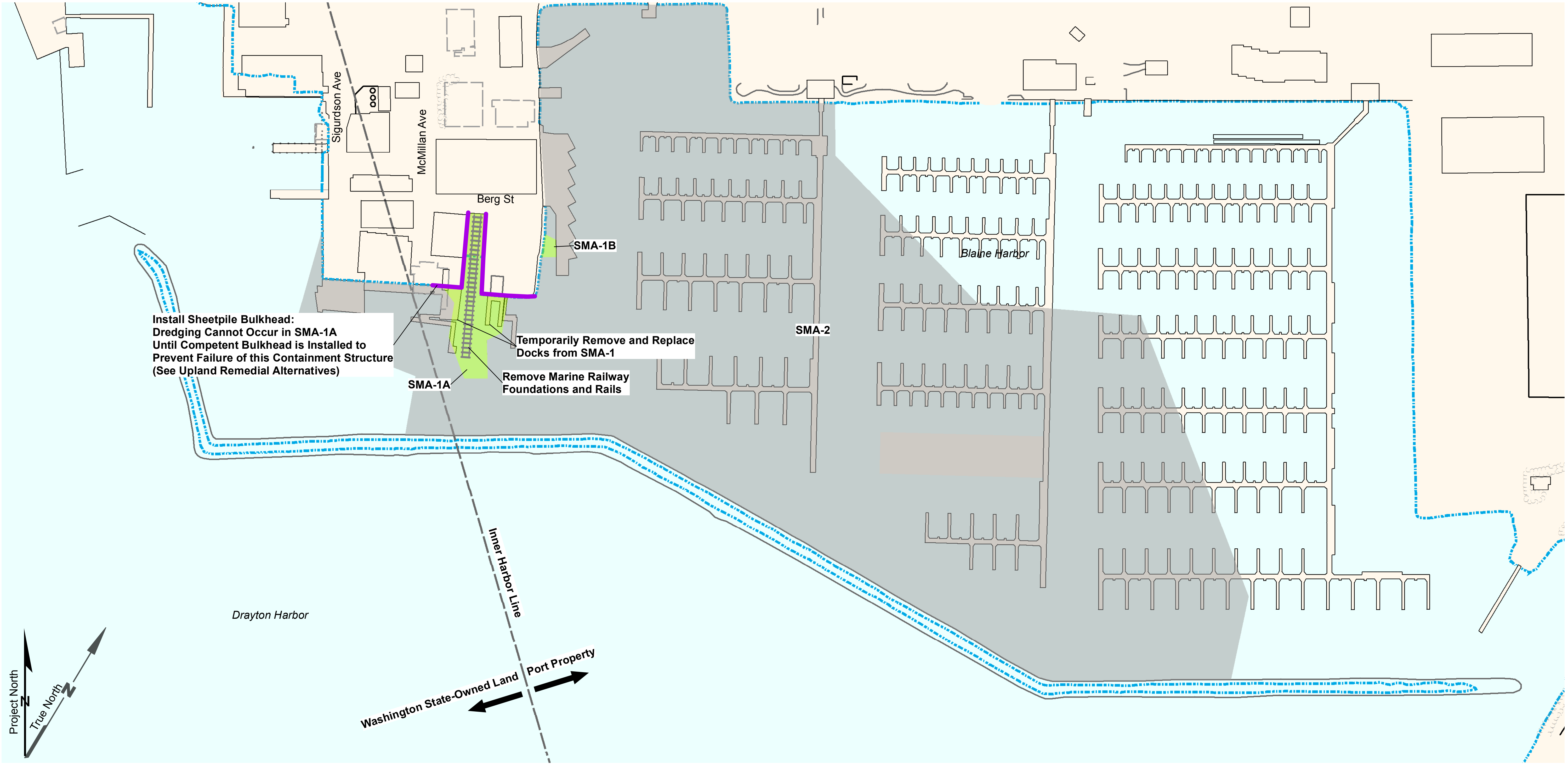

Legend

🟩	SMA-1
▨	Sediment Removal Area
━	Sheet Pile Bulkhead
┅	MHHW

Marine Site Unit Remedial Alternative M-4 Includes the Following:

- Install perimeter sheetpile bulkhead to facilitate dredging in the marine portion of the Site and to prevent erosion of upland contaminated soil to the marine environment.
- Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1A.
- In SMA-1A, remove upper 2.5 ft of sediment; in SMA-1B, vacuum-excavate fine grain sediments during low-tide; in SMA-2, remove upper 6 inches of sediment.
- Removal of sediment throughout the harbor with concentrations of IHSs greater than PCLs; disposal at an upland offsite disposal facility.
- Conduct compliance monitoring.
- Place residual cover layer if needed.

0 200 400

Scale in Feet

Abbreviations

IHS = Indicator Hazardous Substances
MHHW = Mean Higher High Water
MNR = Monitored Natural Recovery
SMA = Sediment Management Area
PCBs = Polychlorinated Biphenyls
PCB-TEQ = Dioxin-like PCB Congeners Toxicity Equivalence Quotient

Notes

1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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Blaine Harbor
Blaine, Washington

Marine Site Unit -
Remedial Alternative M-4

Figure
37

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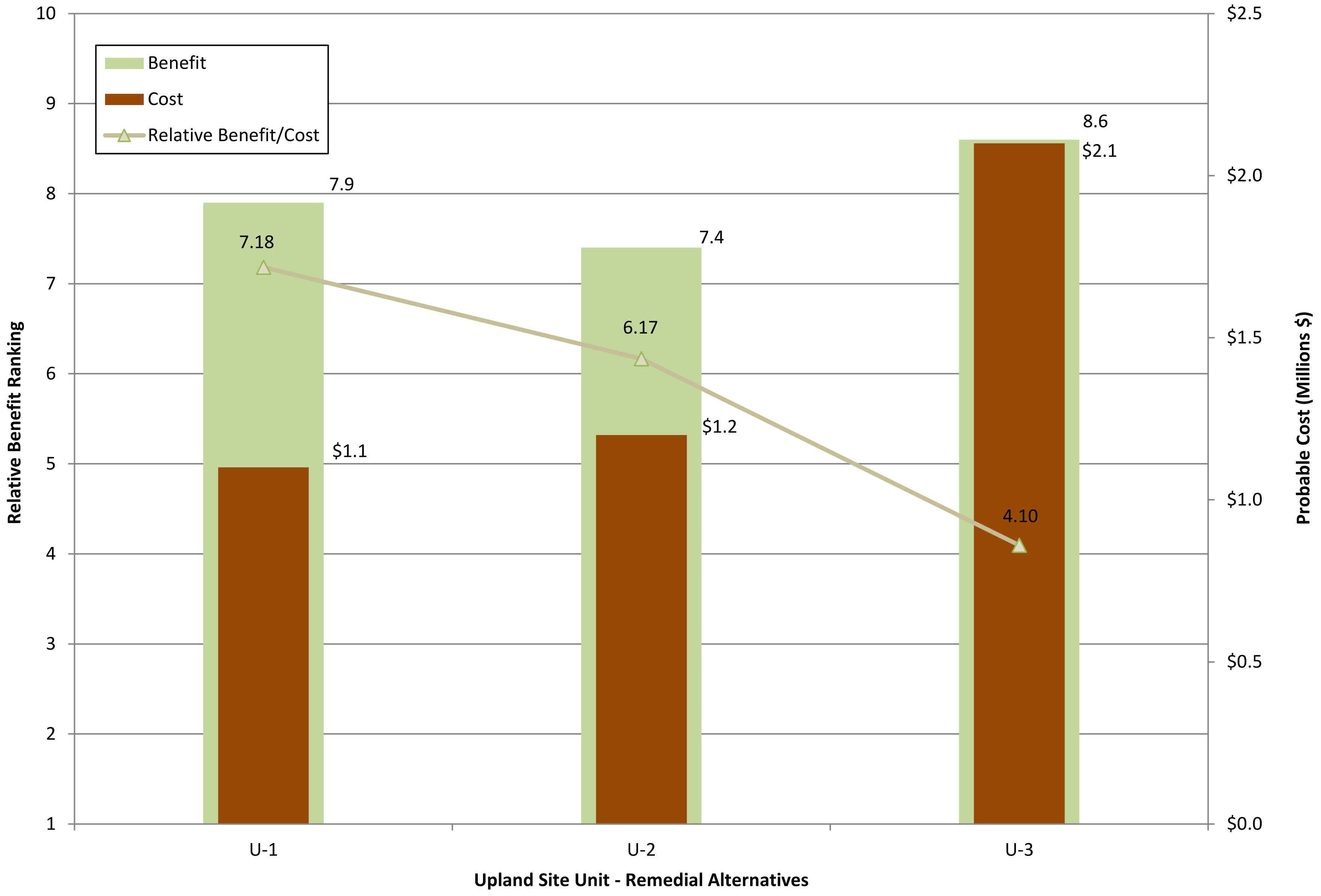

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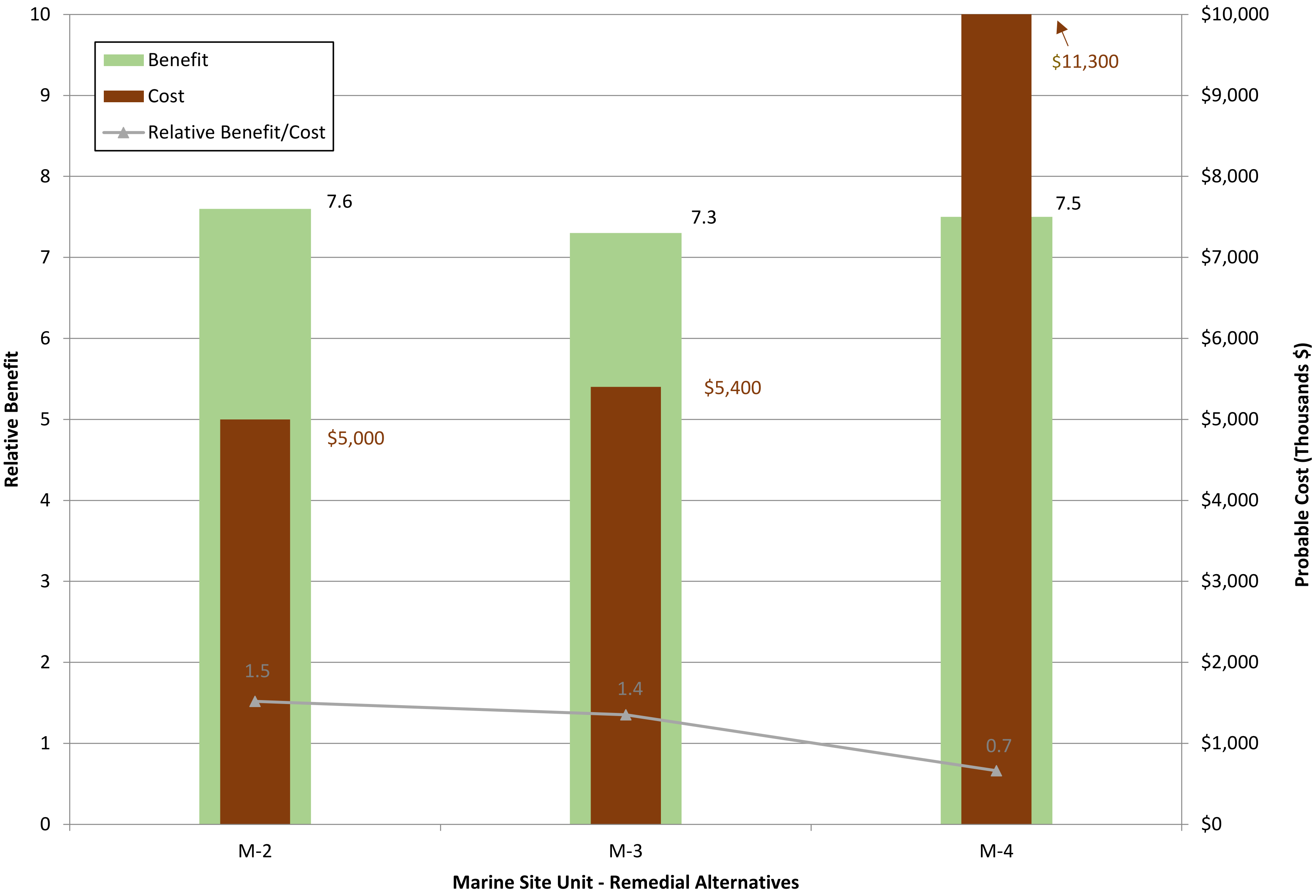
Blaine Harbor
Blaine, Washington

Upland Site Unit
Disproportionate Cost Analysis

Figure
38



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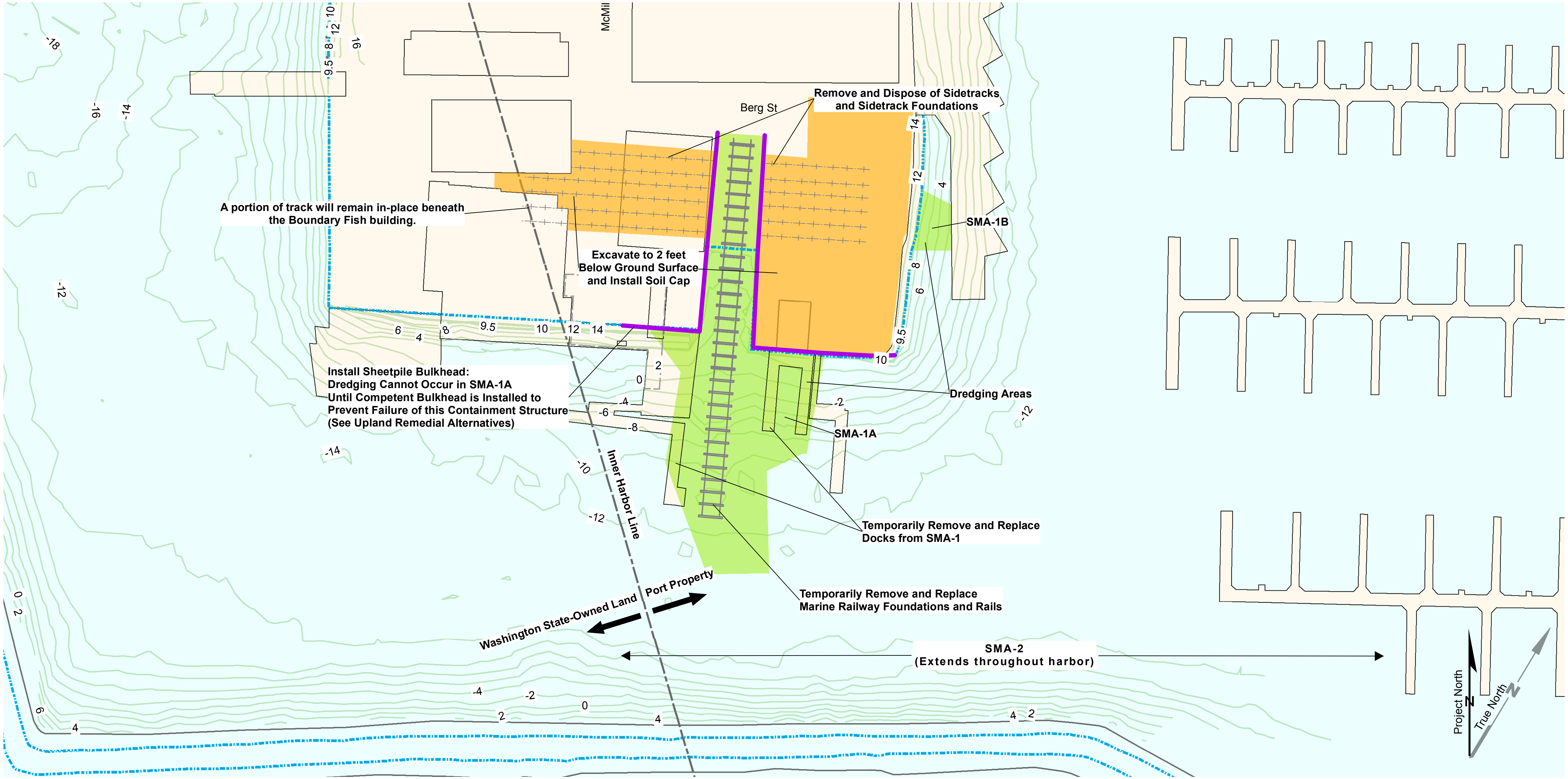
Westman Marine
Blaine Harbor
Blaine, Washington

Marine Site Unit
Disproportionate Cost Analysis

Figure
39



Legend

🟩	SMA-1 (SMA-2 = All of Blaine Harbor outside of SMA-1)
🟧	Excavate to 2 ft Below Ground Surface and Install Soil Cap
━	Sheet Pile Bulkhead
-·-·	MHHW

The Preferred Remedy will Include the Following Actions:

- Remove marine side rails and adjacent soil east and west of Marine Railway.
- Excavation and offsite disposal of top 2 feet of soil east of Marine Railway.
- Install a marker layer and a clean soil cap to prevent direct-contact with soil, returning the site to existing grades.
- Institutional controls (restrictive covenants); and long-term operation and maintenance (assume 30 years).
- Install perimeter sheetpile bulkhead to facilitate dredging in the marine portion of the Site and to prevent erosion of upland contaminated soil to the marine environment.
- Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
- Remove contaminated sediment from throughout SMA-1 (including SMA-1a and SMA-1b) and dispose of the removed materials at an upland offsite disposal facility.
- Conduct compliance monitoring.
- Place residual cover layer if needed.

Abbreviations

IHS = Indicator Hazardous Substances
MHHW = Mean Higher High Water
MNR = Monitored Natural Recovery
SMA = Sediment Management Area
PCBs = Polychlorinated Biphenyls
PCB-TEQ = Dioxin-like PCB Congeners Toxicity Equivalence Quotient

Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

0 75 150
Scale in Feet

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Preferred Remedy

Figure
40

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TABLE 1
SUMMARY OF INTERIM ACTION ENVIRONMENTAL DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Soil	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-SS-1	WM-SS-1	WM-SS-2	WM-SS-2	WM-SS-3	WM-SS-3	WM-SS-4	WM-SS-4	WM-SS-5	WM-SS-6	WM-SS-6	WM-SS-7
	PSL	B-1	S-1	S-2	S-3	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	0-0.5	1-1.5	0-0.5
		XK09P	XK09Q	XK09R	XL60A	XI41A	XI74A	XI41B	XI74B	XI41C	XI74C	XI74D	XI74E	XI41D	XI41E	XI74F/XJ59A	XI41F
	(Unsaturated)	10/16/2013	10/16/2013	10/16/2013	10/28/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013
TOTAL METALS (mg/kg)																	
Methods EPA200.8/ SW6010C/SW7471A																	
Arsenic	7	**3.1**	**5.8**	**3.4**		**3.0**		**3.7**		**5.0**				**2.3**	**4.0**		**3.1**
Cadmium	80	**0.3**	**0.2**	**0.2**		**0.2**		**0.4**		**0.3**				**0.2**	**1.2**		**0.2**
Chromium	2,000	**18.2**	**37.2**	**18.0**		**16.5**		**48.8**		**24.3**				**13.6**	**22.0**		**21.4**
Copper	36	**22.6** J	**45.7**	**16.3**	**23**	**81.4** J	**38.9**	**44.5**	**8,540**	**46.8**	**37.6**	**32.4**	**47.5**	**47.6**	**92.0**	**29.4**	**27.0**
Lead	250	**5.1**	**5.8**	**2.9**		**31.1** J	**10**	**50.7**	**43**	**8.0**	**3.32** J	**5**	**7**	**7.4**	**45.7**	**11.4**	**7.4**
Mercury	0.16	0.03 U	**0.04**	0.03 U		**0.10** J	**0.12**	**0.09**	**0.57**	**0.48**	**0.04**	**0.0220** J	**0.05**	0.02 U	**0.22**	**0.05**	**0.03**
Nickel		**14**	**44**	**18**													
Zinc	100	**40**	**77**	**29**		**233**	**79**	**205**	**217**	**156**	**60**	**53**	**85**	**84**	**339**	**73**	**53**
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																	
NWTPH-Dx																	
Diesel Range Organics	2,000	**950**	**1,200**	**4,900**	**960**	**15**		**23**		**16**				**5.5**	**110**		5.6 U
Lube Oil	2,000	13 U	14 U	12 U	13 U	**84**		**100**		**150**				**44**	**160**		11 U
NWTPH-Gx																	
Gasoline	100	**93**	**100**	**110**	**110**												
PAHs (µg/kg)																	
Method SW8270DSIM																	
Naphthalene	2,300	49 U	**130** M	95 U		4.6 U		**6.2**		4.9 U				4.9 U	**8.4**	**5.5**	4.6 U
2-Methylnaphthalene	320,000	**460**	**1,000**	**3,800**		**5.6**		**8.6**		4.9 U				4.9 U	**14**	**29**	4.6 U
1-Methylnaphthalene	35,000	**670**	**920**	**3,600**		4.6 U		5.0 U		4.9 U				4.9 U	**12**	**14**	4.6 U
Acenaphthylene	---	**51**	4.6 U	95 U		4.6 U		5.0 U		4.9 U				4.9 U	**65**	**9.1**	**11**
Acenaphthene	340	49 U	**24**	**330**		4.6 U		5.0 U		4.9 U				4.9 U	**16**	4.6 U	4.6 U
Fluorene	470	**100**	**140**	**680**		4.6 U		**6.5**		4.9 U				4.9 U	**32**	**10**	4.6 U
Phenanthrene	---	**92**	**140**	**530**		**38**		**53**		4.9 U				**9.4**	**360**	**77**	**39**
Anthracene	4,500	49 U	**7.6**	95 U		**8.2**		**14**		4.9 U				4.9 U	**320**	**97**	**14**
Fluoranthene	3,200	49 U	4.6 U	95 U		**87**		**97**		**5.8**				**22**	**950**	**220**	**120**
Pyrene	20,000	49 U	**5.2**	95 U		**70**		**75**		**6.0**				**19**	**780**	**190**	**130**
Benzo(a)anthracene	130	49 U	4.6 U	95 U		**39**		**33**		4.9 U				**10**	**590**	**140**	**82**
Chrysene	140	49 U	4.6 U	95 U		**57**		**63**		4.9 U				**18**	**570**	**160**	**73**
Benzo(a)pyrene	350	49 U	4.6 U	**200** M		**52**		**48**		4.9 U				**18**	**450**	**140**	**78**
Indeno(1,2,3-cd)pyrene	700	49 U	**14** M	**290** M		**45**		**47**		4.9 U				**15**	**330**	**73**	**41**
Dibenz(a,h)anthracene	140	49 U	4.6 U	95 U		**10**		**9.8**		4.9 U				4.9 U	**110**	**22**	**13**
Benzo(g,h,i)perylene	---	49 U	**4.7**	95 U		**51**		**66**		**5.0**				**16**	**360**	**89**	**48**
Dibenzofuran	---	**52**	**85**	**360**		4.6 U		5.0 U		4.9 U				4.9 U	**16**	**6.8**	4.6 U
Total Benzofluoranthenes	430	49 U	4.6 U	95 U		**120**		**120**		4.9 U				**42**	**930**	**260**	**140**
cPAH TEQ	140	ND	**1.4**	**229**		**74**		**70**		ND				**25**	**652**	**191**	**106**

TABLE 1
SUMMARY OF INTERIM ACTION ENVIRONMENTAL DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Soil	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-SS-1	WM-SS-1	WM-SS-2	WM-SS-2	WM-SS-3	WM-SS-3	WM-SS-4	WM-SS-4	WM-SS-5	WM-SS-6	WM-SS-6	WM-SS-7
	PSL	B-1	S-1	S-2	S-3	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	0-0.5	1-1.5	0-0.5
		XK09P	XK09Q	XK09R	XL60A	XI41A	XI74A	XI41B	XI74B	XI41C	XI74C	XI74D	XI74E	XI41D	XI41E	XI74F/XJ59A	XI41F
	(Unsaturated)	10/16/2013	10/16/2013	10/16/2013	10/28/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013
VOLATILES (µg/kg)																	
Method SW8260C																	
Chloromethane		1.3 U	1.3 U	1.2 U													
Bromomethane		1.3 U	1.3 U	1.2 U													
Vinyl Chloride		1.3 U	1.3 U	1.2 U													
Chloroethane		1.3 U	1.3 U	1.2 U													
Methylene Chloride		9.6 UJ	11 UJ	9.7 UJ													
Acetone		6.4 U	6.3 U	5.9 U													
Carbon Disulfide		**4.0** J	**1.4** J	1.2 U													
1,1-Dichloroethene		1.3 U	1.3 U	1.2 U													
1,1-Dichloroethane		1.3 U	1.3 U	1.2 U													
trans-1,2-Dichloroethene		1.3 U	1.3 U	1.2 U													
cis-1,2-Dichloroethene		1.3 U	1.3 U	1.2 U													
Chloroform		1.3 U	1.3 U	1.2 U													
1,2-Dichloroethane		1.3 U	1.3 U	1.2 U													
2-Butanone		6.4 U	6.3 U	5.9 U													
1,1,1-Trichloroethane		1.3 U	1.3 U	1.2 U													
Carbon Tetrachloride		1.3 U	1.3 U	1.2 U													
Vinyl Acetate		6.4 U	6.3 U	5.9 U													
Bromodichloromethane		1.3 U	1.3 U	1.2 U													
1,2-Dichloropropane		1.3 U	1.3 U	1.2 U													
cis-1,3-Dichloropropene		1.3 U	1.3 U	1.2 U													
Trichloroethene		1.3 U	1.3 U	1.2 U													
Dibromochloromethane		1.3 U	1.3 U	1.2 U													
1,1,2-Trichloroethane		1.3 U	1.3 U	1.2 U													
Benzene		1.3 U	1.3 U	1.2 U													
trans-1,3-Dichloropropene		1.3 U	1.3 U	1.2 U													
2-Chloroethylvinylether		6.4 U	6.3 U	5.9 U													
Bromoform		1.3 U	1.3 U	1.2 U													
4-Methyl-2-Pentanone (MIBK)		6.4 U	6.3 U	5.9 U													
2-Hexanone		6.4 U	6.3 U	5.9 U													
Tetrachloroethene		1.3 U	1.3 U	1.2 U													
1,1,2,2-Tetrachloroethane		1.3 U	1.3 U	1.2 U													
Toluene		1.3 U	1.3 U	1.2 U													
Chlorobenzene		1.3 U	1.3 U	1.2 U													
Ethylbenzene		1.3 U	1.3 U	1.2 U													
Styrene		1.3 U	1.3 U	1.2 U													
Trichlorofluoromethane		1.3 U	1.3 U	1.2 U													
1,1,2-Trichloro-1,2,2-trifluoroethane		2.5 U	2.5 U	2.4 U													
m, p-Xylene		1.3 U	1.3 U	1.2 U													
o-Xylene		1.3 U	1.3 U	1.2 U													
1,2-Dichlorobenzene		1.3 U	1.3 U	1.2 U													
1,3-Dichlorobenzene		1.3 U	1.3 U	1.2 U													
1,4-Dichlorobenzene		1.3 U	1.3 U	1.2 U													
Acrolein		64 U	63 U	59 U													
Iodomethane		1.3 U	1.3 U	1.2 U													
Bromoethane		2.5 U	2.5 U	2.4 U													
Acrylonitrile		6.4 U	6.3 U	5.9 U													
1,1-Dichloropropene		1.3 U	1.3 U	1.2 U													
Dibromomethane		1.3 U	1.3 U	1.2 U													
1,1,1,2-Tetrachloroethane		1.3 U	1.3 U	1.2 U													
1,2-Dibromo-3-chloropropane		6.4 UJ	6.3 UJ	5.9 UJ													
1,2,3-Trichloropropane		2.5 U	2.5 U	2.4 U													
trans-1,4-Dichloro-2-butene		6.4 U	6.3 U	5.9 U													
1,3,5-Trimethylbenzene		1.3 U	1.3 U	1.2 U													
1,2,4-Trimethylbenzene		1.3 U	1.3 U	1.2 U													
Hexachlorobutadiene		6.4 U	6.3 U	5.9 U													
1,2-Dibromoethane		1.3 U	1.3 U	1.2 U													
Bromochloromethane		1.3 U	1.3 U	1.2 U													

TABLE 1
SUMMARY OF INTERIM ACTION ENVIRONMENTAL DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Soil	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-BF-VAULT	WM-SS-1	WM-SS-1	WM-SS-2	WM-SS-2	WM-SS-3	WM-SS-3	WM-SS-4	WM-SS-4	WM-SS-5	WM-SS-6	WM-SS-6	WM-SS-7
	PSL	B-1	S-1	S-2	S-3	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	1-1.5	0-0.5	0-0.5	1-1.5	0-0.5
		XK09P	XK09Q	XK09R	XL60A	XI41A	XI74A	XI41B	XI74B	XI41C	XI74C	XI74D	XI74E	XI41D	XI41E	XI74F/XJ59A	XI41F
	(Unsaturated)	10/16/2013	10/16/2013	10/16/2013	10/28/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013	10/03/2013
2,2-Dichloropropane		1.3 U	1.3 U	1.2 U													
1,3-Dichloropropane		1.3 U	1.3 U	1.2 U													
Isopropylbenzene		1.3 U	1.3 U	1.2 U													
n-Propylbenzene		1.3 U	1.3 U	1.2 U													
Bromobenzene		1.3 U	1.3 U	1.2 U													
2-Chlorotoluene		1.3 U	1.3 U	1.2 U													
4-Chlorotoluene		1.3 U	1.3 U	1.2 U													
tert-Butylbenzene		1.3 U	1.3 U	1.2 U													
sec-Butylbenzene		1.3 U	1.3 U	1.2 U													
4-Isopropyltoluene		1.3 U	1.3 U	1.2 U													
n-Butylbenzene		1.3 U	1.3 U	1.2 U													
1,2,4-Trichlorobenzene		6.4 U	6.3 U	5.9 U													
Naphthalene		6.4 U	6.3 U	5.9 U													
1,2,3-Trichlorobenzene		6.4 U	6.3 U	5.9 U													
Methyl tert-Butyl Ether		1.3 U	1.3 U	1.2 U													

TABLE 1
SUMMARY OF INTERIM ACTION ENVIRONMENTAL DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Soil PSL (Unsaturated)	WM-SS-9	WM-SS-10	WM-SS-11	WM-SS-12	WM-SS-13	WM-SS-14	WM-SS-15	WM-SS-16	WM-SS-17	WM-SS-18	WM-SS-19	WM-SS-20	WM-SS-21	WM-SS-22	WM-SS-23
		0.75-1.0	2.0-2.25	0.75-1.0	0.75-1.0	0.75-1.0	2.0-2.25	0.75-1.0	0.75-1.0	0.75-1.0	2.0-2.25	0.75-1.0	3.0	3.0	3.0	3.0
		XK09B	XK09G	XK09H	XK09I	XK09C	XK09F	XK09J	XK09A	XK09D	XK09E	XK09K	XK09L	XK09M	XK09N	XK09O
		10/15/2013	10/15/2013	10/16/2013	10/16/2013	10/15/2013	10/15/2013	10/16/2013	10/15/2013	10/15/2013	10/15/2013	10/16/2013	10/16/2013	10/16/2013	10/16/2013	10/16/2013
TOTAL METALS (mg/kg) Methods EPA200.8/ SW6010C/SW7471A																
Arsenic	7												**24.3**	**10.1**	**15.1**	**2.0**
Cadmium	80												**1.1**	**0.7**	**0.4**	**0.2**
Chromium	2,000												**42.6**	**26.2**	**13.6**	**6.0**
Copper	36	**15.2**	**103**	**25.9**	**40.4**	**12.0**	**12**	**19.7**	**20.6**	**13.6**	**24.0**	**27.9**	**1,340**	**198**	**186**	**3**
Lead	250												**976**	**52.3**	**28.6**	**0.7**
Mercury	0.16	0.02 U	**1.46**	**0.02**	**0.05**	0.02 U	**0.04**	**0.04**	**0.03**	0.02 U	**0.03**	**0.03**	**20.5**	**1.37**	**2.57**	0.02 U
Nickel																
Zinc	100	**31**	**127**	**51**	**68**	**23**	**13**	**32**	**45**	**34**	**52**	**50**	**814**	**233**	**177**	5 U
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																
NWTPH-Dx																
Diesel Range Organics	2,000												**320**	**18**	**37**	5.2 U
Lube Oil	2,000												**680**	**58**	**34**	10 U
NWTPH-Gx																
Gasoline	100															
PAHs (µg/kg) Method SW8270DSIM																
Naphthalene	2,300	4.7 U	4.8 U	4.4 U	4.8 U	4.8 U	4.6 U	4.8 U	4.7 U	4.7 U	4.6 U	**8.8**	**73**	**12**	4.9 U	4.6 U
2-Methylnaphthalene	320,000	4.7 U	**15**	4.4 U	4.8 U	4.8 U	4.6 U	4.8 U	4.7 U	4.7 U	4.6 U	**12**	**99**	**27**	**14**	4.6 U
1-Methylnaphthalene	35,000	4.7 U	**6.2**	4.4 U	4.8 U	4.8 U	4.6 U	4.8 U	4.7 U	4.7 U	4.6 U	4.6 U	**50**	**13**	**6.2**	4.6 U
Acenaphthylene	---												**33**	4.6 U	4.9 U	4.6 U
Acenaphthene	340												**20**	4.6 U	4.9 U	4.6 U
Fluorene	470												**24**	**5.8**	4.9 U	4.6 U
Phenanthrene	---												**380**	**71**	**15**	4.6 U
Anthracene	4,500												**87**	**14**	4.9 U	4.6 U
Fluoranthene	3,200												**590**	**130**	**29**	4.6 U
Pyrene	20,000												**460**	**98**	**24**	4.6 U
Benzo(a)anthracene	130	4.7 U	**8.5**	4.4 U	**8.2**	4.8 U	4.6 U	4.8 U	4.7 U	**6.2**	**21**	4.6 U	**270**	**70**	**13**	4.6 U
Chrysene	140	4.7 U	**9.5**	4.4 U	**8.7**	4.8 U	4.6 U	4.8 U	**7.4**	**6.1**	**27**	4.6 U	**390**	**78**	**17**	4.6 U
Benzo(a)pyrene	350	4.7 U	**19**	**10**	**18**	4.8 U	**11**	4.8 U	**14**	**16**	**30**	**10**	**330**	**64**	**24**	**10** M
Indeno(1,2,3-cd)pyrene	700	4.7 U	**22**	**14**	**18**	4.8 U	**15**	4.8 U	**17**	**18**	**27**	**15**	**330**	**54**	**26**	**14** M
Dibenz(a,h)anthracene	140	4.7 U	**26**	4.4 U	**26**	4.8 U	4.6 U	4.8 U	**26**	**25**	**28**	4.6 U	**140**	**35**	**28**	4.6 U
Benzo(g,h,i)perylene	---												**490**	**60**	**18**	4.6 U
Dibenzofuran	---												**27**	4.6 U	4.9 U	4.6 U
Total Benzofluoranthenes	430	4.7 U	**20**	4.4 U	**14**	4.8 U	4.6 U	4.8 U	**9.4**	**14**	**50**	4.6 U	**770**	**140**	**32**	4.6 U
cPAH TEQ	140	ND	**27**	**11**	**25**	ND	**13**	ND	**19**	**22**	**43**	**12**	**485**	**95**	**34**	**11**

TABLE 1
SUMMARY OF INTERIM ACTION ENVIRONMENTAL DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Soil PSL	WM-BF-SS-24	WM-BF-SS-25	WM-BF-SS-26	WM-BF-SS-27	WM-BF-SS-28	WM-BF-SS-29	WM-BF-SS-30	WM-BF-SS-31	WM-BF-GP-1	WM-BF-GP-2	WM-BF-GP-3	WM-BF-GP-4
		2.3-2.5	2.3-2.5	2.3-2.5	2.3-2.5	2.3-2.5	2.3-2.5	2.3-2.5	2.3-2.5	9-10	9-10	8.5-9.5	8.5-9.5
		XL60B	XL60C	XL60D	XL60E	XL60F	XL60G	XL60H	XL60I	XL10A	XL10B	XL10C	XL10D
	(Unsaturated)	10/28/2013	10/28/2013	10/28/2013	10/28/2013	10/28/2013	10/28/2013	10/28/2013	10/28/2013	10/23/2013	10/23/2013	10/23/2013	10/23/2013
TOTAL METALS (mg/kg) **Methods EPA200.8/ SW6010C/SW7471A**													
Arsenic	7	**22.1**	**143**	**3.5**	**2.6**	**4.4**	**7.1**	**4.2**	**2.1**				
Cadmium	80	**1.1** J	**1.6**	**2.0**	**0.2**	**0.7**	**0.3**	**0.5**	**0.5**				
Chromium	2,000	**47.1** J	**49.9**	**11.9**	**7.1**	**11.1**	**9.0**	**8.7**	**7.9**				
Copper	36	**1,830**	**3,690**	**62.7**	**18**	**98**	**93.0**	**61.6**	**21**				
Lead	250	**3,870** J	**1,650**	**50.6**	**1.1**	**29.2**	**14.8**	**5.2**	**6.3**				
Mercury	0.16	**17.7**	**104**	**0.49**	**0.03**	**0.79**	**0.68**	**0.17**	**0.05**				
Nickel		**31**	**22**	**15**	**11**	**10**	**16**	**11**	**8**				
Zinc	100	**1,630**	**1,030**	**189**	**19**	**101**	**71**	**73**	**21**				
TOTAL PETROLEUM HYDROCARBONS (mg/kg)													
NWTPH-Dx													
Diesel Range Organics	2,000									**11**	**6.7**	6.3 U	6.5 U
Lube Oil	2,000									**21**	12 U	13 U	13 U
NWTPH-Gx													
Gasoline	100									10 U	7.3 U	7.0 U	6.8 U
PAHs (µg/kg) **Method SW8270DSIM**													
Naphthalene	2,300	**170**	**560**	32 U	15 U	32 U	14 U	14 U	15 U				
2-Methylnaphthalene	320,000	**89**	**650**	32 U	15 U	32 U	14 U	14 U	15 U				
1-Methylnaphthalene	35,000	**86**	**640**	32 U	15 U	32 U	14 U	14 U	15 U				
Acenaphthylene	---	**80**	**1,300**	32 U	15 U	32 U	14 U	14 U	15 U				
Acenaphthene	340	**490**	**450**	**36**	15 U	32 U	14 U	14 U	15 U				
Fluorene	470	**350**	**920**	**33**	15 U	32 U	14 U	14 U	15 U				
Phenanthrene	---	**6,000**	**12,000**	**750**	15 U	**52**	14 U	14 U	15 U				
Anthracene	4,500	**1,600**	**1,400**	**100**	15 U	32 U	14 U	14 U	15 U				
Fluoranthene	3,200	**7,800**	**15,000**	**1,800**	15 U	**81**	14 U	**20**	15 U				
Pyrene	20,000	**9,300**	**20,000**	**1,900**	15 U	**110**	14 U	**24**	15 U				
Benzo(a)anthracene	130	**4,400**	**6,600**	**610**	15 U	**54**	14 U	14 U	15 U				
Chrysene	140	**4,200**	**11,000**	**1,300**	15 U	**73**	14 U	**28**	15 U				
Benzo(a)pyrene	350	**4,000**	**8,600**	**550**	15 U	**63**	14 U	14 U	15 U				
Indeno(1,2,3-cd)pyrene	700	**2,300**	**5,900**	**360**	15 U	**68**	14 U	**17**	15 U				
Dibenz(a,h)anthracene	140	**640**	**1,600**	**110**	15 U	32 U	14 U	14 U	15 U				
Benzo(g,h,i)perylene	---	**2,900**	**7,200**	**510**	15 U	**110**	14 U	**31**	15 U				
Dibenzofuran	---	**150**	**330**	32 U	15 U	32 U	14 U	14 U	15 U				
Total Benzofluoranthenes	430	**6,300**	**15,000**	**1,700**	**32**	**190**	**38**	**71**	**32**				
cPAH TEQ	140	**5,406**	**11,620**	**841**	**3.2**	**95**	**3.8**	**10**	**3.2**				

Notes:

U = The compound was not detected at the reported concentration.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

M = An estimated value of analyte found and confirmed by analyst but with low spectral match.

ND = Not detected.

Bold = Detected compound.

Yellow shaded data represent soil that was removed from the Site during the Interim Action

Green shadded data represent soil remaining following Interim Action.

TABLE 2
GROUNDWATER ELEVATION AND ELECTRICAL CONDUCTIVITY DATA
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Well Name	Elevation (top of pipe) (ft)	Depth to Water (April 2014) (ft)	Water Elevation (April 2014) (ft)	Conductivity (April 2014) (µS/cm)	Depth to Water (July 2014) (ft)	Water Elevation (July 2014) (ft)	Conductivity (July 2014) (µS/cm)
WM-MW-1	15.64	8.84	6.80	923	8.98	6.66	4,713
WM-MW-2	13.27	6.54	6.73	25,645	6.57	6.70	13,722
WM-MW-3	15.32	10.01	5.31	40,608	9.78	5.54	23,772
WM-MW-4	13.24	6.61	6.63	26,671	7.32	5.92	18,658
WM-MW-5	14.18	6.51	7.67	1,494	7.04	7.14	926
WM-MW-6	13.45	8.08	5.37	4,755	8.01	5.44	4,759
WM-MW-7	13.21	10.34	2.87	53,388	9.71	3.50	32,946
WM-MW-8	13.24	6.71	6.53	48,606	5.91	7.33	31,308

µS/cm = MicroSiemens per centimeter.

TABLE 3
GRAIN SIZE ANALYSIS
WESTMAN MARINE – BLAINE, WASHINGTON

Sample Name =	WM-GP-17	WM-MW-3	WM-MW-5	WM-MW-6
Depth Interval =	5-6	7-8	7-8	9-10
Lab Data Package =	XJ14C/YK90A/YN60A	YH18A	YH18C/YN60E	YH18B
Sample Date =	10/08/2013	4/14/2014	4/15/2014	4/14/2014
GRAIN SIZE (%)				
ASTM D422				
Particle/Grain Size, Gravel	0	0	**0.1**	0
Particle/Grain Size, Sand	**83.3**	**69.9**	**51.0**	**73.0**
Particle/Grain Size, Silt/Clay	**16.8**	**30.1**	**49.0**	**27.1**

TABLE 4
SEDIMENT SAMPLE LOCATION COORDINATES AND MUDLINE ELEVATIONS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Label	Northing	Easting	Mudline Elevation (ft MLLW)
Surface Sample Locations			
WM-SG-01	732419	1177332	4.5
WM-SG-02	732338	1177379	-4.6
WM-SG-03	732370	1177396	0.8
WM-SG-04	732385	1177439	-3.9
WM-SG-05	732298	1177283	-1.5
WM-SG-06	732256	1177199	-1.1
WM-SG-07	732491	1177452	2.3
WM-SG-08	732385	1177536	-10.7
WM-SG-09	732291	1177623	-13.5
WM-SG-10	732248	1177420	-11.9
WM-SG-11	732172	1177470	-11.7
WM-SG-12	732185	1177215	-13.7
WM-SG-13	732125	1177221	-14.4
WM-SG-14	732384	1177319	2.9
WM-SG-15	732565	1177493	-12.7
WM-SG-16	732528	1177434	+4.2
WM-SG-17	732447	1177506	-7.0
WM-SG-18	732842	1177468	-12.4
WM-SG-19	732634	1177950	-13.3
WM-SG-20	732147	1176943	-13.2
WM-SG-21	733226	1178117	-1.3
WM-SG-22	732579	1178487	-11.1
WM-SG-23	733165	1178938	+5.2
WM-SG-24	732785	1179456	-6.2
WM-SG-26	732247	1176694	-19.0
WM-SG-27	731990	1176552	-58.1
WM-SG-29	732223	1177375	-13.6
WM-SG-30	732199	1177446	-15.0
WM-SG-31	732277	1177465	-13.5
WM-SG-32	732200	1177329	-13.9
WM-SG-33	732304	1177507	-14.0
WM-SG-34	732239	1177315	-14.3
WM-SG-35	732332	1177473	-12.4
Subsurface Sample Locations			
WM-SC-01	732352	1177363	+2.7
WM-SC-02	732335	1177377	-5.0
WM-SC-03	732369	1177397	+1.7
WM-SC-04	732386	1177440	-0.6
WM-SC-06	732257	1177200	-1.0
WM-SC-10	732248	1177420	-12.2
WM-SC-29	732221	1177373	-13.6
WM-SC-30	732202	1177444	-15.0
WM-SC-31	732274	1177465	-13.5
WM-SC-32	732199	1177331	-13.9
WM-SC-33	732304	1177510	-14.0

MLLW = Mean lower low water

U.S. State Plane 1983, Washington North Zone, U.S. Survey Feet

TABLE 5
SITE SCREENING LEVELS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	APPLICABLE GROUNDWATER VALUES														
	Marine Surface Water Criteria						***Protection of Marine Sediment Recontamination***								
							Partitioning/Distribution Coefficients (a)		*Marine Sediment Quality Standards*						
DETECTED ANALYTES (BY GROUP)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC *(ma-wac)*	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 *(ma-cwa)*	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 *(ma-ntr)*	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 *(hh-cwa)*	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 *(hh-ntr)*	Surface Water, Method B, Most Restrictive, Standard Formula (b) *(sw-b)*	K_{oc} (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)	K_d (Distribution Coefficient for metals) (L/kg)	WAC 173-204 Marine SQS (mg/kg organic carbon)	WAC 173-204 Marine SQS (mg/kg dry weight)	**Calculated Porewater Concentration Protective of Marine Sediment (c)** *(sed)*	**Method A Cleanup Levels** *(MA)*	**Applicable Practical Quantitation Level (PQL) for RI Analyses (d)** *(pql)*	***Groundwater Screening Level***	
Total Petroleum Hydrocarbons (µg/L)															
Gasoline-Range Hydrocarbons (with benzene)												800	250	800	*(MA)*
Gasoline-Range Hydrocarbons (without benzene)												1,000	250	1,000	*(MA)*
Oil-Range Hydrocarbons												500	500	500	*(pql)*
Metals (µg/L)															
Arsenic	36	36	36	0.14	0.14	0.098		*29*		57	2,000	5	0.5	5	*(MA)*
Cadmium	9.3	8.8	9.3			41				5.1		5	0.1	8.8	*(ma-cwa)*
Chromium (Total)										260		50	0.5	50	*(MA)*
Copper	3.1	3.1	2.4			2,900		*22*		390	18,000		0.5	2.4	*(ma-ntr)*
Lead	8.1	8.1	8.1					*10,000*		450	45	15	0.1	8.1	*(ma-wac)*
Zinc	81	81	81	26,000		17,000		*62*		410	6,600		4	81	*(ma-wac)*
Volatile Organic Compounds (µg/L)															
1,2-Dichlorobenzene				1,300	17,000	4,200	*380*		2.3		6.1		0.2	6.1	*(sed)*
Chlorobenzene				1,600	21,000	5,000	*220*						0.5	100	*(vi-b)*
Naphthalene						4,900	*1,200*		99		83		0.2	83	*(sed)*
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/L)															
Acenaphthene				990		640	*4,900*		16		3.3		0.01	3.3	*(sed)*
Acenaphthylene							*5027*		66		13		0.01	13	*(sed)*
Anthracene				40,000	110,000	26,000	*23,000*		220		9.6		0.01	9.6	*(sed)*
Benzo(g,h,i)perylene							*567300*		31		0.055		0.01	0.055	*(sed)*
Fluoranthene				140	370	90	*49,000*		160		3.3		0.01	3.3	*(sed)*
Fluorene				5,300	14,000	3,500	*7,700*		23		3		0.01	3	*(sed)*
Phenanthrene							*16690*		100		6		0.01	6	*(sed)*
Pyrene				4,000	11,000	2,600	*68,000*		1,000		15		0.01	15	*(sed)*
2-Methylnaphthalene							*2478*		38		15		0.01	15	*(sed)*
Naphthalene						4,900	*1,200*		99		83		0.01	83	*(sed)*
Benz(a)anthracene				0.018	0.031	0.3	*360,000*		110		0.31		0.01	0.018	*(hh-cwa)*
Benzo(a)pyrene				0.018	0.031	0.03	*970,000*		99		0.1		0.01	0.018	*(hh-cwa)*
Benzo(b)fluoranthene				0.018	0.031	0.3	*1,200,000*						0.01	0.018	*(hh-cwa)*
Benzo(k)fluoranthene				0.018	0.031	3	*1,200,000*						0.01	0.018	*(hh-cwa)*
Chrysene				0.018	0.031	30	*400,000*		110		0.28		0.01	0.018	*(hh-cwa)*
Dibenzo(a,h)anthracene				0.018	0.031	0.03	*1,800,000*		12		0.0067		0.01	0.01	*(pql)*
Indeno(1,2,3-cd)pyrene				0.018	0.031	0.3	*3,500,000*		34		0.0097		0.01	0.01	*(pql)*
Total cPAHs TEQ				0.018	0.031	0.03	*970,000*		99		0.1		0.0051	0.018	*(hh-cwa)*
Other Semivolatile Organic Compounds (µg/L)															
Bis(2-chloro-1-methylethyl) ether						37							1	37	*(sw-b)*
N-Nitrosodimethylamine				3	8.1	4.9							3	3	*(hh-cwa)*

TABLE 5
SITE SCREENING LEVELS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

(a) Values from Ecology's CLARC database (Ecology website 2012), except as noted.

(b) Method B values are most restrictive of carcinogenic or non-carcinogenic values presented in Ecology's CLARC database (Ecology website 2012).

(c) Calculated assuming equilibrium partitioning: Cw (porewater) = Sediment Quality Standard (SQS; WAC 173-204-320) / K_d.

(d) From Columbia Analytical Services, Inc. (Kelso, WA) and Analytical Resources, Inc. (Tukwila, WA) published method reporting limits. PQLs will be laboratory-specific, thus site-specific and are the lowest concentration of an analyte that can be accurately measured. PQLs are always above the method detection limit (MDL).

Abbreviations:

ARAR = Applicable or Relevant and Appropriate Requirement
Ch = Chapter
CFR = Code of Federal Regulations
CLARC = Cleanup Levels and Risk Calculation
cPAH = Carcinogenic polycyclic aromatic hydrocarbon
Ecology = Washington State Department of Ecology
EPA= U.S. Environmental Protection Agency
K_d = Distribution coefficient
K_{oc} = Soil organic carbon water partitioning coefficient
MDL = Method detection limit
PQL = Practical Quantitation Limit
RI = Remedial Investigation
SQS = Sediment Quality Standards
TEQ = Toxicity equivalency quotient
WAC = Washington Administrative Code

Notes

If empirical data show that sediments are in compliance with sediment Screening Level values, it can be concluded that the groundwater to sediment pathway is protective and does not require further evaluation.

Contaminant concentrations in groundwater that are protective of sediments are calculated using an equilibration partitioning method. Site-specific data [e.g., distribution coefficient (K_d), soil organic carbon water partitioning coefficient [K_{oc}], etc.] can be used to calculate if porewater is protective of sediments. In this table, the equilibrium partitioning equation is used with default parameters and is defined to achieve contaminant concentrations in sediment protective of benthic toxicity.

Blank cells are intentional.

TABLE 6
SITE SCREENING LEVELS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

		APPLICABLE SOIL VALUES									*Soil Screening Level (mg/kg)*	
		Groundwater Protection (a,b)					*Direct Contact (e)*					
		Constants and Coefficients (c)			*Calculated Values (d)*							
DETECTED ANALYTES (BY GROUP)	Most Stringent Unrestricted Land Use Value from Groundwater Screening Level Table (refer to Table 4) (µg/L)	K_{oc} (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)	K_d (Distribution Coefficient for metals) (L/kg)	Henry's Law Constant (unitless)	**Unsaturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (f) *(gwl-u)*	**Saturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (g) *(gwl-s)*	Soil, Method A, Unrestricted Land Use, Table Value (mg/kg) (a, c) *(mA)*	Soil, Method B, Most-Restrictive Standard Formula Value, Direct Contact (ingestion only), Unrestricted Land Use (mg/kg) (b, c) *(mB)*	Natural Background Concentrations (Ecology 1994) (mg/kg) (h) *(back)*	Applicable Practical Quantitation Level (PQL) for RI Analyses (mg/kg) (i) *(pql)*	**Unsaturated Soil**	**Saturated Soil**
Total Petroleum Hydrocarbons												
Gasoline-Range Hydrocarbons (with benzene)	800						30			5	30 *(mA)*	30 *(mA)*
Gasoline-Range Hydrocarbons (without benzene)	1,000						100			5	100 *(mA)*	100 *(mA)*
Diesel-Range Hydrocarbons	500						2,000			25	2,000 *(mA)*	2,000 *(mA)*
Oil-Range Hydrocarbons	500						2,000			100	2,000 *(mA)*	2,000 *(mA)*
Metals												
Arsenic	5		*29*	*0*	2.9	0.15	20	0.67	7	0.5	20 *(mA)*	20 *(mA)*
Cadmium	8.8			*0*			2	80	1	0.1	80 *(mB)*	80 *(mB)*
Chromium (Total)	50						2,000		48	0.5	2,000 *(mA)*	2,000 *(mA)*
Copper	2.4		*22*	*0*	1.1	0.053		3,200	36	0.2	3,200 *(back)*	3,200 *(back)*
Lead	8.1		*10,000*	*0*	1,600	81	250		24	0.1	250 *(mA)*	81 *(gwl-s)*
Mercury	0.15		*52*	*0.47*	0.16	0.0078	2		0.07	0.025	2 *(mA)*	2 *(mA)*
Zinc	81		*62*	*0*	100	5		24,000	85	1	24,000 *(mB)*	24,000 *(mB)*
Volatile Organic Compounds												
1,2-Dichlorobenzene	6.1	*380*		*0.078*	0.072	0.0041		7,200		0.005	0.072 *(gwl-u)*	0.005 *(pql)*
2-Butanone	0							48,000		0.02	48,000 *(mB)*	48,000 *(mB)*
Acetone		*0.58*		*0.0016*				72,000		0.02	72,000 *(mB)*	72,000 *(mB)*
Benzene	23	*62*		*0.23*	0.13	0.008		18		0.005	0.13 *(gwl-u)*	0.008 *(gwl-s)*
Bromomethane	970	*9*		*0.26*	4.5	0.29		110		0.005	4.5 *(gwl-u)*	0.29 *(gwl-s)*
Carbon disulfide	0	*46*		*1.2*				8,000		0.005	8,000 *(mB)*	8,000 *(mB)*
Ethylbenzene	2,100	*200*		*0.32*	18	1		8,000		0.005	18 *(gwl-u)*	1 *(gwl-s)*
Isopropylbenzene	0							8,000		0.02	8,000 *(mB)*	8,000 *(mB)*
Methylene chloride	590	*10*		*0.09*	2.6	0.18		130		0.01	2.6 *(gwl-u)*	0.18 *(gwl-s)*
n-Propylbenzene								8,000		0.02	8,000 *(mB)*	8,000 *(mB)*
Toluene	15,000	*140*		*0.27*	110	6.4		6,400		0.005	110 *(gwl-u)*	6.4 *(gwl-s)*
Xylenes (total)		*230*		*0.28*				16,000		0.02	16,000 *(mB)*	16,000 *(mB)*
Naphthalene	83	*1,200*		*0.02*	2.3	0.12		1,600		0.001	2.3 *(gwl-u)*	0.12 *(gwl-s)*
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	3.3	*4,900*		*0.0064*	0.34	0.017		4,800		0.005	0.34 *(gwl-u)*	0.017 *(gwl-s)*
Anthracene	9.6	*23,000*		*0.0027*	4.5	0.22		24,000		0.005	4.5 *(gwl-u)*	0.22 *(gwl-s)*
Fluoranthene	3.3	*49,000*		*0.00066*	3.2	0.16		3,200		0.005	3.2 *(gwl-u)*	0.16 *(gwl-s)*
Fluorene	3	*7,700*		*0.0026*	0.47	0.024		3,200		0.005	0.47 *(gwl-u)*	0.024 *(gwl-s)*
Pyrene	15	*68,000*		*0.00045*	20	1		2,400		0.005	20 *(gwl-u)*	1 *(gwl-s)*
1-Methylnaphthalene								35		0.005	35 *(mB)*	35 *(mB)*
2-Methylnaphthalene	15							320		0.005	320 *(mB)*	320 *(mB)*
Naphthalene	83	*1,200*		*0.02*	2.3	0.12		1,600		0.005	2.3 *(gwl-u)*	0.12 *(gwl-s)*
Benz(a)anthracene	0.018	*360,000*		*0.00014*	0.13	0.0065		1.4		0.005	0.13 *(gwl-u)*	0.0065 *(gwl-s)*
Benzo(a)pyrene	0.018	*970,000*		*0.000046*	0.35	0.017		0.14		0.005	0.35 *(gwl-u)*	0.017 *(gwl-s)*
Benzo(b)fluoranthene	0.018	*1,200,000*		*0.0046*	0.43	0.022		1.4		0.005	0.43 *(gwl-u)*	0.022 *(gwl-s)*
Benzo(k)fluoranthene	0.018	*1,200,000*		*0.000034*	0.43	0.022		14		0.005	0.43 *(gwl-u)*	0.022 *(gwl-s)*
Chrysene	0.018	*400,000*		*0.0039*	0.14	0.0072		140		0.005	0.14 *(gwl-u)*	0.0072 *(gwl-s)*
Dibenzo(a,h)anthracene	0.01	*1,800,000*		*0.0000006*	0.36	0.018		0.14		0.005	0.14 *(mB)*	0.018 *(gwl-s)*
Indeno(1,2,3-cd)pyrene	0.01	*3,500,000*		*0.000066*	0.7	0.035		1.4		0.005	0.7 *(gwl-u)*	0.035 *(gwl-s)*
Total cPAHs TEQ	0.018							0.14		0.00076	0.14 *(mB)*	0.14 *(mB)*

TABLE 6
SITE SCREENING LEVELS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

		APPLICABLE SOIL VALUES									*Soil Screening Level (mg/kg)*			
		Groundwater Protection (a,b)					*Direct Contact (e)*							
		Constants and Coefficients (c)			*Calculated Values (d)*									
DETECTED ANALYTES (BY GROUP)	Most Stringent Unrestricted Land Use Value from Groundwater Screening Level Table (refer to Table 4) (µg/L)	K_{oc} (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)	K_d (Distribution Coefficient for metals) (L/kg)	Henry's Law Constant (unitless)	**Unsaturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (f) *(gwl-u)*	**Saturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (g) *(gwl-s)*	Soil, Method A, Unrestricted Land Use, Table Value (mg/kg) (a, c) *(mA)*	Soil, Method B, Most-Restrictive Standard Formula Value, Direct Contact (ingestion only), Unrestricted Land Use (mg/kg) (b, c) *(mB)*	Natural Background Concentrations (Ecology 1994) (mg/kg) (h) *(back)*	Applicable Practical Quantitation Level (PQL) for RI Analyses (mg/kg) (i) *(pql)*	**Unsaturated Soil**		**Saturated Soil**	
Other Semivolatile Organic Compounds														
4-Methylphenol								400		0.02	400	*(mB)*	400	*(mB)*
Benzyl alcohol								8,000		0.1	8,000	*(mB)*	8,000	*(mB)*
Benzyl butyl phthalate	1	*14,000*		*0.000052*	0.28	0.014		530		0.02	0.28	*(gwl-u)*	0.02	*(pql)*
Bis(2-ethylhexyl) phthalate	3	*110,000*		*0.0000042*	6.6	0.33		71		0.1	6.6	*(gwl-u)*	0.33	*(gwl-s)*
Dibenzofuran								80		0.02	80	*(mB)*	80	*(mB)*
Diethyl phthalate	740	*82*		*0.000019*	4.2	0.27		64,000		0.02	4.2	*(gwl-u)*	0.27	*(gwl-s)*
Di-n-butyl phthalate	140	*1,600*		*3.9E-08*	5	0.26		8,000		0.02	5	*(gwl-u)*	0.26	*(gwl-s)*
Pentachlorophenol	10	*590*		*0.000001*	0.16	0.0088		2.5		0.1	0.16	*(gwl-u)*	0.1	*(pql)*
Phenol	580	*29*		*0.000016*	3	0.18		24,000		0.03	3	*(gwl-u)*	0.18	*(gwl-s)*
Polychlorinated Biphenyls (PCBs)														
Aroclor 1254	0.01							0.5		0.033	0.5	*(mB)*	0.5	*(mB)*
Aroclor 1260	0.03	*820,000*			0.49	0.025		0.5		0.033	0.49	*(gwl-u)*	0.033	*(pql)*
Total PCBs	0.025	*310,000*			0.16	0.0078	1	0.5		0.05	0.16	*(gwl-u)*	0.05	*(pql)*

TABLE 6
SITE SCREENING LEVELS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

(a) Because groundwater at Blaine Harbor nearshore sites is not a practicable source of drinking water in accordance with MTCA, many Method A soil cleanup levels are not applicable. Method A unrestricted cleanup levels are used only if they are based on background or ARARs, or there are no corresponding Method B direct contact values. Soil leachability to groundwater is addressed separately. Method A values for diesel- and oil-range TPH are based on accumulation of free product, not direct contact.

(b) Method B values are most restrictive of carcinogenic or non-carcinogenic values presented in Ecology's CLARC database (Ecology website 2012).

(c) Values from Ecology's CLARC database (Ecology website 2012), except as noted.

(d) Contaminant concentrations in soil that are protective of groundwater are calculated using either of the methods listed in WAC 173-340-747(3). Concentrations may be derived from either saturated or unsaturated soil. The variable parameter three-phase partitioning model requires at least some site-specific data [e.g., distribution coefficient (K_d), soil bulk density, water-filled soil porosity, air filled soil porosity, or dilution factor] to calculate if soil is protective of groundwater. For this table, the fixed parameter three-phase partitioning model is used with default parameters.

(e) Direct contact criteria applicable for soils to 15-ft depth.

(f) Calculated values from three-phase model, per MTCA Equation 747-1, with groundwater value (Cw) as most stringent value from groundwater screening level process (Table 1), and Dilution Factor = 20.

(g) Calculated values from three-phase model, per MTCA Equation 747-1, with groundwater value (Cw) as most stringent value from groundwater screening level process (Table 1), and Dilution Factor = 1.

(h) Values are from Ecology’s Natural Background Soil Metals Concentrations in Washington State (Ecology 1994).

(i) From Columbia Analytical Services, Inc. (Kelso, WA) and Analytical Resources, Inc. (Tukwila, WA) published method reporting limits. PQLs will be laboratory-specific, thus site-specific and are the lowest concentration of an analyte that can be accurately measured. PQLs are always above the method detection limit (MDL).

Abbreviations:

ARAR = Applicable or Relevant and Appropriate Requirement
CLARC = Cleanup Levels and Risk Calculation
cPAH = Carcinogenic polycyclic aromatic hydrocarbon
Ecology = Washington State Department of Ecology
K_d = Distribution coefficient
K_{oc} = Soil organic carbon water partitioning coefficient
MTCA = Model Toxics Control Act
PQL = Practical Quantitation Limit
RI/FS = Remedial Investigation/Feasibility Study
TEQ = Toxicity equivalency quotient
TPH = Total petroleum hydrocarbons
WAC = Washington Administrative Code

The soil to sediment pathway is not included in the Soil Screening Level Tables because this transport pathway will be evaluated on a site-specific basis when evaluating potential erosion/overland flow, soil to stormwater pathways, etc. later in the RI/FS process. Sediment standards should not be used to define upland soil remedial action levels, but rather those pathways should be controlled during source control efforts. Site-specific evaluation of processes that influence settlement to sediments (e.g., deposition, hydrodynamics, etc.) for situations such as particulates discharging from outfalls may be relevant.

The soil to vapor (indoor and ambient air) pathway is not included in the Soil Screening Level Tables because, as stated in WAC 173-340-745, soil cleanup levels that are protective of indoor and ambient air shall be determined on a site-specific basis. Methods such as indoor air sampling and soil vapor sampling can be used to determine whether soil cleanup levels are protective of air pathways.

Unless dioxin/furans are found at levels indicating a site-specific release, they will not be used as a chemical to define the extent of contamination associated with the site requiring remediation.

Blank cells are intentional.

TABLE 7
SITE SCREENING LEVELS – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Constituents of Potential Concern	Screening Levels for Protection of Benthic Organisms (a)			
Metals	**SCO mg/kg dry wt**		**CSL mg/kg dry wt**	
Arsenic	57		93	
Cadmium	5.1		6.7	
Chromium (Total)	260		270	
Copper	390		390	
Lead	450		530	
Mercury	0.41		0.59	
Zinc	410		960	
Polycyclic Aromatic Hydrocarbons (PAHs)	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
Acenaphthene	16	57	500	500
Acenaphthylene	66	66	1,300	1,300
Anthracene	220	1,200	960	960
Benzo(g,h,i)perylene	31	78	670	720
Fluoranthene	160	1,200	1,700	2,500
Fluorene	23	79	540	540
Phenanthrene	100	480	1,500	1,500
Pyrene	1,000	1,400	2,600	3,300
2-Methylnaphthalene	38	64	670	670
Naphthalene	99	170	2,100	2,100
Benz(a)anthracene	110	270	1,300	1,600
Benzo(a)pyrene	99	210	1,600	1,600
Chrysene	110	460	1,400	2,800
Dibenzo(a,h)anthracene	12	33	230	230
Indeno(1,2,3-cd)pyrene	34	88	600	690
Benzofluoranthenes (total)	230	450	3,200	3,600
Total LPAH (d)	370	780	5,200	5,200
Total HPAH (e)	960	5,300	12,000	17,000
Chlorinated Benzenes	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
1,4-Dichlorobenzene	3.1	9	110	110
Other Semivolatile Organics	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
2,4-Dimethylphenol	-	-	29	29
2-Methylphenol	-	-	63	63
4-Methylphenol	-	-	670	670
Benzoic acid	-	-	650	650
Benzyl alcohol	-	-	57	72
Pentachlorophenol	-	-	360	690
Phenol	-	-	420	1,200
Phthalate Esters	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
Diethyl phthalate	61	110	200	1,200
Dimethyl phthalate	53	53	71	160
Di-n-butyl phthalate	220	1,700	1,400	5,100
Di-n-octyl phthalate	58	4,500	6,200	6,200
Benzyl butyl phthalate	4.9	64	63	900
Bis(2-ethylhexyl) phthalate	47	78	1,300	3,100
Total Polychlorinated Biphenyls (PCBs)	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
Total PCBs (Benthic Criteria)	12	65	130	1,000
Other Carbon Normalized COPCs	**SCO mg/kg OC (b)**	**CSL mg/kg OC (b)**	**SCO (c) µg/kg dry wt**	**CSL (c) µg/kg dry wt**
Dibenzofuran	15	58	540	540
N-Nitrosodiphenylamine	11	11	28	40
Organotins	**SCO µg/L**		**CSL µg/L**	
TBT (Porewater) (f)	0.05		0.15	
TBT (Bulk) (g)	238		738	

TABLE 7
SITE SCREENING LEVELS – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Constituents of Potential Concern	Screening Levels for Protection of Human Health	
Metals	**SCO (h) mg/kg dry wt**	**CSL (h) mg/kg dry wt**
Arsenic	11	11
Cadmium	1	1
Lead	21	21
Mercury	0.2	0.2
Total Polychlorinated Biphenyls (PCBs)	**SCO (i) µg/kg dry wt**	**CSL (i) µg/kg dry wt**
Total PCBs (Risk-Based Concentrations)	6	53
Dioxin-Like PCBs (PCB-TEQ)	**SCO (i) ppt**	**CSL (i) ppt**
PCB-TEQ	0.2	2
cPAHs TEQ	**SCO (i) µg/kg dry wt**	**CSL (i) µg/kg dry wt**
cPAH-TEQ (e)	40	400
Organotins	**SCO µg/L**	**CSL µg/L**
TBT (Porewater) (f)	0.05	0.15
Organotins	**SCO µg/kg dry wt**	**CSL µg/kg dry wt**
TBT (Bulk) (g)	238	738

Numerical Criteria Notes:

(a) SMS Criteria unless otherwise noted

(b) Values represent concentrations on a total organic carbon basis (dry-weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment).

(c) AETs: Dry weight equivalents of SMS criteria. Dry weight normalized AETs can be used when total organic carbon is outside the recommended range for organic carbon normalization of 0.5 to 3.5 percent.

(d) The total LPAH criterion represents the sum of the following low molecular weight polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.

(e) The total HPAH criterion represents the sum of the following high molecular weight polycyclic aromatic compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene.

(f) No SMS criteria available. Criteria from Michelsen et al. 1996 PSDDA Issue Paper and DMMP Guideline ChemIstry Values.

(g) Screening Level developed by Site-specific correlation of bulk and porewater data in Appendix E.

(h) Natural background values from Table 11-1 of SCUM II guidance (Ecology website 2013). Values devleoped from DMMP 2009.

(i) Risk-based screening levels developed in Appendix F.

Abbreviations:

AET = Apparent effects threshold
cPAH = Carcinogenic polycyclic aromatic hydrocarbon
CSL = Cleanup Screening Level
HPAH = High molecular weight polycyclic aromatic hydrocarbon
LPAH = Low molecular weight polycyclic aromatic hydrocarbon
MCUL = Maximum cleanup level
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
mg/kg = Parts per trillion
OC = Organic carbon
PCB = Polychlorinated biphenyl
ppt = Parts per trillion
SCO = Sediment Cleanup Objective
TBT = Tributyltin
TEQ = Toxicity equivalency quotient
WAC = Washington Administrative Code
wt = Weight

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

							Dup of WM-GP-9							Dup of MW-1			
	GW	WM-GP-2	WM-GP-5	WM-GP-7	WM-GP-8	WM-GP-9	WM-GP-DUP	WM-GP-12	WM-GP-13	WM-GP-14	WM-GP-16	WM-GP-17	WM-MW-1	WM-MW-DUP1	WM-MW-1	WM-MW-2	WM-MW-2
	Screening	XJ62B	XJ62A	XJ62F/	XJ62C/	XJ17D/J	XJ17E/K	XJ17B/	XJ62D/	XJ62E/	XJ17C/	XJ17A/	YI69F	YI69I	YQ82E	YI69C	YQ82C
	Level			XM52I	XM52F	XM52D	XM52E	XM52B	XM52G	XM52H	XM52C	XM52A				YU22B	YU21B
		10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/08/2013	10/08/2013	10/08/2013	10/09/2013	10/09/2013	10/08/2013	10/08/2013	4/30/2014	4/30/2014	7/7/2014	4/29/2014	7/7/2014
TOTAL METALS (µg/L)																	
Methods EPA200.8/SW7470A																	
Arsenic	5	**0.4**	**0.200** J	**17**	**4**	**1.8**	**1.8**	**5**	**2.50** J	**0.48** J	**3**	**0.6**	1 U		**0.32** J	**5**	**2**
Cadmium	8.8	0.1 U	0.1 U	1 U	1 U	0.1 U	0.1 U	1 U	1 U	0.2 U	1 U	0.1 U	0.2 U		0.2 U	0.5 U	**0.10** J
Chromium	50	0.5 U	**1.3**	5 U	5 U	**4.4**	**4.2**	**6**	5 U	**3**	5 U	**0.8**	1 U		**0.2** J	2 U	**3**
Copper	2.4	**1.2**	0.5 U	**13**	**3.40** J	**35.0**	**34.4**	**21**	**5**	**3**	**4.10** J	**0.8**	**1**		1 U	**6**	**2.2** J
Lead	8.1	**0.3**	**0.2**	**4**	1 U	**46.7**	**42.3**	**2**	1 U	**3.5**	1 U	**1**	0.2 U		0.2 U	0.5 U	**0.45** J
Mercury	0.15	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U					
Zinc	81	4 U	4 U	**40**	40 U	**20** J	**19**	**410**	40 U	10 U	40 U	**5**	10 U		**3** J	20 U	**7** J
DISSOLVED METALS (µg/L)																	
Methods EPA200.8/SW7470A																	
Arsenic	5			**19**	**2.20** J	**0.82** J	0.5 U	**4**			**4**	**0.5**				**2**	**1.3** J
Cadmium	8.8					0.1 U	0.1 U										
Chromium	50			**5**		**0.8**	**0.8**	**6**									
Copper	2.4			**6**		**0.7** J	**4.9** J	**3**	**1.75** J	**0.9**						5 U (a)	
Lead	8.1					**0.6** J	**1.2** J										
Mercury	0.15					0.1 U	0.1 U										
Zinc	81					4 U	6	**6.8** J									
TOTAL PETROLEUM HYDROCARBONS (mg/L)																	
HCID																	
Gasoline	---	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U		0.25 U	0.25 U	0.25 U
Diesel	---	0.62 U	0.54 U	**>0.59**	0.62 U	0.50 U	**>0.50**	**>0.50**	**>0.62**	0.56 U	0.50 U	0.50 U	0.50 U		0.50 U	0.50 U	**> 0.50**
Oil	---	0.62 U	0.54 U	0.59 U	0.62 U	**>0.50**	**>0.50**	0.50 U	0.62 U	0.56 U	0.50 U	0.50 U	0.50 U		0.50 U	0.50 U	0.50 U
NWTPH-Dx																	
Diesel Range Organics	0.5			0.12 U		0.10 UJ	0.10 U	0.10 U	0.12 U								0.10 U
Lube Oil	0.5			0.24 U		**0.21**	0.20 U	0.20 U	0.25 U								0.20 U
PCBs (µg/L)																	
Method SW8082A																	
Aroclor 1016	---																
Aroclor 1242	---																
Aroclor 1248	---																
Aroclor 1254	---																
Aroclor 1260	---																
Aroclor 1221	---																
Aroclor 1232	---																
Total PCBs	---																
PAHs (µg/L)																	
Method SW8270DSIM																	
Naphthalene	83	**0.035**	**0.011**	**0.031**	**0.011**	**0.022** J	**0.053** J	**0.26**	0.012 U	**0.017**	0.010 U	**0.024**	0.010 U	**0.010**	**0.014**	**0.021**	**0.026**
2-Methylnaphthalene	15	0.010 U	0.011 U	**0.016** M	0.010 U	0.010 UJ	**0.020** J	0.10 U	0.012 U	0.010 U	0.010 U	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
1-Methylnaphthalene	---	0.010 U	0.011 U	**0.012** M	0.010 U	0.010 UJ	**0.019** J	**0.13**	0.012 U	0.010 U	0.010 U	**0.022**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Acenaphthylene	13	0.010 U	0.011 U	0.011 U	0.010 U	**0.018** J	**0.043** J	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Acenaphthene	3.3	**0.015**	**0.11**	**0.012**	0.010 U	**0.017**	**0.026**	**17**	0.012 U	0.010 U	0.010 U	**0.038**	**0.017**	**0.016**	**0.026**	0.010 U	0.010 U
Fluorene	3	0.010 U	**0.042**	**0.017**	0.010 U	**0.020** J	**0.039** J	**0.15**	0.012 U	**0.011**	0.010 U	**0.032**	**0.011**	**0.011**	**0.017**	0.010 U	0.010 U
Phenanthrene	6	0.010 U	**0.036**	**0.036**	0.010 U	**0.13** J	**0.29** J	0.10 U	0.012 U	**0.052**	0.010 U	**0.07**	**0.016**	**0.016**	**0.028**	0.010 U	0.010 U
Anthracene	9.6	0.010 U	0.011 U	0.011 U	0.010 U	**0.030** J	**0.071** J	0.10 U	0.012 U	**0.022**	0.010 U	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Fluoranthene	3.3	0.010 U	**0.033**	**0.016**	0.010 U	**0.18** J	**0.41** J	0.10 U	0.012 U	**0.034**	0.010 U	**0.030**	0.010 U	**0.010**	**0.014**	0.010 U	0.010 U
Pyrene	15	0.010 U	**0.04**	**0.039**	**0.017**	**0.28** J	**0.71** J	0.10 U	0.012 U	**0.032**	0.010 U	**0.037**	**0.018**	**0.018**	**0.027**	0.010 U	0.010 U
Benzo(a)anthracene	0.018	0.010 U	0.011 U	0.011 U	0.010 U	**0.094** J	**0.24** J	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene	0.018	0.010 U	0.011 U	0.011 U	0.010 U	**0.12** J	**0.28** J	0.10 U	0.012 U	**0.011**	0.010 U	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene	0.018	0.010 U	0.011 U	0.011 U	0.010 U	**0.11**	**0.28**	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene	0.01	0.010 U	0.011 U	0.011 U	0.010 U	**0.062** J	**0.16** J	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-GP-2 XJ62B 10/09/2013	WM-GP-5 XJ62A 10/09/2013	WM-GP-7 XJ62F/ XM52I 10/09/2013	WM-GP-8 XJ62C/ XM52F 10/09/2013	WM-GP-9 XJ17D/J XM52D 10/08/2013	Dup of WM-GP-9 WM-GP-DUP XJ17E/K XM52E 10/08/2013	WM-GP-12 XJ17B/ XM52B 10/08/2013	WM-GP-13 XJ62D/ XM52G 10/09/2013	WM-GP-14 XJ62E/ XM52H 10/09/2013	WM-GP-16 XJ17C/ XM52C 10/08/2013	WM-GP-17 XJ17A/ XM52A 10/08/2013	WM-MW-1 YI69F 4/30/2014	Dup of MW-1 WM-MW-DUP1 YI69I 4/30/2014	WM-MW-1 YQ82E 7/7/2014	WM-MW-2 YI69C YU22B 4/29/2014	WM-MW-2 YQ82C YU21B 7/7/2014
Dibenz(a,h)anthracene	0.01	0.010 U	0.011 U	0.011 U	0.010 U	**0.015** J	**0.036** J	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(g,h,i)perylene	0.055	0.010 U	0.011 U	0.011 U	0.010 U	**0.077** J	**0.19** J	0.10 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzofuran	---	0.010 U	0.011 U	**0.044**	0.010 U	**0.010** J	**0.024** J	**0.97**	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total Benzofluoranthenes	0.018	0.021 U	0.022 U	0.022 U	0.021 U	**0.17** J	**0.43** J	0.20 U	0.023 U	0.021 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
TEQ	0.018	ND	ND	ND	ND	**0.145**	**0.369**	ND	ND	**0.00011**	ND	**0.00011**	ND	ND	ND	ND	ND

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-GP-2 XJ62B 10/09/2013	WM-GP-5 XJ62A 10/09/2013	WM-GP-7 XJ62F/ XM52I 10/09/2013	WM-GP-8 XJ62C/ XM52F 10/09/2013	WM-GP-9 XJ17D/J XM52D 10/08/2013	Dup of WM-GP-9 WM-GP-DUP XJ17E/K XM52E 10/08/2013	WM-GP-12 XJ17B/ XM52B 10/08/2013	WM-GP-13 XJ62D/ XM52G 10/09/2013	WM-GP-14 XJ62E/ XM52H 10/09/2013	WM-GP-16 XJ17C/ XM52C 10/08/2013	WM-GP-17 XJ17A/ XM52A 10/08/2013	WM-MW-1 YI69F 4/30/2014	Dup of MW-1 WM-MW-DUP1 YI69I 4/30/2014	WM-MW-1 YQ82E 7/7/2014	WM-MW-2 YI69C YU22B 4/29/2014	WM-MW-2 YQ82C YU21B 7/7/2014
SVOCs (µg/L)																	
Method SW8270D																	
Phenol						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Bis-(2-Chloroethyl) Ether						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2-Chlorophenol						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
1,3-Dichlorobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
1,4-Dichlorobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Benzyl Alcohol						2.0 U	2.0 U	2.0 U		2.0 U		2.0 U					
1,2-Dichlorobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2-Methylphenol						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2,2'-Oxybis(1-Chloropropane)						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
4-Methylphenol						2.0 U	2.0 U	2.0 U		2.0 U		2.0 U					
N-Nitroso-Di-N-Propylamine						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Hexachloroethane						2.0 U	2.0 U	2.0 U		2.0 U		2.0 U					
Nitrobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Isophorone						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2-Nitrophenol						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
2,4-Dimethylphenol						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
Benzoic Acid						20 U	20 U	20 U		20 U		20 U					
bis(2-Chloroethoxy) Methane						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2,4-Dichlorophenol						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
1,2,4-Trichlorobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Naphthalene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
4-Chloroaniline						5.0 U	5.0 U	5.0 U		5.0 U		5.0 U					
Hexachlorobutadiene						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
4-Chloro-3-methylphenol						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
2-Methylnaphthalene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Hexachlorocyclopentadiene						5.0 U	5.0 U	5.0 U		5.0 U		5.0 U					
2,4,6-Trichlorophenol						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
2,4,5-Trichlorophenol						5.0 U	5.0 U	5.0 U		5.0 U		5.0 U					
2-Chloronaphthalene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
2-Nitroaniline						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
Dimethylphthalate						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Acenaphthylene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
3-Nitroaniline						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
Acenaphthene	3.3					1.0 U	1.0 U	**19**		1.0 U		1.0 U					
2,4-Dinitrophenol						20 U	20 U	20 U		20 U		20 U					
4-Nitrophenol	---					10 U	10 U	10 U		10 U		10 U					
Dibenzofuran						1.0 U	1.0 U	**1.1**		1.0 U		1.0 U					
2,6-Dinitrotoluene						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
2,4-Dinitrotoluene						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
Diethylphthalate						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
4-Chlorophenyl-phenylether						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Fluorene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
4-Nitroaniline						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
4,6-Dinitro-2-Methylphenol						10 U	10 U	10 U		10 U		10 U					
N-Nitrosodiphenylamine						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
4-Bromophenyl-phenylether						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Hexachlorobenzene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Pentachlorophenol						10 U	10 U	10 U		10 U		10 U					
Phenanthrene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Carbazole						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Anthracene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Di-n-Butylphthalate						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Fluoranthene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Pyrene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Butylbenzylphthalate						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
3,3'-Dichlorobenzidine						5.0 U	5.0 U	5.0 U		5.0 U		5.0 U					

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

							Dup of WM-GP-9							Dup of MW-1			
	GW	WM-GP-2	WM-GP-5	WM-GP-7	WM-GP-8	WM-GP-9	WM-GP-DUP	WM-GP-12	WM-GP-13	WM-GP-14	WM-GP-16	WM-GP-17	WM-MW-1	WM-MW-DUP1	WM-MW-1	WM-MW-2	WM-MW-2
	Screening	XJ62B	XJ62A	XJ62F/	XJ62C/	XJ17D/J	XJ17E/K	XJ17B/	XJ62D/	XJ62E/	XJ17C/	XJ17A/	YI69F	YI69I	YQ82E	YI69C	YQ82C
	Level			XM52I	XM52F	XM52D	XM52E	XM52B	XM52G	XM52H	XM52C	XM52A				YU22B	YU21B
		10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/08/2013	10/08/2013	10/08/2013	10/09/2013	10/09/2013	10/08/2013	10/08/2013	4/30/2014	4/30/2014	7/7/2014	4/29/2014	7/7/2014
Benzo(a)anthracene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
bis(2-Ethylhexyl)phthalate						3.0 U	3.0 U	3.0 U		3.0 U		3.0 U					
Chrysene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Di-n-Octyl phthalate						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Benzo(a)pyrene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Indeno(1,2,3-cd)pyrene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Dibenz(a,h)anthracene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Benzo(g,h,i)perylene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
1-Methylnaphthalene						1.0 U	1.0 U	1.0 U		1.0 U		1.0 U					
Total Benzofluoranthenes						5.0 U	5.0 U	5.0 U		5.0 U		5.0 U					
VOCs (µg/L)																	
Method SW8260C																	
Chloromethane		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
Bromomethane		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U					
Vinyl Chloride		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Chloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Methylene Chloride		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U					
Acetone		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U					
Carbon Disulfide	---	0.20 U	0.20 U	**0.87**	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.27**	0.20 U	0.20 U					
1,1-Dichloroethene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,1-Dichloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
trans-1,2-Dichloroethene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
cis-1,2-Dichloroethene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Chloroform		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2-Dichloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
2-Butanone		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U					
1,1,1-Trichloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Carbon Tetrachloride		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Vinyl Acetate		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Bromodichloromethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2-Dichloropropane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
cis-1,3-Dichloropropene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Trichloroethene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Dibromochloromethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,1,2-Trichloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Benzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
trans-1,3-Dichloropropene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
2-Chloroethylvinylether		1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 UJ	1.0 UJ	1.0 U	1.0 U	1.0 UJ	1.0 UJ					
Bromoform		0.20 UJ	0.20 UJ	0.20 UJ	0.20 UJ	0.20 U	0.20 U	0.20 U	0.20 UJ	0.20 UJ	0.20 U	0.20 U					
4-Methyl-2-pentanone		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U					
2-Hexanone		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U					
Tetrachloroethene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,1,2,2-Tetrachloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Toluene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Chlorobenzene	100	0.20 U	0.20 U	**0.24**	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Ethylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Styrene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Trichlorofluoromethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
CFC-113		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
m, p-Xylene		0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U					
O-Xylene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2-Dichlorobenzene	6.1	0.20 U	0.20 U	**0.62**	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,3-Dichlorobenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,4-Dichlorobenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Acrolein		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U					
Iodomethane		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U					
Bromoethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-GP-2 XJ62B 10/09/2013	WM-GP-5 XJ62A 10/09/2013	WM-GP-7 XJ62F/ XM52I 10/09/2013	WM-GP-8 XJ62C/ XM52F 10/09/2013	WM-GP-9 XJ17D/J XM52D 10/08/2013	Dup of WM-GP-9 WM-GP-DUP XJ17E/K XM52E 10/08/2013	WM-GP-12 XJ17B/ XM52B 10/08/2013	WM-GP-13 XJ62D/ XM52G 10/09/2013	WM-GP-14 XJ62E/ XM52H 10/09/2013	WM-GP-16 XJ17C/ XM52C 10/08/2013	WM-GP-17 XJ17A/ XM52A 10/08/2013	WM-MW-1 YI69F 4/30/2014	Dup of MW-1 WM-MW-DUP1 YI69I 4/30/2014	WM-MW-1 YQ82E 7/7/2014	WM-MW-2 YI69C YU22B 4/29/2014	WM-MW-2 YQ82C YU21B 7/7/2014
Acrylonitrile		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U					
1,1-Dichloropropene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Dibromomethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,1,1,2-Tetrachloroethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2-Dibromo-3-chloropropane		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
1,2,3-Trichloropropane		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
trans-1,4-Dichloro-2-butene		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U					
1,3,5-Trimethylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2,4-Trimethylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Hexachlorobutadiene		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
1,2-Dibromoethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Bromochloromethane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
2,2-Dichloropropane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,3-Dichloropropane		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Isopropylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
n-Propylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
Bromobenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
2-Chlorotoluene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
4-Chlorotoluene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
tert-Butylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
sec-Butylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
4-Isopropyltoluene	---	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**26**	0.20 U	0.20 U					
n-Butylbenzene		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U					
1,2,4-Trichlorobenzene		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
Naphthalene	---	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	**0.59**	0.50 U	0.50 U	0.50 U	0.50 U					
1,2,3-Trichlorobenzene		0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U					
CONVENTIONALS (mg/L)																	
Method EPA300.0																	
Nitrate	---														1.0 U		1.0 U
Sulfate	---														**63.7**		**780**
FIELD PARAMETERS																	
Temperature (°C)	---	11.99	12.36	13.65	14.55	14.12	14.12	15.07	14.84	14.11	14.21	13.91	9.91	9.91	15.36	9.86	14.03
Conductivity (µS/cm)	---	1,659	211	42,975	32,954	2,737	2,737	30,486	19,873	8,855	30,414	2,057	923	923	4,713	25,645	13,722
Dissolved Oxygen (mg/L)	---	3.59	8.56	0.92	4.40	0.86	0.86	0.28	1.74	1.30	0.55	0.66	2.42	2.42	0.37	3.07	2.07
pH (SU)	---	6.78	9.17	7.51	7.25	6.70	6.70	7.17	7.20	6.82	7.24	6.72	7.37	7.37	7.19	7.82	7.16
ORP (mV)	---	-19.6	41.9	-359.8	-243.4	-251.8	-251.8	-338.6	-342.4	-3191	-333.6	-110.1	-147.2	-147.2	-305.8	-248.1	-128.8
Turbidity (NTU)	---	20.38	26.10	232.7	111.5	263.2	263.2	80.63	20.42	102.9	14.01	11.83	9.86	9.86	0.01	17.24	15.32
Ferrous Iron (mg/L)	---														2.0		1.8

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-MW-3 YI69H YU22F 4/30/2014	WM-MW-3 YQ82F YU21D 7/8/2014	WM-MW-4 YI69G YU22E 4/30/2014	WM-MW-4 YQ82H YU21F 7/8/2014	WM-MW-5 YI69E YU22D 4/29/2014	WM-MW-5 YQ82G YU21E 7/8/2014	WM-MW-6 YI69B 4/29/2014	WM-MW-6 YQ82B 7/7/2014	WM-MW-7 YI69A YU22A 4/29/2014	WM-MW-7 YQ82A YU21A 7/7/2014	WM-MW-8 YI69D YU22C 4/29/2014	WM-MW-8 YQ82D YU21C 7/7/2014	Dup of WM-MW-8 WM-MW-DUP-1 YQ82I 7/7/2014
TOTAL METALS (µg/L)														
Methods EPA200.8/SW7470A														
Arsenic	5	1 U	**0.6** J	**12**	**6**	**6.8**	**9.2**	0.5 U	**0.50** J	**1**	**1.2** J	**2**	**2**	**1.9** J
Cadmium	8.8	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.1 U	0.2 U	**1.0**	**0.3** J	0.5 U	1 U	1 U
Chromium	50	**2**	5 U	**3**	**0.4** J	0.5 U	**0.13** J	0.5 U	**0.1** J	**12**	**34**	**87**	**3.3** J	**1.2** J
Copper	2.4	**5**	5 U(a)	**23**	**11**	**1.0**	**0.8**	**1.5**	1 U	**12**	**3.6** J	**7**	5 U(a)	5 U(a)
Lead	8.1	0.5 U	1 U	**1.6**	1 U	**0.3**	**0.09** J	0.1 U	0.2 U	0.5 U	1 U	0.5 U	**0.6** J	1 U
Mercury	0.15													
Zinc	81	20 U	40 U	20 U	**8** J	4 U	**1.2** J	4 U	**1** J	**30**	**10** J	20 U	40 U	40 U
DISSOLVED METALS (µg/L)														
Methods EPA200.8/SW7470A														
Arsenic	5		**0.6** J	**6**	**4**	**6**	**9**			**1.4** J	**1.3** J	**1.7** J	**1.4** J	
Cadmium	8.8													
Chromium	50											**21**		
Copper	2.4	5 U (a)		5 U (a)	5 U (a)					**2.4** J	**2.5** J	**1.9** J		
Lead	8.1													
Mercury	0.15													
Zinc	81													
TOTAL PETROLEUM HYDROCARBONS (mg/L)														
HCID														
Gasoline	---	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Diesel	---	0.50 U	0.50 U	0.50 U	0.50 U	**> 0.50**	**> 0.50**	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Oil	---	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
NWTPH-Dx														
Diesel Range Organics	0.5					0.10 U	0.10 U							
Lube Oil	0.5					0.20 U	0.20 U							
PCBs (µg/L)														
Method SW8082A														
Aroclor 1016	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1242	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1248	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1254	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1260	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1221	---							0.010 U	0.010 U	0.010 U	0.010 U			
Aroclor 1232	---							0.010 U	0.010 U	0.010 U	0.010 U			
Total PCBs	---							ND	ND	ND	ND			
PAHs (µg/L)														
Method SW8270DSIM														
Naphthalene	83	**0.018**	**0.052**	**0.015**	**0.044**	0.010 U	**0.013**	**0.42**	**0.37**	**0.040**	**0.026**	**0.016**	**0.021**	**0.022**
2-Methylnaphthalene	15	0.010 U	0.010 U	**0.018**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
1-Methylnaphthalene	---	0.010 U	0.010 U	**0.014**	0.010 U	0.010 U	0.010 U	**3.2**	**1.9**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Acenaphthylene	13	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.042**	**0.025**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Acenaphthene	3.3	0.010 U	0.010 U	0.010 U	0.010 U	**0.054**	**0.060**	**6.6**	**4.1**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Fluorene	3	0.010 U	0.010 U	0.010 U	0.010 U	**0.022**	**0.022**	**3.9**	**2.8**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Phenanthrene	6	0.010 U	0.010 U	**0.011**	0.010 U	**0.025**	**0.024**	**2.1**	**2.0**	0.010 U	0.010 U	**0.018**	**0.014**	**0.013**
Anthracene	9.6	0.010 U	0.010 U	0.010 U	0.010 U	**0.012**	0.010 U	**0.073**	**0.086**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Fluoranthene	3.3	0.010 U	0.010 U	0.010 U	0.010 U	**0.028**	**0.031**	**0.25**	**0.32**	**0.013**	0.010 U	**0.011**	0.010 U	0.010 U
Pyrene	15	**0.019**	**0.017**	**0.015**	**0.014**	**0.026**	**0.023**	**0.12**	**0.14**	**0.087**	0.010 U	0.010 U	**0.013**	**0.013**
Benzo(a)anthracene	0.018	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene	0.018	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene	0.018	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Indeno(1,2,3-cd)pyrene	0.01	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

																Dup of WM-MW-8
	GW Screening Level	WM-MW-3	WM-MW-3	WM-MW-4	WM-MW-4	WM-MW-5	WM-MW-5	WM-MW-6	WM-MW-6	WM-MW-7	WM-MW-7	WM-MW-8	WM-MW-8	WM-MW-DUP-1
		YI69H	YQ82F	YI69G	YQ82H	YI69E	YQ82G	YI69B	YQ82B	YI69A	YQ82A	YI69D	YQ82D	YQ82I
		YU22F	YU21D	YU22E	YU21F	YU22D	YU21E			YU22A	YU21A	YU22C	YU21C	
		4/30/2014	7/8/2014	4/30/2014	7/8/2014	4/29/2014	7/8/2014	4/29/2014	7/7/2014	4/29/2014	7/7/2014	4/29/2014	7/7/2014	7/7/2014
Dibenz(a,h)anthracene	0.01	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(g,h,i)perylene	0.055	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzofuran	---	0.010 U	0.010 U	**0.013**	**0.013**	0.010 U	0.010 U	**3.7**	**2.4**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total Benzofluoranthenes	0.018	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
TEQ	0.018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-MW-3 YI69H YU22F 4/30/2014	WM-MW-3 YQ82F YU21D 7/8/2014	WM-MW-4 YI69G YU22E 4/30/2014	WM-MW-4 YQ82H YU21F 7/8/2014	WM-MW-5 YI69E YU22D 4/29/2014	WM-MW-5 YQ82G YU21E 7/8/2014	WM-MW-6 YI69B 4/29/2014	WM-MW-6 YQ82B 7/7/2014	WM-MW-7 YI69A YU22A 4/29/2014	WM-MW-7 YQ82A YU21A 7/7/2014	WM-MW-8 YI69D YU22C 4/29/2014	WM-MW-8 YQ82D YU21C 7/7/2014	Dup of WM-MW-8 WM-MW-DUP-1 YQ82I 7/7/2014
SVOCs (µg/L)														
Method SW8270D														
Phenol								1.0 U	1.0 U					
Bis-(2-Chloroethyl) Ether								1.0 U	1.0 U					
2-Chlorophenol								1.0 U	1.0 U					
1,3-Dichlorobenzene								1.0 U	1.0 U					
1,4-Dichlorobenzene								1.0 U	1.0 U					
Benzyl Alcohol								2.0 U	2.0 U					
1,2-Dichlorobenzene								1.0 U	1.0 U					
2-Methylphenol								1.0 U	1.0 U					
2,2'-Oxybis(1-Chloropropane)								1.0 U	1.0 UJ					
4-Methylphenol								2.0 U	2.0 U					
N-Nitroso-Di-N-Propylamine								1.0 U	1.0 U					
Hexachloroethane								2.0 U	2.0 U					
Nitrobenzene								1.0 U	1.0 U					
Isophorone								1.0 U	1.0 U					
2-Nitrophenol								3.0 U	3.0 U					
2,4-Dimethylphenol								3.0 U	3.0 U					
Benzoic Acid								20 U	20 UJ					
bis(2-Chloroethoxy) Methane								1.0 U	1.0 U					
2,4-Dichlorophenol								3.0 U	3.0 U					
1,2,4-Trichlorobenzene								1.0 U	1.0 U					
Naphthalene								1.0 U	1.0 U					
4-Chloroaniline								5.0 U	5.0 U					
Hexachlorobutadiene								3.0 U	3.0 U					
4-Chloro-3-methylphenol								3.0 U	3.0 U					
2-Methylnaphthalene								1.0 U	1.0 U					
Hexachlorocyclopentadiene								5.0 U	5.0 U					
2,4,6-Trichlorophenol								3.0 U	3.0 U					
2,4,5-Trichlorophenol								5.0 U	5.0 U					
2-Chloronaphthalene								1.0 U	1.0 U					
2-Nitroaniline								3.0 U	3.0 U					
Dimethylphthalate								1.0 U	1.0 U					
Acenaphthylene								1.0 U	1.0 U					
3-Nitroaniline								3.0 UJ	3.0 UJ					
Acenaphthene	3.3							**5.0**	**3.4**					
2,4-Dinitrophenol								20 U	20 U					
4-Nitrophenol	---							10 U	10 U					
Dibenzofuran								**3.0**	**2.2**					
2,6-Dinitrotoluene								3.0 U	3.0 U					
2,4-Dinitrotoluene								3.0 U	3.0 U					
Diethylphthalate								1.0 U	1.0 U					
4-Chlorophenyl-phenylether								1.0 U	1.0 U					
Fluorene								**2.9**	**2.4**					
4-Nitroaniline								3.0 UJ	3.0 U					
4,6-Dinitro-2-Methylphenol								10 U	10 U					
N-Nitrosodiphenylamine								1.0 U	1.0 U					
4-Bromophenyl-phenylether								1.0 U	1.0 U					
Hexachlorobenzene								1.0 U	1.0 U					
Pentachlorophenol								10 U	10 U					
Phenanthrene								**1.5**	**2.1**					
Carbazole								**2.2** J	**2.2** J					
Anthracene								1.0 U	1.0 U					
Di-n-Butylphthalate								1.0 U	1.0 U					
Fluoranthene								1.0 U	1.0 U					
Pyrene								1.0 U	1.0 U					
Butylbenzylphthalate								1.0 U	1.0 U					
3,3'-Dichlorobenzidine								5.0 U	5.0 U					

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	GW Screening Level	WM-MW-3 YI69H YU22F 4/30/2014	WM-MW-3 YQ82F YU21D 7/8/2014	WM-MW-4 YI69G YU22E 4/30/2014	WM-MW-4 YQ82H YU21F 7/8/2014	WM-MW-5 YI69E YU22D 4/29/2014	WM-MW-5 YQ82G YU21E 7/8/2014	WM-MW-6 YI69B 4/29/2014	WM-MW-6 YQ82B 7/7/2014	WM-MW-7 YI69A YU22A 4/29/2014	WM-MW-7 YQ82A YU21A 7/7/2014	WM-MW-8 YI69D YU22C 4/29/2014	WM-MW-8 YQ82D YU21C 7/7/2014	Dup of WM-MW-8 WM-MW-DUP-1 YQ82I 7/7/2014
Benzo(a)anthracene								1.0 U	1.0 U					
bis(2-Ethylhexyl)phthalat								3.0 U	3.0 U					
Chrysene								1.0 U	1.0 U					
Di-n-Octyl phthalate								1.0 U	1.0 U					
Benzo(a)pyrene								1.0 U	1.0 U					
Indeno(1,2,3-cd)pyrene								1.0 U	1.0 U					
Dibenz(a,h)anthracene								1.0 U	1.0 U					
Benzo(g,h,i)perylene								1.0 U	1.0 U					
1-Methylnaphthalene								**2.5**	**1.5** J					
Total Benzofluoranthenes								2.0 U	2.0 U					
VOCs (µg/L)														
Method SW8260C														
Chloromethane														
Bromomethane														
Vinyl Chloride														
Chloroethane														
Methylene Chloride														
Acetone														
Carbon Disulfide	---													
1,1-Dichloroethene														
1,1-Dichloroethane														
trans-1,2-Dichloroethene														
cis-1,2-Dichloroethene														
Chloroform														
1,2-Dichloroethane														
2-Butanone														
1,1,1-Trichloroethane														
Carbon Tetrachloride														
Vinyl Acetate														
Bromodichloromethane														
1,2-Dichloropropane														
cis-1,3-Dichloropropene														
Trichloroethene														
Dibromochloromethane														
1,1,2-Trichloroethane														
Benzene														
trans-1,3-Dichloropropene														
2-Chloroethylvinylether														
Bromoform														
4-Methyl-2-pentanone														
2-Hexanone														
Tetrachloroethene														
1,1,2,2-Tetrachloroethane														
Toluene														
Chlorobenzene	100													
Ethylbenzene														
Styrene														
Trichlorofluoromethane														
CFC-113														
m, p-Xylene														
O-Xylene														
1,2-Dichlorobenzene	6.1													
1,3-Dichlorobenzene														
1,4-Dichlorobenzene														
Acrolein														
Iodomethane														
Bromoethane														

TABLE 8
ANALYTICAL RESULTS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

														Dup of WM-MW-8
	GW	WM-MW-3	WM-MW-3	WM-MW-4	WM-MW-4	WM-MW-5	WM-MW-5	WM-MW-6	WM-MW-6	WM-MW-7	WM-MW-7	WM-MW-8	WM-MW-8	WM-MW-DUP-1
	Screening	YI69H	YQ82F	YI69G	YQ82H	YI69E	YQ82G	YI69B	YQ82B	YI69A	YQ82A	YI69D	YQ82D	YQ82I
	Level	YU22F	YU21D	YU22E	YU21F	YU22D	YU21E			YU22A	YU21A	YU22C	YU21C	
		4/30/2014	7/8/2014	4/30/2014	7/8/2014	4/29/2014	7/8/2014	4/29/2014	7/7/2014	4/29/2014	7/7/2014	4/29/2014	7/7/2014	7/7/2014
Acrylonitrile														
1,1-Dichloropropene														
Dibromomethane														
1,1,1,2-Tetrachloroethane														
1,2-Dibromo-3-chloropropane														
1,2,3-Trichloropropane														
trans-1,4-Dichloro-2-butene														
1,3,5-Trimethylbenzene														
1,2,4-Trimethylbenzene														
Hexachlorobutadiene														
1,2-Dibromoethane														
Bromochloromethane														
2,2-Dichloropropane														
1,3-Dichloropropane														
Isopropylbenzene														
n-Propylbenzene														
Bromobenzene														
2-Chlorotoluene														
4-Chlorotoluene														
tert-Butylbenzene														
sec-Butylbenzene														
4-Isopropyltoluene	---													
n-Butylbenzene														
1,2,4-Trichlorobenzene														
Naphthalene	---													
1,2,3-Trichlorobenzene														
CONVENTIONALS (mg/L)														
Method EPA300.0														
Nitrate	---		5.0 U		2.0 U		0.1 U		0.1 U		5.0 U		**5.2**	5.0 U
Sulfate	---		**1,430**		**1,070**		**0.4**		**451**		**1,810**		**1,690**	**1,700**
FIELD PARAMETERS														
Temperature (°C)	---	10.20	13.86	9.60	14.54	11.94	17.29	10.91	14.94	10.77	15.98	12.35	17.34	17.34
Conductivity (µS/cm)	---	40,608	23,772	26,671	18,658	1,494	926	4,755	4,759	53,388	32,946	48,606	31,308	31,308
Dissolved Oxygen (mg/L)	---	0.79	1.77	2.14	1.48	3.99	2.41	8.46	0.83	2.59	2.50	4.94	0.28	0.28
pH (SU)	---	7.59	7.53	7.29	7.08	6.92	7.03	7.00	6.93	7.58	7.30	8.07	7.50	7.50
ORP (mV)	---	-295.6	-272.4	-283.7	-236.5	-136.0	-139.2	-99.0	-46.9	-11.9	60.2	-157.5	-273.4	-273.4
Turbidity (NTU)	---	6.70	1.14	4.92	4.33	21.74	5.08	17.94	10.57	20.28	13.33	2.91	1.31	1.31
Ferrous Iron (mg/L)	---		0		1.5		6.0		2.4		0		0	

U = The compound was not detected at the reported concentration.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ = The analyte was not detected in the sample; the reported sample detection limit is an estimate
M = An estimated value of analyte found and confirmed by analyst, but with low spectral match
Bold = Detected compound.
Box = Exceedance of cleanup level.
(a) = Analytical laboratory confirms copper was not detected above 1.6 ppb in these samples

TABLE 9
SUMMARY STATISTICS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No. of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
TOTAL/DISSOLVED METALS (µg/L)									
Arsenic, Diss	11	11	100%	All Detects	All Detects	0.6	9	3	27%
Chromium, Diss	1	1	100%	All Detects	All Detects	21	21	0	0%
Copper, Diss	7	2	29%	All Detects	All Detects	1.9	2.5	2	29%
TPH (mg/L)									
Lube Oil	3	0	29%	0.2	0.2	No Detects	No Detects	0	0%
Diesel Range Organics	3	0	46%	0.1	0.1	No Detects	No Detects	0	0%
PCBS (µg/L)									
Aroclor 1016	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1221	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1232	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1242	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1248	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1254	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
Aroclor 1260	4	0	0%	0.01	0.01	No Detects	No Detects	N/A	N/A
SVOCS (µg/L)									
Acenaphthene	2	2	100%	All Detects	All Detects	3.4	5.0	2	100%
Dibenzofuran	2	2	100%	All Detects	All Detects	2.2	3.0	0	0%
1-Methylnaphthalene	2	2	100%	All Detects	All Detects	1.5	2.5	0	0%
Carbazole	2	2	100%	All Detects	All Detects	2.2	2.2	0	0%
Fluorene	2	2	100%	All Detects	All Detects	2.4	2.9	0	0%
Phenanthrene	2	2	100%	All Detects	All Detects	1.5	2.1	0	0%
1,2,4-Trichlorobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
1,2-Dichlorobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
1,3-Dichlorobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
1,4-Dichlorobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2,2'-Oxybis(1-Chloropropan	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2,4,5-Trichlorophenol	2	0	0%	5	5	No Detects	No Detects	N/A	N/A
2,4,6-Trichlorophenol	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2,4-Dichlorophenol	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2,4-Dimethylphenol	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2,4-Dinitrophenol	2	0	0%	20	20	No Detects	No Detects	N/A	N/A
2,4-Dinitrotoluene	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2,6-Dinitrotoluene	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2-Chloronaphthalene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2-Chlorophenol	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2-Methylnaphthalene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2-Methylphenol	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
2-Nitroaniline	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
2-Nitrophenol	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
3,3'-Dichlorobenzidine	2	0	0%	5	5	No Detects	No Detects	N/A	N/A
3-Nitroaniline	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
4,6-Dinitro-2-Methylphenol	2	0	0%	10	10	No Detects	No Detects	N/A	N/A
4-Bromophenyl-phenylether	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
4-Chloro-3-methylphenol	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
4-Chloroaniline	2	0	0%	5	5	No Detects	No Detects	N/A	N/A
4-Chlorophenyl-phenylether	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
4-Methylphenol	2	0	0%	2	2	No Detects	No Detects	N/A	N/A
4-Nitroaniline	2	0	0%	3	3	No Detects	No Detects	N/A	N/A

TABLE 9
SUMMARY STATISTICS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No. of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
4-Nitrophenol	2	0	0%	10	10	No Detects	No Detects	N/A	N/A
Acenaphthylene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Anthracene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Benzo(a)anthracene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Benzo(a)pyrene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Benzo(g,h,i)perylene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Benzoic Acid	2	0	0%	20	20	No Detects	No Detects	N/A	N/A
Benzyl Alcohol	2	0	0%	2	2	No Detects	No Detects	N/A	N/A
bis(2-Chloroethoxy) Methan	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Bis-(2-Chloroethyl) Ether	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
bis(2-Ethylhexyl)phthalate	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
Butylbenzylphthalate	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Chrysene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Dibenz(a,h)anthracene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Diethylphthalate	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Dimethylphthalate	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Di-n-Butylphthalate	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Di-n-Octyl phthalate	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Fluoranthene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Hexachlorobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Hexachlorobutadiene	2	0	0%	3	3	No Detects	No Detects	N/A	N/A
Hexachlorocyclopentadiene	2	0	0%	5	5	No Detects	No Detects	N/A	N/A
Hexachloroethane	2	0	0%	2	2	No Detects	No Detects	N/A	N/A
Indeno(1,2,3-cd)pyrene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Isophorone	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Naphthalene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Nitrobenzene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
N-Nitroso-Di-N-Propylamine	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
N-Nitrosodiphenylamine	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Pentachlorophenol	2	0	0%	10	10	No Detects	No Detects	N/A	N/A
Phenol	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Pyrene	2	0	0%	1	1	No Detects	No Detects	N/A	N/A
Total Benzofluoranthenes	2	0	0%	2	5	No Detects	No Detects	N/A	N/A
SVOC-SIM (µg/L)									
Naphthalene	18	16	89%	0.01	0.01	0.01	0.42	0	0%
Pyrene	18	14	78%	0.01	0.01	0.013	0.14	0	0%
Phenanthrene	18	11	61%	0.01	0.01	0.011	2.1	0	0%
Acenaphthene	18	7	39%	0.01	0.01	0.016	6.6	2	11%
Fluoranthene	18	8	44%	0.01	0.01	0.011	0.32	0	0%
Fluorene	18	7	39%	0.01	0.01	0.011	3.9	1	6%
Dibenzofuran	18	4	22%	0.01	0.01	0.013	3.7	N/A	N/A
1-Methylnaphthalene	18	3	17%	0.01	0.01	0.014	3.2	N/A	N/A
Anthracene	18	3	17%	0.01	0.01	0.012	0.086	0	0%
2-Methylnaphthalene	18	1	6%	0.01	0.01	0.018	0.018	0	0%
Acenaphthylene	18	2	11%	0.01	0.01	0.025	0.042	0	0%
Chrysene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Benzo(a)anthracene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Benzo(a)pyrene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Benzo(g,h,i)perylene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Dibenz(a,h)anthracene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Indeno(1,2,3-cd)pyrene	18	0	0%	0.01	0.01	No Detects	No Detects	0	0%
Total Benzofluoranthenes	18	0	0%	0.02	0.2	No Detects	No Detects	0	0%

TABLE 9
SUMMARY STATISTICS – GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No. of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
CONVENTIONALS (mg/L)									
Nitrate	8	1	13%	0.1	5	5.2	5.2	N/A	N/A

N/A = Not applicable.

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-HA-1 0-0.75 XJ14A 10/8/2013	WM-HA-1 1-1.5 XM23A 10/08/2013	WM-HA-1 2-2.5 XM23B 10/08/2013	WM-HA-1 3-4 XO58A/XT02A 10/08/2013	WM-GP-2 0-1 XJ56G 10/09/2013	WM-GP-2 1-2 XM22C 10/09/2013	WM-GP-2 2-3 XM22D 10/09/2013	WM-GP-2 5-6 XO58C 10/09/2013	WM-GP-3 0.4-1.4 XJ56I 10/09/2013	WM-GP-3 1.4-2.4 XV37C 10/09/2013	WM-GP-3 2.4-3.4 XV37E 10/09/2013	WM-GP-3 5-6 YK90D 10/09/2013	WM-GP-4 0.4-1.4 XJ56H 10/09/2013	WM-GP-4 1.4-2.4 XM22E/XV37B 10/09/2013	WM-GP-4 2.4-3.4 XV37F 10/09/2013	WM-GP-4 5-6 YK90C 10/09/2013	WM-GP-5 0-1 XJ56F 10/09/2013	WM-GP-5 1-2 XM22A 10/09/2013	WM-GP-5 2-3 XM22B 10/09/2013	WM-GP-6 0.5-1.5 XJ56Q 10/10/2013	WM-GP-6 1.5-2.5 XV37A 10/10/2013
TOTAL METALS (mg/kg)																						
Methods EPA200.8/																						
SW6010C/SW7471A																						
Arsenic	20	**4.2**	**3.1**	**5.9**		**10.0**	**13.5**	**9.3**	**2.5**	**2.6**	**2.9**	**2.2**	**2.4**	**2.7**	**3.9**	**5.2**		**3.8**	**3.1**	**3.0**	**2.7** J	**3.5**
Cadmium	80	**0.5**	**0.2**	**0.5**		**0.6**	**0.7**	**0.2**		**0.1**	**0.1**	**0.1**		**0.2**	**0.1**	**0.2**		**0.3**	**0.1**	0.1 U	**0.2**	**0.2**
Chromium	2000	**21.4** J	**14.4**	**21.4**		**16.0**	**19.7**	**29.9**		**17.0**	**15.3**	**11.2**		**18.7**	**12.9**	**21.1**		**21.2**	**18.7**	**16.4**	**17.1**	**15.8**
Copper	3,200	**150** J	**72.3**	**284**	**52.2**	**778**	**480**	**128**	**37.4**	**18.9**	**11.7**	**5.7**	**7.7**	**52.1**	**19.7**	**19.8**	**13.2**	**87.2**	**26.9**	**17.1**	**32.5**	**12.4**
Lead	250	**42.2** J	**16.9**	**43.1**		**103**	**56.1**	**15.0**		**4.2**	**1.7**	**1.0**		**3.1**	**2.3**	**2.7**		**51.1**	**4.3**	**2.6**	**5.1** J	**1.8**
Mercury	2	**0.06**	**0.10**	**0.47**	**0.07** J	**2.21**	**2.3**	**0.25**	**0.16** J	**0.03**	0.02 UJ	0.02 UJ	0.02 UJ	**0.03**	**0.11** J	**0.06** J	**0.03** J	**0.14**	**0.03**	**0.02**	0.02 U	**0.03** J
Zinc	24,000	**671**	**83**	**128**	**59**	**282**	**186**	**90**		**32**	**30**	**20**	**23**	**83**	**33**	**42**		**112**	**47**	**32**	**41**	**31**
TOTAL PETROLEUM																						
HYDROCARBONS (mg/kg)																						
HCID																						
Gasoline	---	<20				<20				<20				<20				<20			<20	
Diesel	---	<50				**>50**				<50				<50				<50			<50	
Oil	---	**>100**				**>100**				<100				**>100**				<100			<100	
NWTPH-Dx																						
Diesel Range Organics	2000	**43**	**30**	**33**		**91**	**47**	**9.7**					6.2 U	**20**					5.3 U	5.4 U		
Lube Oil	2000	**160**	**160**	**120**		**250**	**480**	**41**					12 U	**190**					**14**	**13**		
NWTPH-Gx																						
Gasoline	30/100 (a)																					
PAHs (µg/kg)																						
Method SW8270DSIM																						
Naphthalene	2,300	4.8 U	4.7 UJ	**12** J	**12**	**23**	14 UJ	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**5.5**	4.8 UJ	5.0 UJ	4.9 U	
2-Methylnaphthalene	320,000	4.8 U	**5.3** J	**12** J	**16**	**24**	14 UJ	4.8 UJ		4.8 U			4.7 U	**11**			**15**	4.8 U	4.8 UJ	5.0 UJ	4.9 U	
1-Methylnaphthalene	35,000	4.8 U	4.7 UJ	**5.4** J	**6.0**	**17**	14 UJ	4.8 UJ		4.8 U			4.7 U	9.6 U			**11**	4.8 U	4.8 UJ	5.0 UJ	4.9 U	
Acenaphthylene	---	4.8 U	4.7 UJ	4.8 UJ	4.6 U	**42**	14 UJ	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	4.8 U	4.8 UJ	5.0 UJ	4.9 U	
Acenaphthene	340	4.8 U	4.7 UJ	**15** J	4.6 U	**100**	14 U	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**6.8**	4.8 UJ	5.0 UJ	4.9 U	
Fluorene	470	4.8 U	4.7 UJ	**11** J	4.6 U	**260**	14 UJ	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**6.9**	4.8 UJ	5.0 UJ	4.9 U	
Phenanthrene	---	**34**	**5.5** J	**230** J	**6.3**	**2,600**	**120** J	**9.3** J		4.8 U			**6.1**	**17**			**29**	**76**	4.8 UJ	5.0 UJ	4.9 U	
Anthracene	4500	**7.0**	4.7 UJ	**38** J	4.6 U	**350**	**15** J	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**15**	4.8 UJ	5.0 UJ	4.9 U	
Fluoranthene	3200	**86**	**13** J	**360** J	**6.4**	**4,100**	**230** J	**5.3** J		4.8 U			**9.0**	9.6 U			**16**	**97**	4.8 UJ	5.0 UJ	4.9 U	
Pyrene	20000	**71**	**14** J	**300** J	**6.5**	**3,700**	**150** J	**9.9** J		4.8 U			**8.2**	9.6 U			**14**	**74**	4.8 UJ	**5.6** J	4.9 U	
Benzo(a)anthracene	130	**41**	**5.9** J	**140** J	4.6 U	**1,400**	**85** J	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**42**	4.8 UJ	5.0 UJ	4.9 U	
Chrysene	140	**70**	**8.6** J	**190** J	**5.1**	**2,300**	**140** J	**6.4** J		4.8 U			4.7 U	**14**			**20**	**43**	4.8 UJ	5.0 UJ	4.9 U	
Benzo(a)pyrene	350	**53**	**5.0** J	**120** J	4.6 U	**1,200**	**110** J	4.8 UJ		**11**			4.7 U	**24**			9.3 U	**38**	4.8 UJ	5.0 UJ	4.9 U	
Indeno(1,2,3-cd)pyrene	700	**52**	**5.6** J	**78** J	4.6 U	**820**	**78** J	**4.8** J		4.8 U			4.7 U	9.6 U			9.3 U	**32**	4.8 UJ	5.0 UJ	4.9 U	
Dibenz(a,h)anthracene	140	**34**	4.7 UJ	**26** J	4.6 U	**190**	**19** J	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	**30**	4.8 UJ	5.0 UJ	4.9 U	
Benzo(g,h,i)perylene	---	**56**	**7.9** J	**88** J	**4.9**	**610**	**97** J	**8.2** J		4.8 U			4.7 U	**14**			**27**	**20**	4.8 UJ	5.0 UJ	4.9 U	
Dibenzofuran	---	4.8 U	4.7 UJ	**6.7** UJ	4.6 U	**99**	14 UJ	4.8 UJ		4.8 U			4.7 U	9.6 U			9.3 U	4.8 U	4.8 UJ	5.0 UJ	4.9 U	
Total Benzofluoranthenes	430	**150**	**26** J	**260** J	**8.3**	**3,300**	**300** J	**19** J		4.8 U			**5.8**	9.6 U			**9.8**	**75**	**12** J	**14** J	4.9 U	
TEQ	140	**81**	**8.8** J	**172** J	**0.9**	**1,794**	**160** J	**2.4** J		**11**			**0.58**	**24.1**			**1.18**	**56**	**1.2** J	**1.4** J	ND	
PCBs (µg/kg)																						
Method SW8082A																						
Aroclor 1016	33																					
Aroclor 1242	---																					
Aroclor 1248	---																					
Aroclor 1254	500																					
Aroclor 1260	490																					
Aroclor 1221	---																					
Aroclor 1232	---																					
Aroclor 1262	---																					
Aroclor 1268	---																					
Total PCBs	160																					
VOLATILES (µg/kg)																						
Method SW8260C																						
Chloromethane	---																					
Bromomethane																						
Vinyl Chloride																						
Chloroethane																						
Methylene Chloride	2,600																					
Acetone	72,000,000																					
Carbon Disulfide	8,000,000																					
1,1-Dichloroethene																						
1,1-Dichloroethane																						
trans-1,2-Dichloroethene																						

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-HA-1	WM-HA-1	WM-HA-1	WM-HA-1	WM-GP-2	WM-GP-2	WM-GP-2	WM-GP-2	WM-GP-3	WM-GP-3	WM-GP-3	WM-GP-3	WM-GP-4	WM-GP-4	WM-GP-4	WM-GP-4	WM-GP-5	WM-GP-5	WM-GP-5	WM-GP-6	WM-GP-6
		0-0.75	1-1.5	2-2.5	3-4	0-1	1-2	2-3	5-6	0.4-1.4	1.4-2.4	2.4-3.4	5-6	0.4-1.4	1.4-2.4	2.4-3.4	5-6	0-1	1-2	2-3	0.5-1.5	1.5-2.5
		XJ14A	XM23A	XM23B	XO58A/XT02A	XJ56G	XM22C	XM22D	XO58C	XJ56I	XV37C	XV37E	YK90D	XJ56H	XM22E/XV37B	XV37F	YK90C	XJ56F	XM22A	XM22B	XJ56Q	XV37A
		10/8/2013	10/08/2013	10/08/2013	10/08/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/10/2013	10/10/2013
cis-1,2-Dichloroethene																						
Chloroform																						
1,2-Dichloroethane																						
2-Butanone	48,000,000																					
1,1,1-Trichloroethane																						
Carbon Tetrachloride																						
Vinyl Acetate																						
Bromodichloromethane																						
1,2-Dichloropropane																						
cis-1,3-Dichloropropene																						
Trichloroethene																						
Dibromochloromethane																						
1,1,2-Trichloroethane																						
Benzene	130																					
trans-1,3-Dichloropropene																						
2-Chloroethylvinylether																						
Bromoform																						
4-Methyl-2-pentanone																						
2-Hexanone																						
Tetrachloroethene																						
1,1,2,2-Tetrachloroethane																						
Toluene	110,000																					
Chlorobenzene																						
Ethylbenzene																						
Styrene																						
Trichlorofluoromethane																						
CFC-113																						
m, p-Xylene	---																					
o-Xylene																						
1,2-Dichlorobenzene																						
1,3-Dichlorobenzene																						
1,4-Dichlorobenzene																						
Acrolein																						
Iodomethane																						
Bromoethane																						
Acrylonitrile																						
1,1-Dichloropropene																						
Dibromomethane																						
1,1,1,2-Tetrachloroethane																						
1,2-Dibromo-3-chloropropane																						
1,2,3-Trichloropropane																						
trans-1,4-Dichloro-2-butene																						
1,3,5-Trimethylbenzene																						
1,2,4-Trimethylbenzene																						
Hexachlorobutadiene																						
1,2-Dibromoethane																						
Bromochloromethane																						
2,2-Dichloropropane																						
1,3-Dichloropropane																						
Isopropylbenzene	8,000,000																					
n-Propylbenzene	8,000,000																					
Bromobenzene																						
2-Chlorotoluene																						
4-Chlorotoluene																						
tert-Butylbenzene																						
sec-Butylbenzene	---																					
4-Isopropyltoluene	---																					
n-Butylbenzene																						
1,2,4-Trichlorobenzene																						
Naphthalene	2,300																					
1,2,3-Trichlorobenzene																						
SEMIVOLATILES (µg/kg)																						
Method SW8270D																						
Phenol	2,700																					
Bis-(2-Chloroethyl) Ether																						
2-Chlorophenol																						
1,3-Dichlorobenzene																						
1,4-Dichlorobenzene																						
Benzyl Alcohol	8,000,000																					
1,2-Dichlorobenzene																						

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-HA-1	WM-HA-1	WM-HA-1	WM-HA-1	WM-GP-2	WM-GP-2	WM-GP-2	WM-GP-2	WM-GP-3	WM-GP-3	WM-GP-3	WM-GP-3	WM-GP-4	WM-GP-4	WM-GP-4	WM-GP-4	WM-GP-5	WM-GP-5	WM-GP-5	WM-GP-6	WM-GP-6
		0-0.75	1-1.5	2-2.5	3-4	0-1	1-2	2-3	5-6	0.4-1.4	1.4-2.4	2.4-3.4	5-6	0.4-1.4	1.4-2.4	2.4-3.4	5-6	0-1	1-2	2-3	0.5-1.5	1.5-2.5
		XJ14A	XM23A	XM23B	XO58A/XT02A	XJ56G	XM22C	XM22D	XO58C	XJ56I	XV37C	XV37E	YK90D	XJ56H	XM22E/XV37B	XV37F	YK90C	XJ56F	XM22A	XM22B	XJ56Q	XV37A
		10/8/2013	10/08/2013	10/08/2013	10/08/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/10/2013	10/10/2013
2-Methylphenol																						
2,2'-Oxybis(1-Chloropropane)																						
4-Methylphenol	400,000																					
N-Nitroso-Di-N-Propylamine																						
Hexachloroethane																						
Nitrobenzene																						
Isophorone																						
2-Nitrophenol																						
2,4-Dimethylphenol																						
Benzoic Acid																						
bis(2-Chloroethoxy) Methane																						
2,4-Dichlorophenol																						
1,2,4-Trichlorobenzene																						
Naphthalene	2,300																					
4-Chloroaniline																						
Hexachlorobutadiene																						
4-Chloro-3-methylphenol																						
2-Methylnaphthalene																						
Hexachlorocyclopentadiene																						
2,4,6-Trichlorophenol																						
2,4,5-Trichlorophenol																						
2-Chloronaphthalene																						
2-Nitroaniline																						
Dimethylphthalate	---																					
Acenaphthylene	---																					
3-Nitroaniline																						
Acenaphthene	340																					
2,4-Dinitrophenol																						
4-Nitrophenol																						
Dibenzofuran	80,000																					
2,6-Dinitrotoluene																						
2,4-Dinitrotoluene																						
Diethylphthalate	4,200																					
4-Chlorophenyl-phenylether																						
Fluorene	470																					
4-Nitroaniline																						
4,6-Dinitro-2-Methylphenol																						
N-Nitrosodiphenylamine																						
4-Bromophenyl-phenylether																						
Hexachlorobenzene																						
Pentachlorophenol	160																					
Phenanthrene	---																					
Carbazole	---																					
Anthracene	4,500																					
Di-n-Butylphthalate	5,000																					
Fluoranthene	3,200																					
Pyrene	20,000																					
Butylbenzylphthalate	280																					
3,3'-Dichlorobenzidine																						
Benzo(a)anthracene	130																					
bis(2-Ethylhexyl)phthalate	6,600																					
Chrysene	140																					
Di-n-Octyl phthalate																						
Benzo(a)pyrene	350																					
Indeno(1,2,3-cd)pyrene	700																					
Dibenz(a,h)anthracene	140																					
Benzo(g,h,i)perylene	---																					
1-Methylnaphthalene	35,000																					
Total Benzofluoranthenes	430																					
ORGANOTINS (µg/kg)																						
KRONE88																						
Tributyltin Ion	---																	3.4 U	3.4 U	3.5 U	3.4 U	
Dibutyltin Ion	---																	5.1 U	5.1 U	5.3 U	5.2 U	
Butyltin Ion	---																	**4.0**	3.6 U	3.7 U	3.6 U	
CONVENTIONALS (%)																						
Total Solids (SM2540B)	---																					
Total Organic Carbon (PLUMB81TC)	---																					

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-6	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-8	WM-GP-8	WM-GP-9	WM-GP-9	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11
		2.5-3.5	0.5-1.5	1.5-2.5	5-6	8-9	10-11	0.7-1.7	5-6	0-1.5	5-6.5	0-1	1-2	2-3	3-4	0-1	1-2	2-3	3-4	5-6	7-8
		XV37G	XJ56M/YH46C	XM22J	XM22K	XJ56C	XM22L	XJ56J	YN60D	XJ14F	YN60C	XJ56O/YH46E	XM22P	XO58G/XT02B	XR13C	XJ56N/YH46D	XM22M	XR13B	XM22N/XO58F	XJ56D	XM22O
		10/10/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/8/2013	10/8/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013
TOTAL METALS (mg/kg)																					
Methods EPA200.8/																					
SW6010C/SW7471A																					
Arsenic	20	**5.0**	**3.1**		**11.9**	**12.3**	**8.7**	**6.7**	**3.0**	**2.2**	**3.5**	**17.6**	**9.2**	**4.2**	**15.9**	**6.7**			**2.9**	**2.8**	
Cadmium	80	**0.2**	**0.2**			**0.4**		**0.1**	**0.2**	**0.1**	**0.2**	**0.7**				**0.5**				**0.2**	
Chromium	2000	**18.0**	**16.2**			**74.0**		**23.4**	**18.8**	**13.5**	**16.7**	**34.4**				**22.2**				**17.4**	
Copper	3,200	**18.9**	**55.1**	**1,540**	**186**	**358**	**257**	**30.2**	**17.0**	**32.2**	**16.9**	**1,600**	**301**	**113**	**179**	**554**	**160**	**26.4**	**16.5**	**36.0**	
Lead	250	**2.3**	**5.6**			**41.8**		**3.4**	**2.1**	**1.9**	**6.6**	**138**				**81.6**				**12.0**	
Mercury	2	**0.04** J	**0.18**	**1.62**	**2.6**	**0.69**	**1.08**	**0.03**	0.03 UJ	0.02 U	0.02 UJ	**2.04**	**0.55**	**0.03** J		**1.00**	**2.3**	**0.04** J	0.03 UJ	**0.07**	
Zinc	24,000	**40**	**46**		**106**	**223**	**217**	**49**	**34**	**59**	**36**	**1,640**	**264**	**112**	**1,450**	**318**	**78**			**44**	
TOTAL PETROLEUM																					
HYDROCARBONS (mg/kg)																					
HCID																					
Gasoline	---		<20			<20		<20		<20		<20				<20				**>20**	
Diesel	---		<50			**>50**		<50		<50		**>50**				**>50**				**>50**	
Oil	---		**>100**			**>100**		**>100**		<100		**>100**				**>100**				**>100**	
NWTPH-Dx																					
Diesel Range Organics	2000		**24**			**64**		**65**				**300**				**170**			**16**	**4,000**	**8.7**
Lube Oil	2000		**110**			**140**		**200**				**940**				**220**			11 U	**710**	12 U
NWTPH-Gx																					
Gasoline	30/100 (a)					6.6 U														**11**	
PAHs (µg/kg)																					
Method SW8270DSIM																					
Naphthalene	2,300		4.9 U		**15** J	**36**	**8.6** J	9.7 U	14 U	4.8 U	48 U	13 U	**7.6** J			**12**	**79** J		**14** J	30 U	**57** J
2-Methylnaphthalene	320,000		4.9 U		**12** J	**46**	**8.9** J	9.7 U		4.8 U		13 U	4.6 UJ			**19**	**25** J		**20** J	**140**	**10** J
1-Methylnaphthalene	35,000		4.9 U		**10** J	**14**	14 UJ	9.7 U		4.8 U		13 U	4.6 UJ			10 U	**20** J		**18** J	**850**	**27** J
Acenaphthylene	---		4.9 U		**30** J	**14**	14 UJ	9.7 U		4.8 U		13 U	**5.3** J			**13**	11 UJ		**12** J	**150**	4.8 UJ
Acenaphthene	340		4.9 U		14 UJ	**14**	14 UJ	9.7 U		4.8 U		13 U	4.6 UJ			**10**	**28** J		**5.6** J	**450**	**38** J
Fluorene	470		4.9 U		**8.8** J	**25**	**8.0** J	9.7 U		4.8 U		**16**	4.6 UJ			**17**	**18** J		**11** J	**1,300**	**46** J
Phenanthrene	---		**15**		**110** J	**100**	**83** J	**18**		4.8 U		**180**	**47** J			**140**	**84** J		**53** J	**2,000**	**15** J
Anthracene	4500		4.9 U		**33** J	**61**	**27** J	9.7 U		4.8 U		**39**	**11** J			**40**	**26** J		**9.0** J	30 U	**5.5** J
Fluoranthene	3200		**22**		**120** J	**1,000**	**180** J	**13**		4.8 U		**320**	**81** J			**310**	**200** J		**140** J	**170**	**19** J
Pyrene	20000		**20**		**160** J	**1,100**	**270** J	9.7 U		4.8 U		**240**	**83** J			**260**	**260** J		**160** J	**190**	**26** J
Benzo(a)anthracene	130		**14**		**71** J	**240**	**77** J	9.7 U	14 U	4.8 U	48 U	**130**	**37** J			**170**	**130** J		**77** J	**54**	4.8 UJ
Chrysene	140		**19**		**110** J	**270**	**91** J	9.7 U	14 U	4.8 U	48 U	**200**	**54** J			**220**	**180** J		**91** J	**99**	**6.6** J
Benzo(a)pyrene	350		**25**		**110** J	**120**	**60** J	9.7 U	14 U	4.8 U	48 U	**150**	**47** J			**220**	**140** J		**74** J	**110**	**6.4** J
Indeno(1,2,3-cd)pyrene	700		**24**		**96** J	**58**	**38** J	**31** M	14 U	**15**	48 U	**160**	**43** J			**200**	**95** J		**55** J	**120**	**7.5** J
Dibenz(a,h)anthracene	140		**28**		**20** J	**37**	14 UJ	9.7 U	14 U	4.8 U	48 U	**96**	**25** J			**94**	**26** J		**11** J	**160**	4.8 UJ
Benzo(g,h,i)perylene	---		**19**		**140** J	**53**	**48** J	9.7 U	14 U	4.8 U	48 U	**200**	**73** J			**240**	**110** J		**73** J	**45**	**11** J
Dibenzofuran	---		4.9 U		**7.5** J	**35**	**9.5** J	9.7 U	14 U	4.8 U	48 U	13 U	4.6 UJ			10 U	**26** J		**9.3** J	**450**	**23** J
Total Benzofluoranthenes	430		**34**		**220** J	**330**	**130** J	9.7 U	14 U	4.8 U	48 U	**400**	**86** J			**560**	**310** J		**150** J	**110**	**23** J
TEQ	140		**35**		**152** J	**189**	**85** J	**3.1**	ND	**1.5**	ND	**231**	**67** J			**325**	**198** J		**104** J	**155**	**10** J
PCBs (µg/kg)																					
Method SW8082A																					
Aroclor 1016	33		33 U							32 U		33 U									
Aroclor 1242	---		33 U							32 U		33 U									
Aroclor 1248	---		33 U							32 U		33 U									
Aroclor 1254	500		33 U							32 U		**83**									
Aroclor 1260	490		33 U							32 U		33 U									
Aroclor 1221	---		33 U							32 U		33 U									
Aroclor 1232	---		33 U							32 U		33 U									
Aroclor 1262	---		33 U							32 U		33 U									
Aroclor 1268	---		33 U							32 U		33 U									
Total PCBs	160		ND							ND		**83**									
VOLATILES (µg/kg)																					
Method SW8260C																					
Chloromethane	---					**1.2**														1.2 U	
Bromomethane						1.1 U														1.2 U	
Vinyl Chloride						1.1 U														1.2 U	
Chloroethane						1.1 U														1.2 U	
Methylene Chloride	2,600					5.6 UJ														12 UJ	
Acetone	72,000,000					**45**														**59**	
Carbon Disulfide	8,000,000					**18**														**5.7** J	
1,1-Dichloroethene						1.1 U														1.2 U	
1,1-Dichloroethane						1.1 U														1.2 U	
trans-1,2-Dichloroethene						1.1 U														1.2 U	

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-6	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-8	WM-GP-8	WM-GP-9	WM-GP-9	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11
		2.5-3.5	0.5-1.5	1.5-2.5	5-6	8-9	10-11	0.7-1.7	5-6	0-1.5	5-6.5	0-1	1-2	2-3	3-4	0-1	1-2	2-3	3-4	5-6	7-8
		XV37G	XJ56M/YH46C	XM22J	XM22K	XJ56C	XM22L	XJ56J	YN60D	XJ14F	YN60C	XJ56O/YH46E	XM22P	XO58G/XT02B	XR13C	XJ56N/YH46D	XM22M	XR13B	XM22N/XO58F	XJ56D	XM22O
		10/10/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/8/2013	10/8/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013
cis-1,2-Dichloroethene						1.1 U														1.2 U	
Chloroform						1.1 U														1.2 U	
1,2-Dichloroethane						1.1 U														1.2 U	
2-Butanone	48,000,000					5.7 U														**7.0**	
1,1,1-Trichloroethane						1.1 U														1.2 U	
Carbon Tetrachloride						1.1 U														1.2 U	
Vinyl Acetate						5.7 U														6.0 U	
Bromodichloromethane						1.1 U														1.2 U	
1,2-Dichloropropane						1.1 U														1.2 U	
cis-1,3-Dichloropropene						1.1 U														1.2 U	
Trichloroethene						1.1 U														1.2 U	
Dibromochloromethane						1.1 U														1.2 U	
1,1,2-Trichloroethane						1.1 U														1.2 U	
Benzene	130					**1.2**														1.2 U	
trans-1,3-Dichloropropene						1.1 U														1.2 U	
2-Chloroethylvinylether						5.7 U														6.0 U	
Bromoform						1.1 U														1.2 U	
4-Methyl-2-pentanone						5.7 U														6.0 U	
2-Hexanone						5.7 U														6.0 U	
Tetrachloroethene						1.1 U														1.2 U	
1,1,2,2-Tetrachloroethane						1.1 U														1.2 U	
Toluene	110,000					1.1 U														1.2 U	
Chlorobenzene						1.1 U														1.2 U	
Ethylbenzene						1.1 U														1.2 U	
Styrene						1.1 U														1.2 U	
Trichlorofluoromethane						1.1 U														1.2 U	
CFC-113						2.3 U														2.4 U	
m, p-Xylene	---					**1.8**														**1.5**	
o-Xylene						1.1 U														1.2 U	
1,2-Dichlorobenzene						1.1 U														1.2 U	
1,3-Dichlorobenzene						1.1 U														1.2 U	
1,4-Dichlorobenzene						1.1 U														1.2 U	
Acrolein						57 U														60 U	
Iodomethane						1.1 U														1.2 U	
Bromoethane						2.3 U														2.4 U	
Acrylonitrile						5.7 U														6.0 U	
1,1-Dichloropropene						1.1 U														1.2 U	
Dibromomethane						1.1 U														1.2 U	
1,1,1,2-Tetrachloroethane						1.1 U														1.2 U	
1,2-Dibromo-3-chloropropane						5.7 U														6.0 UJ	
1,2,3-Trichloropropane						2.3 U														2.4 U	
trans-1,4-Dichloro-2-butene						5.7 U														6.0 U	
1,3,5-Trimethylbenzene						1.1 U														1.2 U	
1,2,4-Trimethylbenzene						1.1 U														1.2 U	
Hexachlorobutadiene						5.7 U														6.0 U	
1,2-Dibromoethane						1.1 U														1.2 U	
Bromochloromethane						1.1 U														1.2 U	
2,2-Dichloropropane						1.1 U														1.2 U	
1,3-Dichloropropane						1.1 U														1.2 U	
Isopropylbenzene	8,000,000					1.1 U														**1.3**	
n-Propylbenzene	8,000,000					1.1 U														**1.3**	
Bromobenzene						1.1 U														1.2 U	
2-Chlorotoluene						1.1 U														1.2 U	
4-Chlorotoluene						1.1 U														1.2 U	
tert-Butylbenzene						1.1 U														1.2 U	
sec-Butylbenzene	---					1.1 U														**18**	
4-Isopropyltoluene	---					1.1 U														**14**	
n-Butylbenzene						1.1 U														1.2 U	
1,2,4-Trichlorobenzene						5.7 U														6.0 U	
Naphthalene	2,300					5.7 U														6.0 U	
1,2,3-Trichlorobenzene						5.7 U														6.0 U	
SEMIVOLATILES (µg/kg)																					
Method SW8270D																					
Phenol	2,700									19 U											
Bis-(2-Chloroethyl) Ether										19 U											
2-Chlorophenol										19 U											
1,3-Dichlorobenzene										19 U											
1,4-Dichlorobenzene										19 U											
Benzyl Alcohol	8,000,000									19 U											
1,2-Dichlorobenzene										19 U											

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-6	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-7	WM-GP-8	WM-GP-8	WM-GP-9	WM-GP-9	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-10	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11	WM-GP-11
		2.5-3.5	0.5-1.5	1.5-2.5	5-6	8-9	10-11	0.7-1.7	5-6	0-1.5	5-6.5	0-1	1-2	2-3	3-4	0-1	1-2	2-3	3-4	5-6	7-8
		XV37G	XJ56M/YH46C	XM22J	XM22K	XJ56C	XM22L	XJ56J	YN60D	XJ14F	YN60C	XJ56O/YH46E	XM22P	XO58G/XT02B	XR13C	XJ56N/YH46D	XM22M	XR13B	XM22N/XO58F	XJ56D	XM22O
		10/10/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/8/2013	10/8/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013	10/10/2013
2-Methylphenol										19 U											
2,2'-Oxybis(1-Chloropropane)										19 U											
4-Methylphenol	400,000									19 U											
N-Nitroso-Di-N-Propylamine										19 U											
Hexachloroethane										19 U											
Nitrobenzene										19 U											
Isophorone										19 U											
2-Nitrophenol										19 U											
2,4-Dimethylphenol										95 U											
Benzoic Acid										190 U											
bis(2-Chloroethoxy) Methane										19 U											
2,4-Dichlorophenol										95 U											
1,2,4-Trichlorobenzene										19 U											
Naphthalene	2,300									19 U											
4-Chloroaniline										95 U											
Hexachlorobutadiene										19 U											
4-Chloro-3-methylphenol										95 U											
2-Methylnaphthalene										19 U											
Hexachlorocyclopentadiene										95 U											
2,4,6-Trichlorophenol										95 U											
2,4,5-Trichlorophenol										95 U											
2-Chloronaphthalene										19 U											
2-Nitroaniline										95 U											
Dimethylphthalate	---									19 U											
Acenaphthylene	---									19 U											
3-Nitroaniline										95 U											
Acenaphthene	340									19 U											
2,4-Dinitrophenol										190 U											
4-Nitrophenol										95 U											
Dibenzofuran	80,000									19 U											
2,6-Dinitrotoluene										95 U											
2,4-Dinitrotoluene										95 U											
Diethylphthalate	4,200									19 U											
4-Chlorophenyl-phenylether										19 U											
Fluorene	470									19 U											
4-Nitroaniline										95 U											
4,6-Dinitro-2-Methylphenol										190 U											
N-Nitrosodiphenylamine										19 U											
4-Bromophenyl-phenylether										19 U											
Hexachlorobenzene										19 U											
Pentachlorophenol	160									95 U											
Phenanthrene	---									19 U											
Carbazole	---									19 U											
Anthracene	4,500									19 U											
Di-n-Butylphthalate	5,000									19 U											
Fluoranthene	3,200									19 U											
Pyrene	20,000									19 U											
Butylbenzylphthalate	280									19 U											
3,3'-Dichlorobenzidine										95 U											
Benzo(a)anthracene	130									19 U											
bis(2-Ethylhexyl)phthalate	6,600									48 U											
Chrysene	140									19 U											
Di-n-Octyl phthalate										19 U											
Benzo(a)pyrene	350									19 U											
Indeno(1,2,3-cd)pyrene	700									19 U											
Dibenz(a,h)anthracene	140									19 U											
Benzo(g,h,i)perylene	---									19 U											
1-Methylnaphthalene	35,000									19 U											
Total Benzofluoranthenes	430									38 U											
ORGANOTINS (µg/kg)																					
KRONE88																					
Tributyltin Ion	---											**260**				**300**					
Dibutyltin Ion	---											**230**				**580**					
Butyltin Ion	---											**450**				**360**					
CONVENTIONALS (%)																					
Total Solids (SM2540B)	---																				
Total Organic Carbon (PLUMB81TC)	---																				

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-12	WM-GP-12	WM-GP-12	WM-GP-12	WM-GP-13	WM-GP-13	WM-GP-13	WM-GP-13	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-15	WM-GP-15	WM-GP-15	WM-GP-16	WM-GP-16
		0-1	1-2	2-3	5-6	0-1	1-2	5-6	6-7	0-1	1-2	3-4	7-8	10.5-11.5	13.5-14.5	0-1	1-2	2-3	0-1	1-2
		XJ14D/YH46A	XM23C/YK90B	XO07A	YN60B	XJ56K/YH46B	XM22F	XO58D	XR13A	XJ56L	XM22G	XO58E	XM22H	XJ56B	XM22I	XJ56P/YH46F	XM22Q	XO58H	XJ14E	XM23D/XO58B
		10/8/2013	10/08/2013	10/5/2013	10/5/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/10/2013	10/09/2013	10/10/2013	10/10/2013	10/10/2013	10/8/2013	10/08/2013
TOTAL METALS (mg/kg)																				
Methods EPA200.8/ SW6010C/SW7471A																				
Arsenic	20	**10.8**	**6.4**		**3.9**	**5.8**				**5.8**			**3.5**	**8.6**	**1.4**	**5.2**			**7.8**	**30.8**
Cadmium	80	**0.8**			**0.4**	**2.5**				**0.9**				**0.3**		**0.7**			**0.8**	
Chromium	2000	**29**			**20.0**	**25.4**				**23.9**				**16.9**		**49.0**			**24**	
Copper	3,200	**1,100**	**32.8**		**68.9**	**3,920**	**273**	**182**	**44.0**	**810**	**30.8**		**9.0**	**466**	**2.8**	**2,340**	**341**	**36.2**	**2,470**	**408**
Lead	250	**67.8**			**12.2**	**73.4**				**111**				**136**		**116**			**90.6**	
Mercury	2	**1.30**	**0.25**	0.02 UJ	**0.1** J	**0.52**	**0.16**			**0.14**				**0.03**		**0.88**	**0.55**	**0.09** J	**1.89**	**17.7**
Zinc	24,000	**829**	**43**		**70**	**1,240**	**172**	**137**	**49**	**763**	**116**	**54**	**23**	**151**	**10**	**1,340**	**169**	**43**	**887**	**65**
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																				
HCID																				
Gasoline	---	<20				<20				<20				<20		<20			<20	
Diesel	---	**>50**				**>50**				**>50**				**>50**		**>50**			**>50**	
Oil	---	**>100**				**>100**				**>100**				**>100**		**>100**			**>100**	
NWTPH-Dx																				
Diesel Range Organics	2000	**120**	5.4 U			**79**				**96**				**140**		**210**			**140**	
Lube Oil	2000	**400**	11 U			**290**				**410**				**57**		**600**			**370**	
NWTPH-Gx																				
Gasoline	30/100 (a)												8.0 U	**65**	7.2 U					
PAHs (µg/kg)																				
Method SW8270DSIM																				
Naphthalene	2,300	11 U	**7.6** J		48 U	10 U	4.6 UJ			**15**	4.8 UJ		**31** J	**320**	4.8 UJ	**14**	13 UJ		**12**	**34** J
2-Methylnaphthalene	320,000	**12**	5.0 UJ			**11**	4.6 UJ			**15**	**8.0** J		4.7 UJ	**46**	4.8 UJ	**20**	**59** J		**43**	**72** J
1-Methylnaphthalene	35,000	11 U	5.0 UJ			10 U	4.6 UJ			11 U	4.8 UJ		4.7 UJ	**29**	4.8 UJ	**12**	**72** J		**37**	**30** J
Acenaphthylene	---	11 U	5.0 UJ			10 U	4.6 UJ			**32**	4.8 UJ		4.7 UJ	**92**	4.8 UJ	**36**	**18** J		11 U	4.6 UJ
Acenaphthene	340	11 U	5.0 UJ			10 U	4.6 UJ			11 U	4.8 UJ		4.7 UJ	**22**	4.8 UJ	**20**	**38** J		11 U	4.6 UJ
Fluorene	470	11 U	5.0 UJ			10 U	4.6 UJ			**19**	4.8 UJ		4.7 UJ	**61**	4.8 UJ	**18**	**26** J		11 U	4.6 UJ
Phenanthrene	---	**60**	**16** J			**73**	**15** J			**120**	4.8 UJ		**11** J	**480**	4.8 UJ	**320**	**87** J		**64**	**15** J
Anthracene	4500	**14**	5.0 UJ			**22**	4.6 UJ			**44**	4.8 UJ		4.7 UJ	**160**	**6.6** J	**74**	13 UJ		**15**	**5.2** J
Fluoranthene	3200	**120**	**40** J			**170**	**19** J			**260**	4.8 UJ		**15** J	**630**	**6.1** J	**900**	**72** J		**120**	**12** J
Pyrene	20000	**97**	**49** J			**130**	**23** J			**210**	4.8 UJ		**19** J	**720**	**5.7** J	**590**	**44** J		**110**	**16** J
Benzo(a)anthracene	130	**64**	**21** J		48 U	**73**	**12** J			**120**	4.8 UJ		**7.2** J	**310**	4.8 UJ	**310**	13 UJ		**100**	**9.1** J
Chrysene	140	**120**	**26** J		48 U	**160**	**20** J			**200**	4.8 UJ		**7.8** J	**330**	4.8 UJ	**470**	**41** J		**310**	**15** J
Benzo(a)pyrene	350	**98**	**23** J		48 U	**110**	**14** J			**160**	4.8 UJ		**6.3** J	**290**	4.8 UJ	**360**	**72** J		**170**	**14** J
Indeno(1,2,3-cd)pyrene	700	**130**	**16** J		48 U	**120**	**10** J			**160**	4.8 UJ		4.7 UJ	**150**	4.8 UJ	**380**	13 UJ		**270**	**12** J
Dibenz(a,h)anthracene	140	**75**	**5.3** J		48 U	**72**	4.6 UJ			**85**	4.8 UJ		4.7 UJ	**60**	4.8 UJ	**130**	13 UJ		**110**	4.6 UJ
Benzo(g,h,i)perylene	---	**150**	**20** J		48 UJ	**120**	**15** J			**200**	4.8 UJ		**5.5** J	**200**	4.8 UJ	**460**	13 UJ		**310**	**18** J
Dibenzofuran	---	11 U	5.0 UJ		48 U	10 U	4.6 UJ			11 U	4.8 UJ		4.7 UJ	**49**	4.8 UJ	**12**	**14** J		11 U	4.6 UJ
Total Benzofluoranthenes	430	**310**	**51** J		**56**	**410**	**41** J			**440**	**13** J		**20** J	**490**	**12** J	**1,000**	13 UJ		**840**	**37** J
TEQ	140	**157**	**33** J		**5.6**	**179**	**21** J			**243**	**1.3** J		**9.1** J	**394**	**1.2** J	**547**	**72** J		**305**	**20** J
PCBs (µg/kg)																				
Method SW8082A																				
Aroclor 1016	33	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1242	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1248	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1254	500	**110**				**91**				31 U				32 U		**57**			**250**	32 U
Aroclor 1260	490	**40**				32 U				**34**				32 U		33 U			**100**	32 U
Aroclor 1221	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1232	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1262	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Aroclor 1268	---	33 U				32 U				31 U				32 U		33 U			33 U	32 U
Total PCBs	160	**150**				**91**				**34**				ND		**57**			**350**	ND
VOLATILES (µg/kg)																				
Method SW8260C																				
Chloromethane	---													1.4 U						
Bromomethane														1.4 U						
Vinyl Chloride														1.4 U						
Chloroethane														1.4 U						
Methylene Chloride	2,600													12 UJ						
Acetone	72,000,000													**110**						
Carbon Disulfide	8,000,000													**10** J						
1,1-Dichloroethene														1.4 U						
1,1-Dichloroethane														1.4 U						
trans-1,2-Dichloroethene														1.4 U						

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-12 0-1 XJ14D/YH46A 10/8/2013	WM-GP-12 1-2 XM23C/YK90B 10/08/2013	WM-GP-12 2-3 XO07A 10/5/2013	WM-GP-12 5-6 YN60B 10/5/2013	WM-GP-13 0-1 XJ56K/YH46B 10/09/2013	WM-GP-13 1-2 XM22F 10/09/2013	WM-GP-13 5-6 XO58D 10/09/2013	WM-GP-13 6-7 XR13A 10/09/2013	WM-GP-14 0-1 XJ56L 10/09/2013	WM-GP-14 1-2 XM22G 10/09/2013	WM-GP-14 3-4 XO58E 10/09/2013	WM-GP-14 7-8 XM22H 10/09/2013	WM-GP-14 10.5-11.5 XJ56B 10/10/2013	WM-GP-14 13.5-14.5 XM22I 10/09/2013	WM-GP-15 0-1 XJ56P/YH46F 10/10/2013	WM-GP-15 1-2 XM22Q 10/10/2013	WM-GP-15 2-3 XO58H 10/10/2013	WM-GP-16 0-1 XJ14E 10/8/2013	WM-GP-16 1-2 XM23D/XO58B 10/08/2013
cis-1,2-Dichloroethene														1.4 U						
Chloroform														1.4 U						
1,2-Dichloroethane														1.4 U						
2-Butanone	48,000,000													6.9 U						
1,1,1-Trichloroethane														1.4 U						
Carbon Tetrachloride														1.4 U						
Vinyl Acetate														6.9 U						
Bromodichloromethane														1.4 U						
1,2-Dichloropropane														1.4 U						
cis-1,3-Dichloropropene														1.4 U						
Trichloroethene														1.4 U						
Dibromochloromethane														1.4 U						
1,1,2-Trichloroethane														1.4 U						
Benzene	130													**1.9**						
trans-1,3-Dichloropropene														1.4 U						
2-Chloroethylvinylether														6.9 U						
Bromoform														1.4 U						
4-Methyl-2-pentanone														6.9 U						
2-Hexanone														6.9 U						
Tetrachloroethene														1.4 U						
1,1,2,2-Tetrachloroethane														1.4 U						
Toluene	110,000													**1.7**						
Chlorobenzene														1.4 U						
Ethylbenzene														1.4 U						
Styrene														1.4 U						
Trichlorofluoromethane														1.4 U						
CFC-113														2.8 U						
m, p-Xylene	---													1.4 U						
o-Xylene														1.4 U						
1,2-Dichlorobenzene														1.4 U						
1,3-Dichlorobenzene														1.4 U						
1,4-Dichlorobenzene														1.4 U						
Acrolein														69 U						
Iodomethane														1.4 U						
Bromoethane														2.8 U						
Acrylonitrile														6.9 U						
1,1-Dichloropropene														1.4 U						
Dibromomethane														1.4 U						
1,1,1,2-Tetrachloroethane														1.4 U						
1,2-Dibromo-3-chloropropane														6.9 UJ						
1,2,3-Trichloropropane														2.8 U						
trans-1,4-Dichloro-2-butene														6.9 U						
1,3,5-Trimethylbenzene														1.4 U						
1,2,4-Trimethylbenzene														1.4 U						
Hexachlorobutadiene														6.9 U						
1,2-Dibromoethane														1.4 U						
Bromochloromethane														1.4 U						
2,2-Dichloropropane														1.4 U						
1,3-Dichloropropane														1.4 U						
Isopropylbenzene	8,000,000													1.4 U						
n-Propylbenzene	8,000,000													1.4 U						
Bromobenzene														1.4 U						
2-Chlorotoluene														1.4 U						
4-Chlorotoluene														1.4 U						
tert-Butylbenzene														1.4 U						
sec-Butylbenzene	---													1.4 U						
4-Isopropyltoluene	---													**2,300**						
n-Butylbenzene														1.4 U						
1,2,4-Trichlorobenzene														6.9 U						
Naphthalene	2,300													6.9 U						
1,2,3-Trichlorobenzene														6.9 U						
SEMIVOLATILES (µg/kg)																				
Method SW8270D																				
Phenol	2,700	**37**	61 U							**61**	59 U		62 U	**86** J	63 U					
Bis-(2-Chloroethyl) Ether		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2-Chlorophenol		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
1,3-Dichlorobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
1,4-Dichlorobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Benzyl Alcohol	8,000,000	**29**	300 U							**82**	300 U		310 U	22 UJ	320 U					
1,2-Dichlorobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-12	WM-GP-12	WM-GP-12	WM-GP-12	WM-GP-13	WM-GP-13	WM-GP-13	WM-GP-13	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-14	WM-GP-15	WM-GP-15	WM-GP-15	WM-GP-16	WM-GP-16
		0-1	1-2	2-3	5-6	0-1	1-2	5-6	6-7	0-1	1-2	3-4	7-8	10.5-11.5	13.5-14.5	0-1	1-2	2-3	0-1	1-2
		XJ14D/YH46A	XM23C/YK90B	XO07A	YN60B	XJ56K/YH46B	XM22F	XO58D	XR13A	XJ56L	XM22G	XO58E	XM22H	XJ56B	XM22I	XJ56P/YH46F	XM22Q	XO58H	XJ14E	XM23D/XO58B
		10/8/2013	10/08/2013	10/5/2013	10/5/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/09/2013	10/10/2013	10/09/2013	10/10/2013	10/10/2013	10/10/2013	10/8/2013	10/08/2013
2-Methylphenol		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2,2'-Oxybis(1-Chloropropane)		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
4-Methylphenol	400,000	20 U	61 U							20 U	59 U		62 U	**49** J	63 U					
N-Nitroso-Di-N-Propylamine		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Hexachloroethane		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Nitrobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Isophorone		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2-Nitrophenol		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2,4-Dimethylphenol		98 U	61 U							98 U	59 U		62 U	110 UJ	63 U					
Benzoic Acid		200 U	610 U							200 U	590 U		620 U	220 UJ	630 U					
bis(2-Chloroethoxy) Methane		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2,4-Dichlorophenol		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
1,2,4-Trichlorobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Naphthalene	2,300	20 U	61 U							**32**	59 U		62 U	**390** J	63 U					
4-Chloroaniline		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Hexachlorobutadiene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
4-Chloro-3-methylphenol		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
2-Methylnaphthalene		20 U	61 U							**30**	59 U		62 U	**39** J	63 U					
Hexachlorocyclopentadiene		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
2,4,6-Trichlorophenol		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
2,4,5-Trichlorophenol		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
2-Chloronaphthalene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
2-Nitroaniline		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Dimethylphthalate	---	**100**	61 U							**190**	59 U		62 U	22 UJ	63 U					
Acenaphthylene	---	20 U	61 U							**72**	59 U		62 U	22 UJ	63 U					
3-Nitroaniline		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Acenaphthene	340	20 U	61 U							**24**	59 U		62 U	**30** J	63 U					
2,4-Dinitrophenol		200 U	610 U							200 U	590 U		620 U	220 UJ	630 U					
4-Nitrophenol		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Dibenzofuran	80,000	20 U	61 U							**20**	59 U		62 U	**51** J	63 U					
2,6-Dinitrotoluene		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
2,4-Dinitrotoluene		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Diethylphthalate	4,200	**22**	61 U							20 U	59 U		62 U	22 UJ	63 U					
4-Chlorophenyl-phenylether		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Fluorene	470	20 U	61 U							**20**	59 U		62 U	**54** J	63 U					
4-Nitroaniline		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
4,6-Dinitro-2-Methylphenol		200 U	610 U							200 U	590 U		620 U	220 UJ	630 U					
N-Nitrosodiphenylamine		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
4-Bromophenyl-phenylether		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Hexachlorobenzene		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Pentachlorophenol	160	**180**	300 U							**110**	300 U		310 U	110 UJ	320 U					
Phenanthrene	---	**130**	61 U							**380**	59 U		62 U	**670** J	63 U					
Carbazole	---	**22**	61 U							**94**	59 U		62 U	**25** J	63 U					
Anthracene	4,500	**29**	61 U							**93**	59 U		62 U	**160** J	63 U					
Di-n-Butylphthalate	5,000	**31**	61 U							**85**	59 U		62 U	22 UJ	63 U					
Fluoranthene	3,200	**230**	61 U							**870**	59 U		62 U	**1,000** J	63 U					
Pyrene	20,000	**260**	61 U							**610**	59 U		62 U	**960** J	63 U					
Butylbenzylphthalate	280	20 U	61 U							**110**	59 U		62 U	22 UJ	63 U					
3,3'-Dichlorobenzidine		98 U	300 U							98 U	300 U		310 U	110 UJ	320 U					
Benzo(a)anthracene	130	**110**	61 U							**280**	59 U		62 U	**430** J	63 U					
bis(2-Ethylhexyl)phthalate	6,600	**240**	61 U							**370**	59 U		62 U	55 UJ	63 U					
Chrysene	140	**180**	61 U							**500**	59 U		62 U	**470** J	63 U					
Di-n-Octyl phthalate		20 U	61 U							20 U	59 U		62 U	22 UJ	63 U					
Benzo(a)pyrene	350	**120**	61 U							**410**	59 U		62 U	**490** J	63 U					
Indeno(1,2,3-cd)pyrene	700	**150**	61 U							**370**	59 U		62 U	**310** J	63 U					
Dibenz(a,h)anthracene	140	**38**	61 U							**98**	59 U		62 U	**76** J	63 U					
Benzo(g,h,i)perylene	---	**170**	61 U							**430**	59 U		62 U	**400** J	63 U					
1-Methylnaphthalene	35,000	20 U	61 U							**20**	59 U		62 U	**27** J	63 U					
Total Benzofluoranthenes	430	**310**	61 U							**940**	59 U		62 U	**650** J	63 U					
ORGANOTINS (µg/kg)																				
KRONE88																				
Tributyltin Ion	---	**640**				**3,100**													**2,100**	3.6 U
Dibutyltin Ion	---	**730**				**2,000**													**3,000**	5.3 U
Butyltin Ion	---	**1,400**				**1,200**													**2,800**	3.8 U
CONVENTIONALS (%)																				
Total Solids (SM2540B)	---																			
Total Organic Carbon (PLUMB81TC)	---																			

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-16 2-3 XO07B 10/5/2013	WM-GP-17 0.5-1 XJ14B 10/8/2013	WM-GP-17 1-2 XV37D 10/8/2013	WM-GP-17 2-3 XV37H 10/8/2013	WM-GP-17 5-6 XJ14C/YK90A/YN60A 10/08/2013	WM-GP-18 10-12 XO58I 10/10/2013	WM-GP-19 11-12 XO58J 10/10/2013	WM-GP-20 7-8 YI99I 4/16/2014	WM-GP-20 10.5-11.5 YH19I 4/16/2014	WM-GP-20 12-13 YI99J 4/16/2014	WM-GP-21 7-8 YH19A/YH71E/YI99G 4/16/2014	WM-GP-21 10-11 YH19C 4/16/2014	WM-GP-21 12-13 YH19B/YH71F/YI99H 4/16/2014	WM-GP-22 7.5-8.5 YH71M/YI99M 4/16/2014	WM-GP-22 10.5-11.5 YH19J 4/16/2014	WM-GP-22 12-13 YH71N/YI99N 4/16/2014	WM-GP-23 8.5-10 YH71G/YI99K 4/16/2014	WM-GP-23 10-11 YH19D 4/16/2014	WM-GP-23 12-13 YH71H/YI99L 4/16/2014
TOTAL METALS (mg/kg) **Methods EPA200.8/ SW6010C/SW7471A**																				
Arsenic	20	**3.7**	**2.6**	**2.3**	**2.6**	**2.2**				**6.2**		**82.7**	**13.4**	**4.1**		**4.7**		**18.0**	**27.0** J	**1.4**
Cadmium	80		**0.1**	0.1 U	0.1 U	**0.2**	**0.6**	**0.2**												
Chromium	2000		**12.5**	**12.0**	**12.6**	**11.9**														
Copper	3,200	**27.4**	**13.3**	**12.6**	**19.7**	**6.5**	**408**	**44.7**	**49.6**	**53.6**	**65**	**553**	**168**	**29**	**100**	**42**	**4.4**	**318**	**378** J	**3.4**
Lead	250		**1.6**	**1.4**	**5.4**	**1.2**														
Mercury	2	**0.04** J	0.02 U	0.02 UJ	**0.03** J	0.02 UJ													**0.07** U	
Zinc	24,000		**26**	**26**	**51**	**22**	**365**	**58**		**79**		**142**	**190**	**31**		**30**		**140**	**190** J	**13**
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																				
HCID								67	67											
Gasoline	---		<20																	
Diesel	---		<50																	
Oil	---		<100																	
NWTPH-Dx																				
Diesel Range Organics	2000					5.5 U							**36**						**180**	
Lube Oil	2000					11 U							**120**						**370**	
NWTPH-Gx																				
Gasoline	30/100 (a)						**50** J	9.6 UJ		8.5 U		23 U	5.5 U	25 U	21 U	32 U	5.6 U	27 U	19 U	4.9 U
PAHs (µg/kg) **Method SW8270DSIM**																				
Naphthalene	2,300		4.7 U			4.6 U	**200**	**49**	**50**	**150**	**1,600**	**500**	**250**	**360**		**46**		**740**	**180**	**14**
2-Methylnaphthalene	320,000		4.7 U			4.6 U	**53** J	**11**	**12**	**39**	**170**	**170**	**44**	**38**		**13**		**210**	**65**	5.0 U
1-Methylnaphthalene	35,000		4.7 U			4.6 U	**32** J	**10**	**12**	**26**	**110**	**87**	**29**	**22**		**14**		**200**	**35**	5.0 U
Acenaphthylene	---		4.7 U			4.6 U	**440**	**27**	**59**	**65**	**200**	**320**	**280**	**86**		**7.7**		**850**	**40**	5.0 U
Acenaphthene	340		4.7 U			4.6 U	**43** J	**20**	**36**	**39**	**66**	**79**	**64**	**31**		**15**		**350**	**34**	**18**
Fluorene	470		4.7 U			4.6 U	**190**	**44**	**47**	**50**	**170**	**260**	**250**	**70**		**23**		**1,200**	**70**	**53**
Phenanthrene	---		4.7 U			4.6 U	**2,000**	**320**	**450**	**300**	**710**	**2,000**	**2,400**	**400**		**83**		**8,800**	**220**	**24**
Anthracene	4500		4.7 U			4.6 U	**730**	**62**	**87**	**83**	**190**	**770**	**590**	**120**		**19**		**3,100**	**68**	**49**
Fluoranthene	3200		4.7 U			4.6 U	**5,300**	**410**	**760**	**550**	**800**	**5,900**	**4,000**	**970**		**110**		**17,000**	**290**	**52**
Pyrene	20000		4.7 U			4.6 U	**6,000**	**450**	**1,000**	**620**	**780**	**7,000**	**4,500**	**1,000**		**100**		**17,000**	**420**	**35**
Benzo(a)anthracene	130		4.7 U			4.6 U	**2,300**	**140** J	**320**	**180**	**210**	**2,300**	**1,500**	**320**		**48**		**6,900**	**160**	5.0 U
Chrysene	140		4.7 U			4.6 U	**2,700**	**170** J	**380**	**210**	**280**	**2,600**	**1,700**	**360**		**44**		**7,500**	**190**	5.0 U
Benzo(a)pyrene	350		4.7 U			4.6 U	**2,800**	**160** J	**360**	**200**	**220**	**2,500**	**1,600**	**320**		**33**		**7,300**	**150**	5.0 U
Indeno(1,2,3-cd)pyrene	700		**15**			4.6 U	**1,400**	**81**	**210**	**110**	**130**	**1,300**	**800**	**140**		**21**		**4,300**	**130**	5.0 U
Dibenz(a,h)anthracene	140		4.7 U			4.6 U	**350**	**20**	**58**	**32**	**31**	**340**	**260**	**38**		**6.1**		**1,200**	**24**	5.0 U
Benzo(g,h,i)perylene	---		4.7 U			4.6 U	**1,800**	**100**	**270**	**140**	**180**	**1,700**	**1,000**	**180**		**36**		**6,900**	**220**	5.0 U
Dibenzofuran	---		4.7 U			4.6 U	**73**	**18**	**27**	**53**	**160**	**150**	**77**	**34**		**17**		**370**	**50**	**24**
Total Benzofluoranthenes	430		4.7 U			4.6 U	**3,600**	**220**	**530**	**300**	**400**	**3,500**	**2,000**	**420**		**52**		**10,000**	**280**	5.0 U
TEQ	140		**1.5**			ND	**3,592**	**208**	**476**	**264**	**300**	**3,270**	**2,073**	**415**		**46**		**9,615**	**211**	ND
PCBs (µg/kg) **Method SW8082A**																				
Aroclor 1016	33		32 U																	
Aroclor 1242	---		32 U																	
Aroclor 1248	---		32 U																	
Aroclor 1254	500		32 U																	
Aroclor 1260	490		32 U																	
Aroclor 1221	---		32 U																	
Aroclor 1232	---		32 U																	
Aroclor 1262	---		32 U																	
Aroclor 1268	---		32 U																	
Total PCBs	160		ND																	
VOLATILES (µg/kg) **Method SW8260C**																				
Chloromethane	---						2.2 UJ	1.2 UJ				1.5 U	1.0 U	**4.6**				2.8 U	**3.1**	0.7 U
Bromomethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Vinyl Chloride							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Chloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Methylene Chloride	2,600						**220** J	**18** J				**17**	**2.9**	**24**				5.6 U	4.7 U	1.5 U
Acetone	72,000,000						**1,100** J	**460** J				390 UJ	**290**	10 U				**1,100** J	12 U	3.7 U
Carbon Disulfide	8,000,000						**33** J	**23** J				**2.5**	**20**	**12**				**83**	**9.5**	**11**
1,1-Dichloroethene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,1-Dichloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
trans-1,2-Dichloroethene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-16	WM-GP-17	WM-GP-17	WM-GP-17	WM-GP-17	WM-GP-18	WM-GP-19	WM-GP-20	WM-GP-20	WM-GP-20	WM-GP-21	WM-GP-21	WM-GP-21	WM-GP-22	WM-GP-22	WM-GP-22	WM-GP-23	WM-GP-23	WM-GP-23
		2-3	0.5-1	1-2	2-3	5-6	10-12	11-12	7-8	10.5-11.5	12-13	7-8	10-11	12-13	7.5-8.5	10.5-11.5	12-13	8.5-10	10-11	12-13
		XO07B	XJ14B	XV37D	XV37H	XJ14C/YK90A/YN60A	XO58I	XO58J	YI99I	YH19I	YI99J	YH19A/YH71E/YI99G	YH19C	YH19B/YH71F/YI99H	YH71M/YI99M	YH19J	YH71N/YI99N	YH71G/YI99K	YH19D	YH71H/YI99L
		10/5/2013	10/8/2013	10/8/2013	10/8/2013	10/08/2013	10/10/2013	10/10/2013	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014
cis-1,2-Dichloroethene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Chloroform							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,2-Dichloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
2-Butanone	48,000,000						**160** J	**66** J				7.3 U	**17**	10 U				**100**	**16**	3.7 U
1,1,1-Trichloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Carbon Tetrachloride							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Vinyl Acetate							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
Bromodichloromethane							2.2 UJ	1.2 UJ				1.5 UJ	1.0 U	2.0 UJ				2.8 UJ	2.3 U	0.7 U
1,2-Dichloropropane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
cis-1,3-Dichloropropene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Trichloroethene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Dibromochloromethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,1,2-Trichloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Benzene	130						2.2 UJ	**1.3** J				1.5 U	**21**	2.0 U				2.8 U	2.3 U	0.7 U
trans-1,3-Dichloropropene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
2-Chloroethylvinylether							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
Bromoform							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
4-Methyl-2-pentanone							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
2-Hexanone							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
Tetrachloroethene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,1,2,2-Tetrachloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Toluene	110,000						**2.7** J	1.2 UJ				1.5 U	**12**	2.0 U				2.8 U	2.3 U	0.7 U
Chlorobenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Ethylbenzene							2.2 UJ	1.2 UJ				1.5 U	**1.5**	2.0 U				2.8 U	2.3 U	0.7 U
Styrene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Trichlorofluoromethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
CFC-113							4.4 UJ	2.5 UJ				2.9 U	2.0 U	4.0 U				5.6 U	4.7 U	1.5 U
m, p-Xylene	---						2.2 UJ	1.2 UJ				1.5 U	**1.8**	2.0 U				2.8 U	2.3 U	0.7 U
o-Xylene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,2-Dichlorobenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,3-Dichlorobenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,4-Dichlorobenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Acrolein							110 UJ	62 UJ				73 U	49 U	100 U				140 U	120 U	37 U
Iodomethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Bromoethane							4.4 UJ	2.5 UJ				2.9 U	2.0 U	4.0 U				5.6 U	4.7 U	1.5 U
Acrylonitrile							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
1,1-Dichloropropene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Dibromomethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,1,1,2-Tetrachloroethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,2-Dibromo-3-chloropropane							11 UJ	6.2 UJ				7.3 UJ	4.9 U	10 UJ				14 UJ	12 U	3.7 U
1,2,3-Trichloropropane							4.4 UJ	2.5 UJ				2.9 U	2.0 U	4.0 U				5.6 U	4.7 U	1.5 U
trans-1,4-Dichloro-2-butene							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
1,3,5-Trimethylbenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,2,4-Trimethylbenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Hexachlorobutadiene							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
1,2-Dibromoethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Bromochloromethane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
2,2-Dichloropropane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,3-Dichloropropane							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Isopropylbenzene	8,000,000						2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
n-Propylbenzene	8,000,000						2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
Bromobenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
2-Chlorotoluene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
4-Chlorotoluene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
tert-Butylbenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
sec-Butylbenzene	---						2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
4-Isopropyltoluene	---						**30** J	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	**2.8**	0.7 U
n-Butylbenzene							2.2 UJ	1.2 UJ				1.5 U	1.0 U	2.0 U				2.8 U	2.3 U	0.7 U
1,2,4-Trichlorobenzene							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
Naphthalene	2,300						11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
1,2,3-Trichlorobenzene							11 UJ	6.2 UJ				7.3 U	4.9 U	10 U				14 U	12 U	3.7 U
SEMIVOLATILES (µg/kg)																				
Method SW8270D																				
Phenol	2,700		19 U																	
Bis-(2-Chloroethyl) Ether			19 U																	
2-Chlorophenol			19 U																	
1,3-Dichlorobenzene			19 U																	
1,4-Dichlorobenzene			19 U																	
Benzyl Alcohol	8,000,000		19 U																	
1,2-Dichlorobenzene			19 U																	

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-16 2-3 XO07B 10/5/2013	WM-GP-17 0.5-1 XJ14B 10/8/2013	WM-GP-17 1-2 XV37D 10/8/2013	WM-GP-17 2-3 XV37H 10/8/2013	WM-GP-17 5-6 XJ14C/YK90A/YN60A 10/08/2013	WM-GP-18 10-12 XO58I 10/10/2013	WM-GP-19 11-12 XO58J 10/10/2013	WM-GP-20 7-8 YI99I 4/16/2014	WM-GP-20 10.5-11.5 YH19I 4/16/2014	WM-GP-20 12-13 YI99J 4/16/2014	WM-GP-21 7-8 YH19A/YH71E/YI99G 4/16/2014	WM-GP-21 10-11 YH19C 4/16/2014	WM-GP-21 12-13 YH19B/YH71F/YI99H 4/16/2014	WM-GP-22 7.5-8.5 YH71M/YI99M 4/16/2014	WM-GP-22 10.5-11.5 YH19J 4/16/2014	WM-GP-22 12-13 YH71N/YI99N 4/16/2014	WM-GP-23 8.5-10 YH71G/YI99K 4/16/2014	WM-GP-23 10-11 YH19D 4/16/2014	WM-GP-23 12-13 YH71H/YI99L 4/16/2014
2-Methylphenol			19 U																	
2,2'-Oxybis(1-Chloropropane)			19 U																	
4-Methylphenol	400,000		19 U																	
N-Nitroso-Di-N-Propylamine			19 U																	
Hexachloroethane			19 U																	
Nitrobenzene			19 U																	
Isophorone			19 U																	
2-Nitrophenol			19 U																	
2,4-Dimethylphenol			94 U																	
Benzoic Acid			190 U																	
bis(2-Chloroethoxy) Methane			19 U																	
2,4-Dichlorophenol			94 U																	
1,2,4-Trichlorobenzene			19 U																	
Naphthalene	2,300		19 U																	
4-Chloroaniline			94 U																	
Hexachlorobutadiene			19 U																	
4-Chloro-3-methylphenol			94 U																	
2-Methylnaphthalene			19 U																	
Hexachlorocyclopentadiene			94 U																	
2,4,6-Trichlorophenol			94 U																	
2,4,5-Trichlorophenol			94 U																	
2-Chloronaphthalene			19 U																	
2-Nitroaniline			94 U																	
Dimethylphthalate	---		19 U																	
Acenaphthylene	---		19 U																	
3-Nitroaniline			94 U																	
Acenaphthene	340		19 U																	
2,4-Dinitrophenol			190 U																	
4-Nitrophenol			94 U																	
Dibenzofuran	80,000		19 U																	
2,6-Dinitrotoluene			94 U																	
2,4-Dinitrotoluene			94 U																	
Diethylphthalate	4,200		**20**																	
4-Chlorophenyl-phenylether			19 U																	
Fluorene	470		19 U																	
4-Nitroaniline			94 U																	
4,6-Dinitro-2-Methylphenol			190 U																	
N-Nitrosodiphenylamine			19 U																	
4-Bromophenyl-phenylether			19 U																	
Hexachlorobenzene			19 U																	
Pentachlorophenol	160		94 U																	
Phenanthrene	---		19 U																	
Carbazole	---		19 U																	
Anthracene	4,500		19 U																	
Di-n-Butylphthalate	5,000		19 U																	
Fluoranthene	3,200		19 U																	
Pyrene	20,000		19 U																	
Butylbenzylphthalate	280		19 U																	
3,3'-Dichlorobenzidine			94 U																	
Benzo(a)anthracene	130		19 U																	
bis(2-Ethylhexyl)phthalate	6,600		47 U																	
Chrysene	140		19 U																	
Di-n-Octyl phthalate			19 U																	
Benzo(a)pyrene	350		19 U																	
Indeno(1,2,3-cd)pyrene	700		19 U																	
Dibenz(a,h)anthracene	140		19 U																	
Benzo(g,h,i)perylene	---		19 U																	
1-Methylnaphthalene	35,000		19 U																	
Total Benzofluoranthenes	430		38 U																	
ORGANOTINS (µg/kg)																				
KRONE88																				
Tributyltin Ion	---																			
Dibutyltin Ion	---																			
Butyltin Ion	---																			
CONVENTIONALS (%)																				
Total Solids (SM2540B)	---					**89.40**														
Total Organic Carbon (PLUMB81TC)	---					**0.082**														

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-25	WM-GP-25	WM-GP-25	WM-GP-25	WM-GP-26	WM-GP-26	WM-GP-26	WM-GP-27	WM-GP-27	WM-GP-28	WM-GP-28	WM-GP-29	WM-GP-29	WM-GP-30
		1-2	2-3	5-6	6-7	7-8	10-11	1-2	5-6	6-7	10-11	1-2	2-3	6-7	5-6	6-7	5-6	6-7	5-6	6-7	1-2
		YH19N	YI99O	YK90H	YN60M	YN60J	YN60K	YH19M	YK90F	YI44B	YK90G	YH18P	YI99F	YN60L	YH19K	YH19L	YH18S	YH18T	YH18Q/YN60F	YH18R/YN60G	YH18K
		4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014
TOTAL METALS (mg/kg)																					
Methods EPA200.8/ SW6010C/SW7471A																					
Arsenic	20	**3.5**		**6.9**				**4.1**				**12.2**	**5.6**	**2.7**					**5.3**	**3.0**	**5.9**
Cadmium	80																				
Chromium	2000																				
Copper	3,200	**38.6**	**16.5**	**287**	**272**	**193**	**18.0**	**18.0**			**140**	**363**	**20.6**	**17.1**					**714**	**13.9**	**198**
Lead	250																				
Mercury	2	**0.10**		**0.11** J				**0.09**				**1.11**	**0.06**	0.04 UJ					**0.31** J	0.03 UJ	**0.91**
Zinc	24,000	**80**		**281**	**206**	**260**	**32**	**34**			**185**	**160**	**46**	**29**					**320**	**32**	**340**
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																					
HCID																					
Gasoline	---																				
Diesel	---																				
Oil	---																				
NWTPH-Dx																					
Diesel Range Organics	2000			**25**											**56**	6.7 U	**26**	6.0 U	**21**	6.2 U	
Lube Oil	2000			**94**											**83**	14 U	**73**	12 U	**55**	12 U	
NWTPH-Gx																					
Gasoline	30/100 (a)																				
PAHs (µg/kg)																					
Method SW8270DSIM																					
Naphthalene	2,300	4.8 U		**37**				4.7 U	**6.8**		**57**	**36**		**24**	**13**	**8.1**	**6.5**	**14**	4.9 U	**10**	**5.7**
2-Methylnaphthalene	320,000	4.8 U		**20**				**13**	5.0 U		4.8 U	**90**			**16**	**5.4**	**8.2**	5.0 U	4.9 U	4.8 U	**6.8**
1-Methylnaphthalene	35,000	4.8 U		**14**				**5.6**	5.0 U		4.8 U	**45**			**26**	4.8 U	4.6 U	5.0 U	4.9 U	**31**	4.9 U
Acenaphthylene	---	4.8 U		**36**				4.7 U	5.0 U		**16**	**5.0**			**9.4**	4.8 U	**13**	5.0 U	**7.0**	4.8 U	4.9 U
Acenaphthene	340	4.8 U		**11**				4.7 U	5.0 U		**5.0**	**8.6**			4.8 U	**8.3**	**6.8**	5.0 U	4.9 U	**120**	4.9 U
Fluorene	470	4.8 U		**17**				4.7 U	5.0 U		**11**	**9.2**			**5.2**	**8.5**	**6.7**	5.0 U	4.9 U	**13**	4.9 U
Phenanthrene	---	**13**		**300**				**7.5**	**16**		**86**	**44**			**20**	**22**	**120**	**15**	**34**	**7.2**	**41**
Anthracene	4500	4.8 U		**65**				4.7 U	5.0 U		**23**	**9.3**			**7.3**	**4.9**	**28**	5.0 U	**15**	4.8 U	**7.6**
Fluoranthene	3200	**23**		**600**				**11**	**29**		**180**	**22**			**49**	**23**	**280**	**12**	**98**	**7.0**	**78**
Pyrene	20000	**22**		**520**				**13**	**32**		**210**	**23**			**45**	**25**	**200**	**11**	**73**	**6.9**	**61**
Benzo(a)anthracene	130	**10**		**210**	**3800**	**38**	**71**	**7.4**	**16**		**66**	**9.2**		14 U	**26**	**7.8**	**110**	5.0 U	**46**	4.8 U	**31**
Chrysene	140	**16**		**270**	**4200**	**54**	**76**	**12**	**23**		**96**	**18**		14 U	**41**	**9.7**	**160**	5.0 U	**83**	4.8 U	**47**
Benzo(a)pyrene	350	**12**		**240**	**4200**	**41**	49 U	**7.5**	**20**		**90**	**17**		14 U	**39**	**8.0**	**140**	5.0 U	**64**	4.8 U	**38**
Indeno(1,2,3-cd)pyrene	700	**7.8**		**130**	**2000**	**22**	49 U	**10**	**22**		**200**	**34**		14 U	**38**	**5.2**	**120**	5.0 U	**65**	4.8 U	**34**
Dibenz(a,h)anthracene	140	4.8 U		**35**	**570**	15 U	49 U	4.7 U	5.0 U		**23**	4.7 U		14 U	**8.6**	4.8 U	**27**	5.0 U	**16**	4.8 U	**8.2**
Benzo(g,h,i)perylene	---	**11**		**170**				**24**	**41**		**430**	**58**		14 U	**53**	**8.8**	**160**	5.0 U	**75**	4.8 U	**47**
Dibenzofuran	---	4.8 U		**20**				4.7 U	5.0 U		**16**	**19**		**18**	4.8 U	**4.9**	**5.9**	5.0 U	4.9 U	**32**	4.9 U
Total Benzofluoranthenes	430	**23**		**450**	**5500**	**74**	**79**	**19**	**40**		**260**	**28**		14 U	**79**	**14**	**280**	5.0 U	**200**	4.8 U	**82**
TEQ	140	**16**		**325**	**5429**	**55**	**16**	**11**	**28**		**146**	**24**		ND	**55**	**11**	**195**	ND	**98**	ND	**54**
PCBs (µg/kg)																					
Method SW8082A																					
Aroclor 1016	33																				
Aroclor 1242	---																				
Aroclor 1248	---																				
Aroclor 1254	500																				
Aroclor 1260	490																				
Aroclor 1221	---																				
Aroclor 1232	---																				
Aroclor 1262	---																				
Aroclor 1268	---																				
Total PCBs	160																				
VOLATILES (µg/kg)																					
Method SW8260C																					
Chloromethane	---																				
Bromomethane																					
Vinyl Chloride																					
Chloroethane																					
Methylene Chloride	2,600																				
Acetone	72,000,000																				
Carbon Disulfide	8,000,000																				
1,1-Dichloroethene																					
1,1-Dichloroethane																					
trans-1,2-Dichloroethene																					

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-24	WM-GP-25	WM-GP-25	WM-GP-25	WM-GP-25	WM-GP-26	WM-GP-26	WM-GP-26	WM-GP-27	WM-GP-27	WM-GP-28	WM-GP-28	WM-GP-29	WM-GP-29	WM-GP-30
		1-2	2-3	5-6	6-7	7-8	10-11	1-2	5-6	6-7	10-11	1-2	2-3	6-7	5-6	6-7	5-6	6-7	5-6	6-7	1-2
		YH19N	YI99O	YK90H	YN60M	YN60J	YN60K	YH19M	YK90F	YI44B	YK90G	YH18P	YI99F	YN60L	YH19K	YH19L	YH18S	YH18T	YH18Q/YN60F	YH18R/YN60G	YH18K
		4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/16/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014
cis-1,2-Dichloroethene																					
Chloroform																					
1,2-Dichloroethane																					
2-Butanone	48,000,000																				
1,1,1-Trichloroethane																					
Carbon Tetrachloride																					
Vinyl Acetate																					
Bromodichloromethane																					
1,2-Dichloropropane																					
cis-1,3-Dichloropropene																					
Trichloroethene																					
Dibromochloromethane																					
1,1,2-Trichloroethane																					
Benzene	130																				
trans-1,3-Dichloropropene																					
2-Chloroethylvinylether																					
Bromoform																					
4-Methyl-2-pentanone																					
2-Hexanone																					
Tetrachloroethene																					
1,1,2,2-Tetrachloroethane																					
Toluene	110,000																				
Chlorobenzene																					
Ethylbenzene																					
Styrene																					
Trichlorofluoromethane																					
CFC-113																					
m, p-Xylene	---																				
o-Xylene																					
1,2-Dichlorobenzene																					
1,3-Dichlorobenzene																					
1,4-Dichlorobenzene																					
Acrolein																					
Iodomethane																					
Bromoethane																					
Acrylonitrile																					
1,1-Dichloropropene																					
Dibromomethane																					
1,1,1,2-Tetrachloroethane																					
1,2-Dibromo-3-chloropropane																					
1,2,3-Trichloropropane																					
trans-1,4-Dichloro-2-butene																					
1,3,5-Trimethylbenzene																					
1,2,4-Trimethylbenzene																					
Hexachlorobutadiene																					
1,2-Dibromoethane																					
Bromochloromethane																					
2,2-Dichloropropane																					
1,3-Dichloropropane																					
Isopropylbenzene	8,000,000																				
n-Propylbenzene	8,000,000																				
Bromobenzene																					
2-Chlorotoluene																					
4-Chlorotoluene																					
tert-Butylbenzene																					
sec-Butylbenzene	---																				
4-Isopropyltoluene	---																				
n-Butylbenzene																					
1,2,4-Trichlorobenzene																					
Naphthalene	2,300																				
1,2,3-Trichlorobenzene																					
SEMIVOLATILES (µg/kg)																					
Method SW8270D																					
Phenol	2,700																				
Bis-(2-Chloroethyl) Ether																					
2-Chlorophenol																					
1,3-Dichlorobenzene																					
1,4-Dichlorobenzene																					
Benzyl Alcohol	8,000,000																				
1,2-Dichlorobenzene																					

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-24 1-2 YH19N 4/16/2014	WM-GP-24 2-3 YI99O 4/16/2014	WM-GP-24 5-6 YK90H 4/16/2014	WM-GP-24 6-7 YN60M 4/16/2014	WM-GP-24 7-8 YN60J 4/16/2014	WM-GP-24 10-11 YN60K 4/16/2014	WM-GP-25 1-2 YH19M 4/16/2014	WM-GP-25 5-6 YK90F 4/16/2014	WM-GP-25 6-7 YI44B 4/16/2014	WM-GP-25 10-11 YK90G 4/16/2014	WM-GP-26 1-2 YH18P 4/15/2014	WM-GP-26 2-3 YI99F 4/15/2014	WM-GP-26 6-7 YN60L 4/15/2014	WM-GP-27 5-6 YH19K 4/15/2014	WM-GP-27 6-7 YH19L 4/15/2014	WM-GP-28 5-6 YH18S 4/15/2014	WM-GP-28 6-7 YH18T 4/15/2014	WM-GP-29 5-6 YH18Q/YN60F 4/15/2014	WM-GP-29 6-7 YH18R/YN60G 4/15/2014	WM-GP-30 1-2 YH18K 4/15/2014
2-Methylphenol																					
2,2'-Oxybis(1-Chloropropane)																					
4-Methylphenol	400,000																				
N-Nitroso-Di-N-Propylamine																					
Hexachloroethane																					
Nitrobenzene																					
Isophorone																					
2-Nitrophenol																					
2,4-Dimethylphenol																					
Benzoic Acid																					
bis(2-Chloroethoxy) Methane																					
2,4-Dichlorophenol																					
1,2,4-Trichlorobenzene																					
Naphthalene	2,300																				
4-Chloroaniline																					
Hexachlorobutadiene																					
4-Chloro-3-methylphenol																					
2-Methylnaphthalene																					
Hexachlorocyclopentadiene																					
2,4,6-Trichlorophenol																					
2,4,5-Trichlorophenol																					
2-Chloronaphthalene																					
2-Nitroaniline																					
Dimethylphthalate	---																				
Acenaphthylene	---																				
3-Nitroaniline																					
Acenaphthene	340																				
2,4-Dinitrophenol																					
4-Nitrophenol																					
Dibenzofuran	80,000																				
2,6-Dinitrotoluene																					
2,4-Dinitrotoluene																					
Diethylphthalate	4,200																				
4-Chlorophenyl-phenylether																					
Fluorene	470																				
4-Nitroaniline																					
4,6-Dinitro-2-Methylphenol																					
N-Nitrosodiphenylamine																					
4-Bromophenyl-phenylether																					
Hexachlorobenzene																					
Pentachlorophenol	160																				
Phenanthrene	---																				
Carbazole	---																				
Anthracene	4,500																				
Di-n-Butylphthalate	5,000																				
Fluoranthene	3,200																				
Pyrene	20,000																				
Butylbenzylphthalate	280																				
3,3'-Dichlorobenzidine																					
Benzo(a)anthracene	130																				
bis(2-Ethylhexyl)phthalate	6,600																				
Chrysene	140																				
Di-n-Octyl phthalate																					
Benzo(a)pyrene	350																				
Indeno(1,2,3-cd)pyrene	700																				
Dibenz(a,h)anthracene	140																				
Benzo(g,h,i)perylene	---																				
1-Methylnaphthalene	35,000																				
Total Benzofluoranthenes	430																				
ORGANOTINS (µg/kg)																					
KRONE88																					
Tributyltin Ion	---																				
Dibutyltin Ion	---																				
Butyltin Ion	---																				
CONVENTIONALS (%)																					
Total Solids (SM2540B)	---									**70.43**											
Total Organic Carbon (PLUMB81TC)	---									**1.51** J											

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-30 3-4 YH18L 4/15/2014	WM-GP-30 5-6.5 YH18E 4/15/2014	WM-GP-30 6.5-8 YH71B/YI99D 4/15/2014	WM-GP-30 14-15 YN60I 4/15/2014	WM-GP-31 1-2 YH18H 4/15/2014	WM-GP-31 3-4 YH18I 4/15/2014	WM-GP-31 5-6 YH18J 4/15/2014	WM-GP-31 7-8 YI99C 4/15/2014	WM-GP-31 10-11 YM64A 4/15/2014	WM-GP-31 11-12 YN60H 4/15/2014	WM-GP-32 1-2 YH18O 4/15/2014	WM-GP-32 2-3 YH18M 4/15/2014	WM-GP-32 5-6 YH18N 4/15/2014	WM-GP-32 7-8 YI99E 4/15/2014	WM-GP-32 12-13 YH71D 4/15/2014	WM-GP-32 13.5-15 YH18G 4/15/2014	WM-GP-33 6-7 YH71I 4/16/2014	WM-GP-33 7-8 YH19E 4/16/2014	WM-GP-33 10-11 YH71J 4/16/2014
TOTAL METALS (mg/kg) Methods EPA200.8/ SW6010C/SW7471A																				
Arsenic	20	**14.0**	**18.4**	**5.6**	**1.2**	**10.1**	**10.3**	**10.3**	**6.9** J			**4.6**	**15.3**	**4.9**			**1.5**		**2.6**	
Cadmium	80																			
Chromium	2000																			
Copper	3,200	**438**	**156**	**25.7**	**2.9**	**1,370**	**83.9**	**350**	**106** J	**176**	**4.3**	**81.8**	**956**	**44.2**	**6.9**		**3.8**		**9.1**	
Lead	250																			
Mercury	2	**1.30**	**1.17**	**0.12**	0.02 UJ	**1.76**	**1.88**	**1.21**	**0.83** J	**1.01** J	0.03 UJ	**0.56**	**9.6**	**0.67**	0.03 U		0.03 U		0.02 U	
Zinc	24,000	**241**	**138**	**49**	**10**	**1,030**	**85**	**303**	**97**			**62**	**246**	**46**	**22**		**16**		**23**	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																				
HCID																				
Gasoline	---																			
Diesel	---																			
Oil	---																			
NWTPH-Dx																				
Diesel Range Organics	2000		**92**														**43**		6.4 U	
Lube Oil	2000		**330**														**68**		13 U	
NWTPH-Gx																				
Gasoline	30/100 (a)		**6.0**	5.2 U												8.7 U	5.2 U	5.1 U	4.8 U	6.3 U
PAHs (µg/kg) Method SW8270DSIM																				
Naphthalene	2,300	**22**	**25**		4.8 U	**31**	4.7 U	**8.5**				**9.7**	**13**	**7.0**			**7.9**		**29**	
2-Methylnaphthalene	320,000	**27**	**15**			**32**	4.7 U	**7.6**				**15**	**18**	**13**			4.9 U		5.0 U	
1-Methylnaphthalene	35,000	**11**	**9.2**			**19**	4.7 U	4.8 U				**7.7**	**20**	**7.9**			4.9 U		5.0 U	
Acenaphthylene	---	**7.8**	**5.1**			**15**	4.7 U	**6.5**				**5.1**	**8.7**	4.8 U			4.9 U		**5.1**	
Acenaphthene	340	**51**	**39**			**13**	4.7 U	**7.0**				4.6 U	**6.0**	4.8 U			4.9 U		**11**	
Fluorene	470	**120**	**59**			**15**	4.7 U	**10**				4.6 U	4.6 U	**5.5**			**5.6**		**15**	
Phenanthrene	---	**150**	**82**			**140**	**32**	**69**				**18**	**47**	**23**			**25**		**38**	
Anthracene	4500	**45**	**34**			**32**	**9.8**	**21**				**8.8**	**23**	**8.4**			**8.9**		**14**	
Fluoranthene	3200	**460**	**320**			**360**	**69**	**170**				**12**	**110**	**19**			**50**		**65**	
Pyrene	20000	**360**	**180**			**220**	**58**	**120**				**8.9**	**70**	**16**			**48**		**53**	
Benzo(a)anthracene	130	**91**	**62**		4.8 U	**110**	**34**	**60**				4.6 U	**57**	**7.0**			**18**		**16**	
Chrysene	140	**160**	**86**		4.8 U	**200**	**40**	**75**				**8.2**	**94**	**12**			**22**		**17**	
Benzo(a)pyrene	350	**78**	**60**		4.8 U	**140**	**42**	**61**				**8.6**	**87**	**7.5**			**18**		**12**	
Indeno(1,2,3-cd)pyrene	700	**54**	**37**		4.8 U	**120**	**32**	**42**				**12**	**110**	**8.3**			**9.4**		**5.7**	
Dibenz(a,h)anthracene	140	**15**	**9.7**		4.8 U	**29**	**19**	**12**				4.6 U	**23**	4.8 U			4.9 U		5.0 U	
Benzo(g,h,i)perylene	---	**63**	**46**		4.8 UJ	**160**	**44**	**52**				**16**	**140**	**17**			**11**		**7.2**	
Dibenzofuran	---	**98**	**60**		4.8 U	**19**	4.7 U	**13**				**11**	**9.5**	**6.0**			4.9 U		**9.4**	
Total Benzofluoranthenes	430	**200**	**130**		4.8 U	**370**	**75**	**120**				**18**	**200**	**15**			**31**		**21**	
TEQ	140	**116**	**85**		ND	**205**	**58**	**85**				**12**	**127**	**11**			**24**		**16**	
PCBs (µg/kg) Method SW8082A																				
Aroclor 1016	33																			
Aroclor 1242	---																			
Aroclor 1248	---																			
Aroclor 1254	500																			
Aroclor 1260	490																			
Aroclor 1221	---																			
Aroclor 1232	---																			
Aroclor 1262	---																			
Aroclor 1268	---																			
Total PCBs	160																			
VOLATILES (µg/kg) Method SW8260C																				
Chloromethane	---		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Bromomethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Vinyl Chloride			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Chloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Methylene Chloride	2,600		1.4 U	**3.8**												**11**	1.6 U	**3.1**	1.4 U	**12**
Acetone	72,000,000		**82**	110 UJ												200 UJ	**150**	100 UJ	**92**	**45**
Carbon Disulfide	8,000,000		**6.0**	**4.3**												**26**	**12**	**2.5**	0.7 U	**15**
1,1-Dichloroethene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,1-Dichloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
trans-1,2-Dichloroethene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening	WM-GP-30	WM-GP-30	WM-GP-30	WM-GP-30	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-33	WM-GP-33	WM-GP-33
	Levels	3-4	5-6.5	6.5-8	14-15	1-2	3-4	5-6	7-8	10-11	11-12	1-2	2-3	5-6	7-8	12-13	13.5-15	6-7	7-8	10-11
		YH18L	YH18E	YH71B/YI99D	YN60I	YH18H	YH18I	YH18J	YI99C	YM64A	YN60H	YH18O	YH18M	YH18N	YI99E	YH71D	YH18G	YH71I	YH19E	YH71J
		4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/16/2014	4/16/2014	4/16/2014
cis-1,2-Dichloroethene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Chloroform			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,2-Dichloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
2-Butanone	48,000,000		3.4 U	3.2 U												**7.4**	**4.7**	3.1 U	3.5 U	8.8 U
1,1,1-Trichloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Carbon Tetrachloride			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Vinyl Acetate			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
Bromodichloromethane			0.7 U	0.6 UJ												1.4 UJ	0.8 U	0.6 UJ	0.7 U	1.8 U
1,2-Dichloropropane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
cis-1,3-Dichloropropene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Trichloroethene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Dibromochloromethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,1,2-Trichloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Benzene	130		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
trans-1,3-Dichloropropene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
2-Chloroethylvinylether			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
Bromoform			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
4-Methyl-2-pentanone			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
2-Hexanone			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
Tetrachloroethene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,1,2,2-Tetrachloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Toluene	110,000		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Chlorobenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Ethylbenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Styrene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Trichlorofluoromethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
CFC-113			1.4 U	1.3 U												2.8 U	1.6 U	1.2 U	1.4 U	3.5 U
m, p-Xylene	---		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
o-Xylene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,2-Dichlorobenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,3-Dichlorobenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,4-Dichlorobenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Acrolein			34 U	32 U												69 U	40 U	31 U	35 U	88 U
Iodomethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Bromoethane			1.4 U	1.3 U												2.8 U	1.6 U	1.2 U	1.4 U	3.5 U
Acrylonitrile			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
1,1-Dichloropropene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Dibromomethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,1,1,2-Tetrachloroethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,2-Dibromo-3-chloropropane			3.4 U	3.2 UJ												6.9 UJ	4.0 U	3.1 UJ	3.5 U	8.8 U
1,2,3-Trichloropropane			1.4 U	1.3 U												2.8 U	1.6 U	1.2 U	1.4 U	3.5 U
trans-1,4-Dichloro-2-butene			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
1,3,5-Trimethylbenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,2,4-Trimethylbenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Hexachlorobutadiene			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
1,2-Dibromoethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Bromochloromethane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
2,2-Dichloropropane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,3-Dichloropropane			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Isopropylbenzene	8,000,000		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
n-Propylbenzene	8,000,000		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
Bromobenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
2-Chlorotoluene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
4-Chlorotoluene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
tert-Butylbenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
sec-Butylbenzene	---		0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
4-Isopropyltoluene	---		0.7 U	0.6 U												**1.5**	0.8 U	0.6 U	0.7 U	1.8 U
n-Butylbenzene			0.7 U	0.6 U												1.4 U	0.8 U	0.6 U	0.7 U	1.8 U
1,2,4-Trichlorobenzene			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
Naphthalene	2,300		3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
1,2,3-Trichlorobenzene			3.4 U	3.2 U												6.9 U	4.0 U	3.1 U	3.5 U	8.8 U
SEMIVOLATILES (μg/kg)																				
Method SW8270D																				
Phenol	2,700																			
Bis-(2-Chloroethyl) Ether																				
2-Chlorophenol																				
1,3-Dichlorobenzene																				
1,4-Dichlorobenzene																				
Benzyl Alcohol	8,000,000																			
1,2-Dichlorobenzene																				

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-30	WM-GP-30	WM-GP-30	WM-GP-30	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-31	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-32	WM-GP-33	WM-GP-33	WM-GP-33
		3-4	5-6.5	6.5-8	14-15	1-2	3-4	5-6	7-8	10-11	11-12	1-2	2-3	5-6	7-8	12-13	13.5-15	6-7	7-8	10-11
		YH18L	YH18E	YH71B/YI99D	YN60I	YH18H	YH18I	YH18J	YI99C	YM64A	YN60H	YH18O	YH18M	YH18N	YI99E	YH71D	YH18G	YH71I	YH19E	YH71J
		4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/15/2014	4/16/2014	4/16/2014	4/16/2014
2-Methylphenol																				
2,2'-Oxybis(1-Chloropropane)																				
4-Methylphenol	400,000																			
N-Nitroso-Di-N-Propylamine																				
Hexachloroethane																				
Nitrobenzene																				
Isophorone																				
2-Nitrophenol																				
2,4-Dimethylphenol																				
Benzoic Acid																				
bis(2-Chloroethoxy) Methane																				
2,4-Dichlorophenol																				
1,2,4-Trichlorobenzene																				
Naphthalene	2,300																			
4-Chloroaniline																				
Hexachlorobutadiene																				
4-Chloro-3-methylphenol																				
2-Methylnaphthalene																				
Hexachlorocyclopentadiene																				
2,4,6-Trichlorophenol																				
2,4,5-Trichlorophenol																				
2-Chloronaphthalene																				
2-Nitroaniline																				
Dimethylphthalate	---																			
Acenaphthylene	---																			
3-Nitroaniline																				
Acenaphthene	340																			
2,4-Dinitrophenol																				
4-Nitrophenol																				
Dibenzofuran	80,000																			
2,6-Dinitrotoluene																				
2,4-Dinitrotoluene																				
Diethylphthalate	4,200																			
4-Chlorophenyl-phenylether																				
Fluorene	470																			
4-Nitroaniline																				
4,6-Dinitro-2-Methylphenol																				
N-Nitrosodiphenylamine																				
4-Bromophenyl-phenylether																				
Hexachlorobenzene																				
Pentachlorophenol	160																			
Phenanthrene	---																			
Carbazole	---																			
Anthracene	4,500																			
Di-n-Butylphthalate	5,000																			
Fluoranthene	3,200																			
Pyrene	20,000																			
Butylbenzylphthalate	280																			
3,3'-Dichlorobenzidine																				
Benzo(a)anthracene	130																			
bis(2-Ethylhexyl)phthalate	6,600																			
Chrysene	140																			
Di-n-Octyl phthalate																				
Benzo(a)pyrene	350																			
Indeno(1,2,3-cd)pyrene	700																			
Dibenz(a,h)anthracene	140																			
Benzo(g,h,i)perylene	---																			
1-Methylnaphthalene	35,000																			
Total Benzofluoranthenes	430																			
ORGANOTINS (µg/kg)																				
KRONE88																				
Tributyltin Ion	---																			
Dibutyltin Ion	---																			
Butyltin Ion	---																			
CONVENTIONALS (%)																				
Total Solids (SM2540B)	---																			
Total Organic Carbon (PLUMB81TC)	---																			

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-33 13-14 YH19F 4/16/2014	WM-GP-34 6-7 YH71K/YI44A 4/16/2014	WM-GP-34 7-8 YH19G 4/16/2014	WM-GP-34 8-9 YH71L 4/16/2014	WM-GP-35 5-6.5 YH19H 4/16/2014	WM-GP-35 10-11 YI99P 4/16/2014	WM-MW-3 7-8 YH18A 4/14/2014	WM-MW-3 7-8 YK90E 4/14/2014	WM-MW-4 11-12 YH71C 4/15/2014	WM-MW-4 12-13 YH18F 4/15/2014	WM-MW-5 7-8 YH18C/YN60E 4/15/2014	WM-MW-6 6-7 YH71A/YI99A 4/14/2014	WM-MW-6 7-8 YH18D 4/14/2014	WM-MW-6 8-9 YI99B 4/14/2014	WM-MW-6 9-10 YH18B 4/14/2014
TOTAL METALS (mg/kg) Methods EPA200.8/ SW6010C/SW7471A																
Arsenic	20	**1.4**		**3.8**		**19.9**	**7.8**		**3.7**		**1.5**	**4.0**		**3.1**		
Cadmium	80															
Chromium	2000															
Copper	3,200	**4.6**		**12.3**		**455**	**204**		**14.3**		**2.9**	**21.4**		**12.9** J		
Lead	250															
Mercury	2	0.03 U		0.02 U		**0.17**	**0.35**				0.03 U	**0.03** J		0.03 U		
Zinc	24,000	**16**		**33**		**490**	**520**		**38**		**12**	**45**		**37**		
TOTAL PETROLEUM HYDROCARBONS (mg/kg)																
HCID																
Gasoline	---															
Diesel	---															
Oil	---															
NWTPH-Dx																
Diesel Range Organics	2000	**12**		6.3 U		**1,800**	**140**				6.4 U			**12**		
Lube Oil	2000	**16**		13 U		**3,000**	**210**				13 U			12 U		
NWTPH-Gx																
Gasoline	30/100 (a)	5.8 U	5.0 U	5.0 U	4.6 U	13 U				5.0 U	5.0 U		4.4 U	4.0 U		
PAHs (µg/kg) Method SW8270DSIM																
Naphthalene	2,300	**19**		**23**		**41**	**24**				4.9 U		**49**	**450**	**32**	
2-Methylnaphthalene	320,000	4.9 U		4.8 U		38 U	**34**				4.9 U		**7.3**	**25**	4.8 U	
1-Methylnaphthalene	35,000	4.9 U		4.8 U		38 U	**10**				4.9 U		**11**	**89**	**10**	
Acenaphthylene	---	**6.2**		4.8 U		**120**	**27**				4.9 U		**5.5**	4.7 U	4.8 U	
Acenaphthene	340	**5.7**		4.8 U		38 U	**13**				4.9 U		**36**	**710**	**140**	
Fluorene	470	**13**		4.8 U		**140**	**48**				4.9 U		**13**	**940**	**110**	
Phenanthrene	---	**62**		**14**		**1,300**	**370**				4.9 U		**17**	**1,200**	**170**	
Anthracene	4500	**16**		4.8 U		**310**	**77**				4.9 U		**9.2**	**120**	**14**	
Fluoranthene	3200	**90**		**15**		**1,500**	**430**				4.9 U		**34**	**1,000**	**160**	
Pyrene	20000	**90**		**15**		**1,000**	**300**				4.9 U		**29**	**560**	**110**	
Benzo(a)anthracene	130	**29**		4.8 U		**550**	**140**				4.9 U		**15**	**170**	**31**	
Chrysene	140	**34**		4.8 U		**720**	**170**				4.9 U		**42** J	**100**	**23**	
Benzo(a)pyrene	350	**26**		4.8 U		**540**	**130**				4.9 U		**28**	**77**	**15**	
Indeno(1,2,3-cd)pyrene	700	**14**		4.8 U		**260**	**62**				4.9 U		**30**	**25**	**7.2**	
Dibenz(a,h)anthracene	140	4.9 U		4.8 U		**86**	**20**				4.9 U		**7.3**	**8.4**	4.8 U	
Benzo(g,h,i)perylene	---	**17**		4.8 U		**330**	**69**				4.9 U		**41**	**30**	**9.4**	
Dibenzofuran	---	**5.4**		4.8 U		**77**	**22**				4.9 U		**15**	**1,000**	**100**	
Total Benzofluoranthenes	430	**39**		**5.9**		**930**	**210**				4.9 U		**78**	**240**	**45**	
TEQ	140	**35**		**0.59**		**730**	**175**				ND		**41** J	**122**	**24**	
PCBs (µg/kg) Method SW8082A																
Aroclor 1016	33															
Aroclor 1242	---															
Aroclor 1248	---															
Aroclor 1254	500															
Aroclor 1260	490															
Aroclor 1221	---															
Aroclor 1232	---															
Aroclor 1262	---															
Aroclor 1268	---															
Total PCBs	160															
VOLATILES (µg/kg) Method SW8260C																
Chloromethane	---	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		**0.7**	0.6 U		
Bromomethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		**0.6** J	0.6 U		
Vinyl Chloride		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Chloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Methylene Chloride	2,600	3.1 U	**1.3**	1.3 U	**20**	270 U				**6.0**	1.1 U		**2.7**	1.2 U		
Acetone	72,000,000	**310**	50 UJ	**72**	**81**	**1,500**				250 UJ	**79**		83 UJ	**82**		
Carbon Disulfide	8,000,000	**43**	**1.8**	**2.3**	**2.7**	140 U				**17**	**1.4**		**1.8**	**2.0**		
1,1-Dichloroethene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,1-Dichloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
trans-1,2-Dichloroethene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-33 13-14 YH19F 4/16/2014	WM-GP-34 6-7 YH71K/YI44A 4/16/2014	WM-GP-34 7-8 YH19G 4/16/2014	WM-GP-34 8-9 YH71L 4/16/2014	WM-GP-35 5-6.5 YH19H 4/16/2014	WM-GP-35 10-11 YI99P 4/16/2014	WM-MW-3 7-8 YH18A 4/14/2014	WM-MW-3 7-8 YK90E 4/14/2014	WM-MW-4 11-12 YH71C 4/15/2014	WM-MW-4 12-13 YH18F 4/15/2014	WM-MW-5 7-8 YH18C/YN60E 4/15/2014	WM-MW-6 6-7 YH71A/YI99A 4/14/2014	WM-MW-6 7-8 YH18D 4/14/2014	WM-MW-6 8-9 YI99B 4/14/2014	WM-MW-6 9-10 YH18B 4/14/2014
cis-1,2-Dichloroethene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Chloroform		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,2-Dichloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
2-Butanone	48,000,000	**29**	3.0 U	3.2 U	6.0 U	680 U				5.4 U	**3.7**		2.9 U	2.9 U		
1,1,1-Trichloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Carbon Tetrachloride		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Vinyl Acetate		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
Bromodichloromethane		1.6 U	0.6 UJ	0.6 U	1.2 U	140 U				1.1 UJ	0.6 U		0.6 UJ	0.6 U		
1,2-Dichloropropane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
cis-1,3-Dichloropropene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Trichloroethene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Dibromochloromethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,1,2-Trichloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Benzene	130	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
trans-1,3-Dichloropropene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
2-Chloroethylvinylether		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
Bromoform		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
4-Methyl-2-pentanone		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
2-Hexanone		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
Tetrachloroethene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,1,2,2-Tetrachloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Toluene	110,000	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Chlorobenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Ethylbenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Styrene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Trichlorofluoromethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
CFC-113		3.1 U	1.2 U	1.3 U	2.4 U	270 U				2.2 U	1.1 U		1.2 U	1.2 U		
m, p-Xylene	---	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
o-Xylene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,2-Dichlorobenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				**2.9**	**1.1**		0.6 U	0.6 U		
1,3-Dichlorobenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,4-Dichlorobenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Acrolein		78 U	30 U	32 U	60 U	6,800 U				54 U	28 U		29 U	29 U		
Iodomethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		**1.1** J	0.6 U		
Bromoethane		3.1 U	1.2 U	1.3 U	2.4 U	270 U				2.2 U	1.1 U		1.2 U	1.2 U		
Acrylonitrile		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
1,1-Dichloropropene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Dibromomethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,1,1,2-Tetrachloroethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,2-Dibromo-3-chloropropane		7.8 U	3.0 UJ	3.2 U	6.0 U	680 U				5.4 UJ	2.8 U		2.9 UJ	2.9 U		
1,2,3-Trichloropropane		3.1 U	1.2 U	1.3 U	2.4 U	270 U				2.2 U	1.1 U		1.2 U	1.2 U		
trans-1,4-Dichloro-2-butene		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
1,3,5-Trimethylbenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,2,4-Trimethylbenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Hexachlorobutadiene		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
1,2-Dibromoethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Bromochloromethane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
2,2-Dichloropropane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,3-Dichloropropane		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Isopropylbenzene	8,000,000	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
n-Propylbenzene	8,000,000	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
Bromobenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
2-Chlorotoluene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
4-Chlorotoluene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
tert-Butylbenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
sec-Butylbenzene	---	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
4-Isopropyltoluene	---	1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
n-Butylbenzene		1.6 U	0.6 U	0.6 U	1.2 U	140 U				1.1 U	0.6 U		0.6 U	0.6 U		
1,2,4-Trichlorobenzene		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
Naphthalene	2,300	7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	**3.0**		
1,2,3-Trichlorobenzene		7.8 U	3.0 U	3.2 U	6.0 U	680 U				5.4 U	2.8 U		2.9 U	2.9 U		
SEMIVOLATILES (µg/kg)																
Method SW8270D																
Phenol	2,700															
Bis-(2-Chloroethyl) Ether																
2-Chlorophenol																
1,3-Dichlorobenzene																
1,4-Dichlorobenzene																
Benzyl Alcohol	8,000,000															
1,2-Dichlorobenzene																

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Screening Levels	WM-GP-33 13-14 YH19F 4/16/2014	WM-GP-34 6-7 YH71K/YI44A 4/16/2014	WM-GP-34 7-8 YH19G 4/16/2014	WM-GP-34 8-9 YH71L 4/16/2014	WM-GP-35 5-6.5 YH19H 4/16/2014	WM-GP-35 10-11 YI99P 4/16/2014	WM-MW-3 7-8 YH18A 4/14/2014	WM-MW-3 7-8 YK90E 4/14/2014	WM-MW-4 11-12 YH71C 4/15/2014	WM-MW-4 12-13 YH18F 4/15/2014	WM-MW-5 7-8 YH18C/YN60E 4/15/2014	WM-MW-6 6-7 YH71A/YI99A 4/14/2014	WM-MW-6 7-8 YH18D 4/14/2014	WM-MW-6 8-9 YI99B 4/14/2014	WM-MW-6 9-10 YH18B 4/14/2014
2-Methylphenol																
2,2'-Oxybis(1-Chloropropane)																
4-Methylphenol	400,000															
N-Nitroso-Di-N-Propylamine																
Hexachloroethane																
Nitrobenzene																
Isophorone																
2-Nitrophenol																
2,4-Dimethylphenol																
Benzoic Acid																
bis(2-Chloroethoxy) Methane																
2,4-Dichlorophenol																
1,2,4-Trichlorobenzene																
Naphthalene	2,300															
4-Chloroaniline																
Hexachlorobutadiene																
4-Chloro-3-methylphenol																
2-Methylnaphthalene																
Hexachlorocyclopentadiene																
2,4,6-Trichlorophenol																
2,4,5-Trichlorophenol																
2-Chloronaphthalene																
2-Nitroaniline																
Dimethylphthalate	---															
Acenaphthylene	---															
3-Nitroaniline																
Acenaphthene	340															
2,4-Dinitrophenol																
4-Nitrophenol																
Dibenzofuran	80,000															
2,6-Dinitrotoluene																
2,4-Dinitrotoluene																
Diethylphthalate	4,200															
4-Chlorophenyl-phenylether																
Fluorene	470															
4-Nitroaniline																
4,6-Dinitro-2-Methylphenol																
N-Nitrosodiphenylamine																
4-Bromophenyl-phenylether																
Hexachlorobenzene																
Pentachlorophenol	160															
Phenanthrene	---															
Carbazole	---															
Anthracene	4,500															
Di-n-Butylphthalate	5,000															
Fluoranthene	3,200															
Pyrene	20,000															
Butylbenzylphthalate	280															
3,3'-Dichlorobenzidine																
Benzo(a)anthracene	130															
bis(2-Ethylhexyl)phthalate	6,600															
Chrysene	140															
Di-n-Octyl phthalate																
Benzo(a)pyrene	350															
Indeno(1,2,3-cd)pyrene	700															
Dibenz(a,h)anthracene	140															
Benzo(g,h,i)perylene	---															
1-Methylnaphthalene	35,000															
Total Benzofluoranthenes	430															
ORGANOTINS (µg/kg)																
KRONE88																
Tributyltin Ion	---															
Dibutyltin Ion	---															
Butyltin Ion	---															
CONVENTIONALS (%)																
Total Solids (SM2540B)	---		**80.06**													
Total Organic Carbon (PLUMB81TC)	---		**0.188**													

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

U = The compound was not detected at the reported concentration.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
M = An estimated value of analyte found and confirmed by analyst but with low spectral match.
Bold = Detected compound.
Box = Exceedance of Soil Screening Level (unsaturated).
Shade = Exceedance of Direct Contact Soil Screening Level..

(a) For gasoline-range petroleum hydrocarbons, 30 mg/kg is the screening level if benzene is present. If benzene is not present, the screening level is 100 mg/kg.

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

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ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

TABLE 10
ANALYTICAL RESULTS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

TABLE 11
SUMMARY STATISTICS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No.of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
TOTAL METALS (mg/kg)									
Arsenic	101	101	100%	All Detects	All Detects	1.4	82.7	3	3%
Chromium	50	50	100%	All Detects	All Detects	6	74	0	0%
Copper	138	138	100%	All Detects	All Detects	2.8	3,920	1	1%
Lead	52	52	100%	All Detects	All Detects	1	138	0	0%
Zinc	125	124	99%	5	5	10	1,640	0	0%
Cadmium	52	49	94%	0.1	0.1	0.1	2.5	0	0%
Mercury	113	85	75%	0.02	0.07	0.02	17.7	7	6%
ORGANOTINS (µg/kg)									
Butyltin	10	6	60%	3.6	3.8	4	2,800	N/A	N/A
Dibutyltin Ion	10	5	50%	5.1	5.3	230	3,000	N/A	N/A
Tributyltin Ion	10	5	50%	3.4	3.6	260	3,100	N/A	N/A
TPH (mg/kg)									
Diesel Range Organics	53	38	72%	5.2	6.7	6.7	4,000	1	2%
Lube Oil	53	33	62%	10	14	13	3,000	1	2%
Gasoline Range Organics	40	7	18%	4	32	6	110	1	3%
PCBS (µg/kg)									
Aroclor 1254	11	5	45%	31	33	57	250	0	0%
Aroclor 1260	11	3	27%	32	33	34	100	0	0%
Aroclor 1016	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1221	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1232	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1242	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1248	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1262	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Aroclor 1268	11	0	0%	31	33	No Detects	No Detects	N/A	N/A
Total PCBs	11	5	45%	31	33	34	350	1	9%
VOCS (µg/kg)									
Carbon Disulfide	29	27	93%	0.7	140	1.4	83	0	0%
Acetone	29	17	59%	3.7	390	45	1,500	0	0%
Methylene Chloride	29	13	45%	1.1	270	1.3	220	0	0%
2-Butanone	29	10	34%	2.9	680	3.7	160	0	0%
4-Isopropyltoluene	29	5	17%	0.6	140	1.5	2,300	N/A	N/A
Benzene	29	4	14%	0.6	140	1.2	21	0	0%
Chloromethane	29	4	14%	0.6	140	0.7	4.6	N/A	N/A
m, p-Xylene	29	3	10%	0.6	140	1.5	1.8	N/A	N/A
Toluene	29	3	10%	0.6	140	1.7	12	0	0%
1,2-Dichlorobenzene	29	2	7%	0.6	140	1.1	2.9	N/A	N/A
Bromomethane	29	1	3%	0.6	140	0.6	0.6	N/A	N/A
Ethylbenzene	29	1	3%	0.6	140	1.5	1.5	N/A	N/A
Iodomethane	29	1	3%	0.6	140	1.1	1.1	N/A	N/A
Isopropylbenzene	29	1	3%	0.6	140	1.3	1.3	0	0%
Naphthalene	29	1	3%	2.8	680	3	3	0	0%
n-Propylbenzene	29	1	3%	0.6	140	1.3	1.3	0	0%
sec-Butylbenzene	29	1	3%	0.6	140	18	18	0	0%
1,1,1,2-Tetrachloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1,1-Trichloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1,2,2-Tetrachloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1,2-Trichloro-1,2,2-trifluor	29	0	0%	1.1	270	No Detects	No Detects	N/A	N/A

TABLE 11
SUMMARY STATISTICS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No.of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
1,1,2-Trichloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1-Dichloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1-Dichloroethene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,1-Dichloropropene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,2,3-Trichlorobenzene	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
1,2,3-Trichloropropane	29	0	0%	1.1	270	No Detects	No Detects	N/A	N/A
1,2,4-Trichlorobenzene	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
1,2,4-Trimethylbenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,2-Dibromo-3-chloropropar	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
1,2-Dibromoethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,2-Dichloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,2-Dichloropropane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,3,5-Trimethylbenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,3-Dichlorobenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,3-Dichloropropane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
1,4-Dichlorobenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
2,2-Dichloropropane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
2-Chloroethylvinylether	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
2-Chlorotoluene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
2-Hexanone	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
4-Chlorotoluene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
4-Methyl-2-pentanone	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
Acrolein	29	0	0%	28	6800	No Detects	No Detects	N/A	N/A
Acrylonitrile	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
Bromobenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Bromochloromethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Bromodichloromethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Bromoethane	29	0	0%	1.1	270	No Detects	No Detects	N/A	N/A
Bromoform	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Carbon Tetrachloride	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Chlorobenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Chloroethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Chloroform	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
cis-1,2-Dichloroethene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
cis-1,3-Dichloropropene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Dibromochloromethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Dibromomethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Hexachlorobutadiene	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
Methyl tert-Butyl Ether	2	0	0%	1.3	1.3	No Detects	No Detects	N/A	N/A
n-Butylbenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
o-Xylene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Styrene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
tert-Butylbenzene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Tetrachloroethene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
trans-1,2-Dichloroethene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
trans-1,3-Dichloropropene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
trans-1,4-Dichloro-2-butene	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
Trichloroethene	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Trichlorofluoromethane	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A
Vinyl Acetate	29	0	0%	2.8	680	No Detects	No Detects	N/A	N/A
Vinyl Chloride	29	0	0%	0.6	140	No Detects	No Detects	N/A	N/A

TABLE 11
SUMMARY STATISTICS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No.of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
SVOC (µg/kg)									
Anthracene	9	3	33%	19	63	29	160	0	0%
Benzo(a)anthracene	9	3	33%	19	63	110	430	2	22%
Benzo(a)pyrene	9	3	33%	19	63	120	490	2	22%
Benzo(g,h,i)perylene	9	3	33%	19	63	170	430	N/A	N/A
Carbazole	9	3	33%	19	63	22	94	N/A	N/A
Chrysene	9	3	33%	19	63	180	500	3	33%
Dibenz(a,h)anthracene	9	3	33%	19	63	38	98	0	0%
Fluoranthene	9	3	33%	19	63	230	1,000	0	0%
Indeno(1,2,3-cd)pyrene	9	3	33%	19	63	150	370	0	0%
Phenanthrene	9	3	33%	19	63	130	670	N/A	N/A
Phenol	9	3	33%	19	63	37	86	0	0%
Pyrene	9	3	33%	19	63	260	960	0	0%
Total Benzofluoranthenes	9	3	33%	38	63	310	940	2	22%
1-Methylnaphthalene	9	2	22%	19	63	20	27	0	0%
2-Methylnaphthalene	9	2	22%	19	63	30	39	N/A	N/A
Acenaphthene	9	2	22%	19	63	24	30	0	0%
Benzyl Alcohol	9	2	22%	19	320	29	82	0	0%
bis(2-Ethylhexyl)phthalate	9	2	22%	47	63	240	370	0	0%
Dibenzofuran	9	2	22%	19	63	20	51	0	0%
Diethylphthalate	9	2	22%	19	63	20	22	0	0%
Dimethylphthalate	9	2	22%	19	63	100	190	N/A	N/A
Di-n-Butylphthalate	9	2	22%	19	63	31	85	0	0%
Fluorene	9	2	22%	19	63	20	54	0	0%
Naphthalene	9	2	22%	19	63	32	390	0	0%
Pentachlorophenol	9	2	22%	94	320	110	180	1	11%
4-Methylphenol	9	1	11%	19	63	49	49	0	0%
Acenaphthylene	9	1	11%	19	63	72	72	N/A	N/A
Butylbenzylphthalate	9	1	11%	19	63	110	110	0	0%
1,2,4-Trichlorobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
1,2-Dichlorobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
1,3-Dichlorobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
1,4-Dichlorobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
2,2'-Oxybis(1-Chloropropan	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
2,4,5-Trichlorophenol	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2,4,6-Trichlorophenol	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2,4-Dichlorophenol	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2,4-Dimethylphenol	9	0	0%	59	110	No Detects	No Detects	N/A	N/A
2,4-Dinitrophenol	9	0	0%	190	630	No Detects	No Detects	N/A	N/A
2,4-Dinitrotoluene	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2,6-Dinitrotoluene	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2-Chloronaphthalene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
2-Chlorophenol	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
2-Methylphenol	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
2-Nitroaniline	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
2-Nitrophenol	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
3,3'-Dichlorobenzidine	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
3-Nitroaniline	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
4,6-Dinitro-2-Methylphenol	9	0	0%	190	630	No Detects	No Detects	N/A	N/A
4-Bromophenyl-phenylether	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
4-Chloro-3-methylphenol	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
4-Chloroaniline	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
4-Chlorophenyl-phenylether	9	0	0%	19	63	No Detects	No Detects	N/A	N/A

TABLE 11
SUMMARY STATISTICS – SOIL
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	No.of Samples	No. of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection	No. of SL Exceedances	Frequency of Exceedances
4-Nitroaniline	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
4-Nitrophenol	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
Benzoic Acid	9	0	0%	190	630	No Detects	No Detects	N/A	N/A
bis(2-Chloroethoxy) Methan	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Bis-(2-Chloroethyl) Ether	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Di-n-Octyl phthalate	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Hexachlorobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Hexachlorobutadiene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Hexachlorocyclopentadiene	9	0	0%	94	320	No Detects	No Detects	N/A	N/A
Hexachloroethane	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Isophorone	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
Nitrobenzene	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
N-Nitroso-Di-N-Propylamine	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
N-Nitrosodiphenylamine	9	0	0%	19	63	No Detects	No Detects	N/A	N/A
SVOC-SIM (µg/kg)									
Pyrene	103	85	83%	4.6	49	5.2	20,000	0	0%
Phenanthrene	103	84	82%	4.6	48	5.5	12,000	N/A	N/A
Fluoranthene	103	82	80%	4.6	49	5.3	17,000	5	5%
Total Benzofluoranthenes	115	91	79%	4.4	49	5.8	15,000	14	12%
Benzo(g,h,i)perylene	103	76	74%	4.6	49	4.7	7,200	N/A	N/A
Indeno(1,2,3-cd)pyrene	115	85	74%	4.6	49	4.8	5,900	6	5%
Benzo(a)pyrene	115	83	72%	4.6	49	5	8,600	9	8%
Chrysene	115	83	72%	4.4	49	5.1	11,000	28	24%
Benzo(a)anthracene	115	74	64%	4.4	49	5.9	6,900	21	18%
Anthracene	103	63	61%	4.6	49	4.9	3,100	0	0%
Naphthalene	112	62	55%	4.4	49	5.5	1,600	0	0%
2-Methylnaphthalene	112	57	51%	4.4	48	5.3	1,000	0	0%
Fluorene	103	54	52%	4.6	48	5.2	1,300	3	3%
Dibenz(a,h)anthracene	115	57	50%	4.4	49	5.3	1,600	7	6%
Dibenzofuran	103	49	48%	4.6	48	4.9	1,000	N/A	N/A
1-Methylnaphthalene	112	46	41%	4.4	48	5.4	920	0	0%
Acenaphthene	103	45	44%	4.6	49	5	710	2	2%
Acenaphthylene	103	43	42%	4.6	48	5	1,300	N/A	N/A
cPAH-TEQ	94	84	89%	-	-	0.58	3,592	32	34%
CONVENTIONALS (%)									
Total Organic Carbon	3	3	100%	All Detects	All Detects	0.082	1.51	N/A	N/A
Total Solids	3	3	100%	All Detects	All Detects	70.43	89.4	N/A	N/A

N/A = Not applicable.

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-01	WM-SG-02	WM-SG-03	WM-SG-04	WM-SG-05	WM-SG-DUP	WM-SG-06	WM-SG-07	WM-SG-08	WM-SG-09	WM-SG-10	WM-SG-11	WM-SG-12	WM-SG-13	WM-SG-14	WM-SG-15
			XJ39D	XJ39K	XJ39L	XJ39B	XJ39E	XJ39P	XJ39F	XJ39A	XJ39N	XJ39M	XJ39J	XJ39I	XJ39G	XJ39H	XJ39C	XJ39O
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013
TOTAL METALS (mg/kg)																		
Methods SW6010C/SW7471A/200.8																		
Arsenic	57	93	**30**	**12**	20 U	6 U	7 U	7 U	7 U	20 U	**10**	**10**	**12**	**10**	**12**	8 U	**20**	**40**
Cadmium	5.1	6.7	0.7 U	**0.4**	0.7 U	0.3 U	0.3 U	0.3 U	0.3 U	0.7 U	**0.9**	**0.8**	**0.9**	**0.8**	**1.0**	**0.6**	0.7 U	**1.5**
Chromium	260	270	**25**	**27.7**	**14**	**13.7**	**17.7**	**14.6**	**15.0**	**10**	**27**	**28**	**26.4**	**23.2**	**28.0**	**18.8**	**69**	**663** J
Copper	390	390	**1,670**	**715**	**609**	**95.4**	**173**	**209** J	**105**	**47.0**	**144**	**51.9**	**795**	**47.2**	**122**	**31.1**	**6,930**	**13,100** J
Lead	450	530	**88**	**19**	**124**	**6**	**10**	**12**	**11**	7 U	**11**	**8**	**17**	**9**	**10**	**5**	**44**	**133** J
Mercury	0.41	0.59	**0.91**	**0.32**	**0.15**	**0.07**	**0.08**	**0.10**	**0.05**	**0.12**	**0.12**	**0.07**	**0.12**	**0.06**	**0.08**	**0.05**	**0.32**	**0.14** J
Silver	6.1	6.1	1 U	0.6 U	1 U	0.4 U	0.4 U	0.4 U	0.4 U	1 U	0.6 U	0.6 U	0.6 U	0.5 U	0.6 U	0.5 U	1 U	1 U
Zinc	410	960	**1,250**	**263**	**443**	**59**	**90** J	**249** J	**89**	**64**	**108**	**81**	**308**	**72**	**127**	**50**	**1,980**	**1,170** J
PAHs (µg/kg)																		
Method SW8270DSIM																		
Dibenz(a,h)anthracene	230	230	**100**	**61**	**58**	**18**	**35**	**25** J	**44**	**14**	**25**	**11**	**40**	**100**	**30**	**17**	**160**	**41** J
1,4-Dichlorobenzene	110	110	4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
1,2,4-Trichlorobenzene	31	51	4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
Hexachlorobenzene	22	70	4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
Hexachlorobutadiene	11	120	4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
Dimethylphthalate	71	160	**56**	**60**	**15**	**10**	**13**	**8.6**	**2.8** J	**7.2**	**15**	**6.4**	**37**	**8.0**	**13**	**4.3** J	**70**	**120**
Butylbenzylphthalate	63	900	**14**	**14**	**14**	**2.9** J	**11**	**6.1**	**5.7**	**9.1**	4.7 U	4.9 U	**5.5**	5.0 U	**8.4**	4.8 U	**22**	**13**
2-Methylphenol	63	63	**3.6** J	**4.7** J	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	**4.4** J	**3.1** J	**4.6** J	5.0 U	4.7 U	4.8 U	**16**	**4.3** J
2,4-Dimethylphenol	29	29	24 U	24 U	23 U	23 U	23 U	23 U	23 U	24 U	24 U	24 U	24 U	25 U	24 U	24 U	**11** J	24 U
N-Nitrosodiphenylamine	28	40	**28**	**4.6** J	**14**	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	**22**	4.8 U
Benzyl Alcohol	57	72	**16** J	**41**	19 U	18 U	18 U	18 U	18 U	19 U	**12** J	**14** J	**19**	20 U	**21**	19 U	**50**	19 U
Pentachlorophenol	360	690	**58** J	**54** J	19 UJ	18 UJ	18 UJ	**12** J	18 UJ	19 UJ	**13** J	20 UJ	**35** J	20 UJ	**14** J	19 UJ	**270** J	**20** J
1,2-Dichlorobenzene	35	50	4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
1,3-Dichlorobenzene			4.7 U	4.9 U	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.7 U	4.9 U	4.7 U	5.0 U	4.7 U	4.8 U	4.8 U	4.8 U
PAHs (µg/kg)																		
Method SW8270DSIM																		
Naphthalene	2,100	2,100																
2-Methylnaphthalene	670	670																
1-Methylnaphthalene																		
Acenaphthylene	1,300	1,300																
Acenaphthene	500	500																
Fluorene	540	540																
Phenanthrene	1,500	1,500																
Anthracene	960	960																
Fluoranthene	1,700	2,500																
Pyrene	2,600	3,300	*PAHs were not analyzed by 8270D-SIM for Phase I samples.*															
Benzo(a)anthracene	1,300	1,600																
Chrysene	1,400	2,800																
Benzo(a)pyrene	1,600	1,600																
Indeno(1,2,3-cd)pyrene	600	690																
Dibenz(a,h)anthracene	230	230																
Benzo(g,h,i)perylene	670	720																
Dibenzofuran	540	540																
Total Benzofluoranthenes	3,200	3,600																
cPAHs (TEQ)																		

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-01	WM-SG-02	WM-SG-03	WM-SG-04	WM-SG-05	WM-SG-DUP	WM-SG-06	WM-SG-07	WM-SG-08	WM-SG-09	WM-SG-10	WM-SG-11	WM-SG-12	WM-SG-13	WM-SG-14	WM-SG-15
			XJ39D	XJ39K	XJ39L	XJ39B	XJ39E	XJ39P	XJ39F	XJ39A	XJ39N	XJ39M	XJ39J	XJ39I	XJ39G	XJ39H	XJ39C	XJ39O
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013
PCBs (µg/kg)																		
Method SW8082A																		
Aroclor 1016			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Aroclor 1242			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Aroclor 1248			**380**	16 U	39 U	9.2 U	9.5 U	5.7 U	4.7 U	3.8 U	5.9 U	9.8 U	**46**	6.0 U	7.8 U	4.8 U	19 U	12 U
Aroclor 1254			**240**	**22**	**130**	**22**	**18**	**14**	**7.1**	**7.0**	**12**	**32**	**49**	**17**	**15**	**6.4**	**43**	**24**
Aroclor 1260			20 U	**8.4**	**33** P	**7.8**	**7.5**	**7.5**	**5.1**	**3.8**	**8.3**	**16**	**14**	**6.9**	**8.1**	3.8 U	**17**	**15**
Aroclor 1221			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Aroclor 1232			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	5.6 U	3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Aroclor 1262			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	3.8 U	**6.2**	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Aroclor 1268			3.9 U	4.0 U	3.9 U	3.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	3.8 U	3.8 U	4.0 U
Total PCBs	130	1,000	**620**	**30.4**	**163**	**29.8**	**25.5**	**21.5**	**12.2**	**10.8**	**26.5**	**48**	**109**	**23.9**	**23.1**	**6.4**	**60**	**39**
PCBs by Congener Analysis																		
Method SW1668A																		
Total PCBs (µg/kg)	130	1,000																
PCB - TEQ (pg/g) (a),(b)																		
SEMIVOLATILES (µg/kg)																		
Method SW8270D																		
Phenol	420	1,200	**24** J	**170**	**36**	**20**	**45** J	**190** J	**510**	19 U	**39**	**22**	**49**	**17** J	**42**	**11** J	**110**	19 U
1,3-Dichlorobenzene			38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
1,4-Dichlorobenzene	110	110	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
Benzyl Alcohol	57	72	38 U	**35**	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	**19**	20 U	19 U	19 U	**49**	19 U
1,2-Dichlorobenzene	35	50	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
2-Methylphenol	63	63	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	**15** J	19 U
4-Methylphenol	670	670	38 U	**24**	**82**	18 U	**16** J	**41**	**15** J	19 U	**43**	**46**	**86**	**130**	**74**	**27**	**24**	**43**
Hexachloroethane			38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 UJ
2,4-Dimethylphenol	29	29	190 U	98 U	93 U	92 U	92 U	92 U	91 U	95 U	94 U	98 U	95 U	99 U	94 U	97 U	95 U	96 U
Benzoic Acid	650	650	380 U	200 UJ	190 UJ	180 UJ	180 UJ	180 U	180 UJ	190 UJ	**160** J	200 UJ	**150** J	200 UJ	**200** J	190 UJ	**280** J	190 U
1,2,4-Trichlorobenzene	31	51	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
Naphthalene	2,100	2,100	**53**	**42**	**20**	**10** J	**44**	**50**	**16** J	**17** J	**50**	**44**	**110**	**70**	**87**	**50**	**56**	**74**
Hexachlorobutadiene	11	120	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
2-Methylnaphthalene	670	670	**38**	20 U	**12** J	18 U	**16** J	**20**	**10** J	**10** J	**18** J	20 U	**26**	**16** J	**24**	**18** J	**26**	**66** J
Dimethylphthalate	71	160	**64**	**61**	**17** J	**12** J	**13** J	**10** J	18 U	19 U	19 U	20 U	**38**	20 U	19 U	19 U	**68**	**98** J
Acenaphthylene	1,300	1,300	**55** J	**42** J	**25** J	**9.2** J	**29** J	**23** J	**13** J	**16** J	**41** J	**16** J	**48** J	**59** J	**44** J	**18** J	**110** J	**24** J
Acenaphthene	500	500	**53**	**21**	**36**	**11** J	**27**	**18**	18 U	19 U	**15** J	20 U	**37**	**16** J	**20**	**13** J	**120**	**27** J
Dibenzofuran	540	540	**43**	**20**	**17** J	18 U	**28**	**21**	18 U	19 U	**22**	**12** J	**42**	**21**	**27**	**18** J	**66**	**36** J
Diethylphthalate	200	1,200	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	230 U	79 U	21 U	20 U	44 U	19 U	19 U	25 U
Fluorene	540	540	**51**	**27**	**31**	**10** J	**27**	**23**	**11** J	**21**	**37**	**18** J	**14** J	**23**	**55**	**28**	**130**	**44** J
N-Nitrosodiphenylamine	28	40	**30** J	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	**26**	19 UJ
Hexachlorobenzene	22	70	38 U	20 U	19 U	18 U	18 U	18 U	18 U	19 U	19 U	20 U	19 U	20 U	19 U	19 U	19 U	19 U
Pentachlorophenol	360	690	190 U	**75** J	93 UJ	92 UJ	92 UJ	92 U	91 UJ	95 UJ	94 UJ	98 UJ	**48** J	99 UJ	94 UJ	97 UJ	**350** J	96 U
Phenanthrene	1,500	1,500	**440**	**270**	**340**	**68**	**710** J	**130** J	**110**	**150**	**220**	**100**	**400**	**120**	**270**	**160**	**1,100**	**430** J
Anthracene	960	960	**170**	**120**	**91**	**27**	**57**	**56** J	**34**	**29**	**94**	**38**	**140**	**160**	**82**	**50**	**370**	**81** J
Di-n-Butylphthalate	1,400	5,100	**41**	**12** J	**130**	**19**	**12** J	18 U	18 U	**13** J	**16** J	20 U	19 U	20 U	19 U	19 U	**66**	19 U
Fluoranthene	1,700	2,500	**1,400**	**1,400**	**900**	**260**	**1,400** J	**360** J	**340**	**220**	**570**	**210**	**760**	**800**	**570**	**370**	**6,500** J	**790** J
Pyrene	2,600	3,300	**2,800**	**1,300**	**930**	**220**	**980** J	**440** J	**270**	**210**	**620**	**220**	**930**	**820**	**640**	**330**	**3,500** J	**710** J
Butylbenzylphthalate	63	900	38 U	**14** J	**15** J	18 U	**16** J	18 U	18 U	**10** J	19 U	20 U	19 U	20 U	19 U	19 U	**110**	**12** J
Benzo(a)anthracene	1,300	1,600	**500**	**550**	**370**	**82**	**150**	**140** J	**160**	**80**	**200**	**93**	**310**	**540**	**200**	**120**	**1,800**	**300** J
bis(2-Ethylhexyl)phthalate	1,300	3,100	**1,200**	**420**	**180**	**80**	**65**	**110** J	**95**	**190**	**170**	**39** J	**180**	**35** J	**110**	**120**	**1,300**	**83** J
Chrysene	1,400	2,800	**1,100**	**1,000**	**640**	**210**	**510** J	**320** J	**350**	**120**	**540**	**170**	**540**	**1,200**	**320**	**210**	**2,400**	**500** J
Di-n-Octyl phthalate	6,200	6,200	38 U	20 U	19 U	18 U	18 U	18 U	**16** J	19 U	19 U	20 U	19 U	20 U	**15** J	19 U	19 U	19 U
Benzo(a)pyrene	1,600	1,600	**660**	**450**	**420**	**91**	**200**	**160** J	**220**	**78**	**190**	**86**	**300**	**830**	**200**	**110**	**1,000**	**310** J
Indeno(1,2,3-cd)pyrene	600	690	**400**	**190**	**200**	**55**	**140** J	**67** J	**160**	**44**	**92**	**36**	**130**	**250**	**100**	**56**	**540**	**120** J
Dibenz(a,h)anthracene	230	230	**150**	**68**	**64**	**17** J	**33**	**33**	**44**	**14** J	**30**	**11** J	**44**	**100**	**31**	**14** J	**170**	**42** J
Benzo(g,h,i)perylene	670	720	**380**	**170**	**200**	**63**	**150** J	**96** J	**180**	**51**	**89**	**36**	**130**	**240**	**110**	**56**	**550**	**130** J
1-Methylnaphthalene			**30** J	**15** J	19 U	18 U	**12** J	**17** J	18 U	**10** J	19 U	20 U	**23**	**19** J	**18** J	**14** J	**13** J	**36** J
Total Benzofluoranthenes	3,200	3,600	**2,500**	**1,800**	**1,200**	**280**	**740** J	**480** J	**500**	**180**	**700**	**220**	**780**	**1,800**	**530**	**270**	**3,500**	**850** J
cPAHs (TEQ)			**1,026**	**721**	**610**	**137**	**311**	**235**	**310**	**111**	**298**	**124**	**432**	**1,111**	**289**	**158**	**1,625**	**446**

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-01	WM-SG-02	WM-SG-03	WM-SG-04	WM-SG-05	WM-SG-DUP	WM-SG-06	WM-SG-07	WM-SG-08	WM-SG-09	WM-SG-10	WM-SG-11	WM-SG-12	WM-SG-13	WM-SG-14	WM-SG-15
			XJ39D	XJ39K	XJ39L	XJ39B	XJ39E	XJ39P	XJ39F	XJ39A	XJ39N	XJ39M	XJ39J	XJ39I	XJ39G	XJ39H	XJ39C	XJ39O
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013	10/08/2013
BULK ORGANOTINS (µg/kg)																		
KRONE88																		
Tributyltin Ion			**4,500**	**520**	**1,600**	**72**	**290** J	**160** J	**74**	**140**	**300**	**20**	**640**	**200**	**34**	**170**	**2,900**	**31**
Dibutyltin Ion			**2,200**	**290**	**2,100**	**45**	**80**	**65** J	**66**	**86**	**95**	**41**	**720**	**82**	**61**	**50**	**1,300**	**30** J
Butyltin			**240**	**47**	**400**	**20**	**26**	**23** J	**16**	**22**	**14**	**10**	**190**	**13**	**11**	**12**	**170**	**8.7** J
POREWATER ORGANOTINS (µg/L)																		
KRONE89																		
Tributyltin Ion			**0.71**	**0.084**	**0.27**	**0.011**	**0.022**	**0.025**	**0.009**	**0.005** J	**0.032**	**0.015**	**0.19**	**0.014**	**0.024**	**0.029**	**0.70**	**0.006**
Dibutyltin Ion			**0.078**	**0.011**	**0.12**	**0.012**	**0.021**	**0.023**	**0.011**	**0.006** J	**0.014**	**0.014**	**0.027**	**0.006** J	**0.010**	**0.007** J	**0.067**	**0.005** J
Butyltin			**0.025** J	**0.023** J	**0.056** J	0.015 UJ	**0.044** J	**0.041** J	0.012 UJ	0.010 UJ	0.020 UJ	**0.023** J	0.020 UJ	0.014 UJ	**0.025** J	**0.022** J	**0.025** J	0.016 UJ
CONVENTIONALS																		
Total Solids (%) (SM2540B)			**71.90**	**55.49**	**73.42**	**71.88**	**71.42**	**72.30**	**54.71**	**73.94**	**53.90**	**49.21**	**52.71**	**63.26**	**53.94**	**67.16**	**69.00**	**49.48**
Preserved Total Solids (%) (SM2540B/G)			**72.10**	**52.28**	**76.57**	**73.62**	**71.19**	**71.86**	**74.41**	**74.63**	**49.95**	**46.71**	**49.12**	**57.87**	**54.12**	**65.30**	**62.54**	**43.85**
Total Volatile Solids (%) (SM2540E/G)			**2.08**	**4.73**	**1.96**	**1.76**	**2.01**	**1.99**	**4.75**	**1.48**	**4.34**	**4.77**	**4.78**	**3.39**	**4.56**	**2.52**	**3.72**	**5.80**
Ammonia (NH3) as Nitrogen (N) (mg/kg) (EPA350.1M)			**1.68**	**6.33**	**2.12**	**3.58**	**5.59**	**5.63**	**19.2**	**5.07**	**7.20**	**10.9**	**11.4**	**3.99**	**7.96**	**3.29**	**7.34**	**11.1**
Sulfide (mg/kg) (EPA376.2/SM4500-S2D)			**1,480**	**1,490**	**33.8**	**387**	**132**	**138**	**200**	**15.1**	**835**	**866**	**960**	**530**	**585**	**369**	**656**	**2,710** J
Total Organic Carbon (%) (PLUMB81TC)			**1.38**	**2.00**	**3.57**	**4.41**	**1.39**	**1.82**	**1.95**	**2.89**	**2.44**	**1.29**	**1.59**	**1.10**	**1.25**	**0.977**	**1.96**	**2.32** J
GRAIN Size (%)																		
PSEP-PS																		
Particle/Grain Size, Phi Scale <-1			**2.6**	**2.2**	**20.8**	**11.1**	**7.1**	**8.9**	**17.8**	**13.4**	**3.3**	**0.5**	**0.8**	**1.5**	**1.2**	**0.3**	**15.0**	**12.3**
Particle/Grain Size, Phi Scale -1 to 0			**3.5**	**2.1**	**7.5**	**3.6**	**2.7**	**2.7**	**6.3**	**3.8**	**2.0**	**1.4**	**1.4**	**1.1**	**1.6**	**0.4**	**7.4**	**4.0**
Particle/Grain Size, Phi Scale 0 to 1			**8.1**	**2.2**	**5.7**	**2.5**	**2.6**	**2.5**	**5.1**	**2.7**	**1.7**	**1.6**	**1.7**	**1.0**	**1.6**	**0.7**	**11.8**	**2.5**
Particle/Grain Size, Phi Scale 1 to 2			**11.9**	**4.1**	**5.8**	**4.2**	**6.5**	**6.4**	**7.7**	**5.2**	**2.0**	**1.9**	**2.7**	**1.4**	**2.0**	**2.0**	**14.4**	**2.9**
Particle/Grain Size, Phi Scale 2 to 3			**31.3**	**34.4**	**31.6**	**36.4**	**45.4**	**44.7**	**34.5**	**47.3**	**20.4**	**15.0**	**17.3**	**24.0**	**19.8**	**36.5**	**18.3**	**16.2**
Particle/Grain Size, Phi Scale 3 to 4			**25.3**	**29.8**	**17.2**	**30.4**	**25.4**	**24.6**	**17.0**	**21.3**	**32.7**	**32.9**	**38.3**	**44.1**	**34.6**	**39.5**	**16.3**	**14.6**
Particle/Grain Size, Phi Scale 4 to 5			**6.8**	**4.9**	**3.1**	**3.5**	**3.4**	**2.6**	**3.5**	**1.4**	**8.1**	**11.8**	**8.7**	**7.6**	**11.1**	**6.3**	**5.3**	**6.5**
Particle/Grain Size, Phi Scale 5 to 6			**2.4**	**2.9**	**0.8**	**1.1**	**1.0**	**1.2**	**1.2**	**0.7**	**4.6**	**5.2**	**5.0**	**3.4**	**4.7**	**2.3**	**2.5**	**6.1**
Particle/Grain Size, Phi Scale 6 to 7			**2.2**	**2.5**	**0.8**	**1.0**	**0.9**	**1.4**	**1.0**	**0.6**	**4.6**	**5.6**	**4.0**	**2.5**	**4.1**	**2.2**	**1.4**	**6.8**
Particle/Grain Size, Phi Scale 7 to 8			**1.5**	**2.9**	**2.0**	**1.2**	**1.1**	**1.0**	**1.2**	**1.0**	**4.2**	**5.7**	**4.0**	**2.7**	**3.8**	**2.0**	**1.8**	**6.5**
Particle/Grain Size, Phi Scale 8 to 9			**1.5**	**2.7**	**1.0**	**1.3**	**0.8**	**1.1**	**1.2**	**0.7**	**3.0**	**4.2**	**4.1**	**2.2**	**3.2**	**1.7**	**1.5**	**5.0**
Particle/Grain Size, Phi Scale 9 to 10			**0.6**	**2.7**	**1.2**	**1.2**	**1.2**	**1.1**	**1.1**	**0.6**	**4.3**	**3.9**	**2.9**	**2.4**	**3.4**	**1.7**	**1.4**	**5.0**
Particle/Grain Size, Phi Scale >10			**2.2**	**6.6**	**2.5**	**2.7**	**2.0**	**1.9**	**2.5**	**1.3**	**9.1**	**10.2**	**9.0**	**6.2**	**8.8**	**4.5**	**2.9**	**11.8**
Particle/Grain Size, Fines (Silt/Clay)			**17.3**	**25.2**	**11.5**	**11.9**	**10.4**	**10.3**	**11.5**	**6.4**	**37.9**	**46.7**	**37.8**	**26.9**	**39.2**	**20.6**	**16.9**	**47.7**

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-16	WM-SG-17	WM-SG-18	WM-SG-19	WM-SG-20	WM-SG-21	WM-SG-22	WM-SG-23	WM-SG-24	WM-SG-25	WM-SG-26	WM-SG-27	WM-SG-29	WM-SG-30	WM-SG-31	WM-SG-34	WM-SG-35
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	YG22B	YG22A	YG22D	YG22E	YG22C/ ZR58	YJ24C/ YL41D	YJ24B/ YL41C/ ZR58	YL41E	YL41F/ ZR58	YM09A	YJ24A/ YL41A	YL41B/ ZR58	ZP61A	ZP61B	ZP61C/ ZV88A	ZP61D	ZP61E
			04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014
TOTAL METALS (mg/kg)																			
Methods SW6010C/SW7471A/200.8																			
Arsenic	57	93																	
Cadmium	5.1	6.7	**0.2**	**0.6**															
Chromium	260	270	**30**	**19.7**															
Copper	390	390	**838**	**73.2**											**155** J	**84.6**	**94.1**	**169**	**118**
Lead	450	530	**58.1**	**8.7**															
Mercury	0.41	0.59																	
Silver	6.1	6.1																	
Zinc	410	960	**960**	**107**											**141** J	**51**	**93**	**141**	**125**
PAHs (µg/kg)																			
Method SW8270DSIM																			
Dibenz(a,h)anthracene	230	230			**33**	**18** J	**37**												
1,4-Dichlorobenzene	110	110			4.9 U	**2.7** J	15 U												
1,2,4-Trichlorobenzene	31	51			4.9 U	5.0 U	15 U												
Hexachlorobenzene	22	70			4.9 U	5.0 U	15 U												
Hexachlorobutadiene	11	120			4.9 U	5.0 U	15 U												
Dimethylphthalate	71	160			**3.6** J	**6.3**	**26**												
Butylbenzylphthalate	63	900			4.9 U	**5.5** J	**12** J												
2-Methylphenol	63	63			**3.0** J	**4.5** J	**14** J												
2,4-Dimethylphenol	29	29			24 U	25 U	73 U												
N-Nitrosodiphenylamine	28	40			**3.9** J	**2.6** J	15 U												
Benzyl Alcohol	57	72			20 U	20 U	**73**												
Pentachlorophenol	360	690			20 UJ	20 UJ	58 UJ												
1,2-Dichlorobenzene	35	50			4.9 U	5.0 U	15 U												
1,3-Dichlorobenzene					4.9 U	5.0 U	15 U												
PAHs (µg/kg)																			
Method SW8270DSIM																			
Naphthalene	2,100	2,100						**13**	**20**	**12**	**51**	**41**	**73**	**24**					
2-Methylnaphthalene	670	670						4.7 U	**21**	**5.4**	**1,000**	**7.4**	**21**	**14**					
1-Methylnaphthalene								4.7 U	**9.2**	4.7 U	14 U	4.8 U	**15**	**18**					
Acenaphthylene	1,300	1,300						**10**	**14**	4.7 U	**15**	**12**	**31**	**44**					
Acenaphthene	500	500						4.7 U	**7.9**	4.7 U	14 U	4.8 U	**30**	**19**					
Fluorene	540	540						**6.4**	**18**	4.7 U	**21**	4.8 U	**61**	**65**					
Phenanthrene	1,500	1,500						**32**	**130**	**20**	**85**	**39**	**390**	**470**					
Anthracene	960	960						**19**	**44**	**5.4**	**26**	**6.9**	**83**	**88**					
Fluoranthene	1,700	2,500						**440**	**690**	**24**	**180**	**45**	**1,600**	**460**					
Pyrene	2,600	3,300						**310**	**490**	**18**	**160**	**45**	**1,300**	**400**					
Benzo(a)anthracene	1,300	1,600						**63**	**120**	4.7 U	**60**	**6.4**	**200**	**140**					
Chrysene	1,400	2,800						**200**	**300**	**7.0**	**93**	**8.8**	**380**	**160**					
Benzo(a)pyrene	1,600	1,600						**39**	**110**	4.7 U	**67**	**7.2**	**190**	**140**					
Indeno(1,2,3-cd)pyrene	600	690						**18**	**57**	4.7 U	**32**	4.8 U	**100**	**65**					
Dibenz(a,h)anthracene	230	230						**5.6**	**16**	4.7 U	14 U	4.8 U	**24**	**19**					
Benzo(g,h,i)perylene	670	720						**22**	**69**	**5.4**	**46**	**7.4**	**120**	**86**					
Dibenzofuran	540	540						**6.7**	**15**	4.7 U	**16**	**6.0**	**35**	**18**					
Total Benzofluoranthenes	3,200	3,600						**160**	**420**	**11**	**200**	**14**	**550**	**200**					
cPAHs (TEQ)								**66**	**174**	**1.2**	**97**	**9.3**	**281**	**184**					

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-16	WM-SG-17	WM-SG-18	WM-SG-19	WM-SG-20	WM-SG-21	WM-SG-22	WM-SG-23	WM-SG-24	WM-SG-25	WM-SG-26	WM-SG-27	WM-SG-29	WM-SG-30	WM-SG-31	WM-SG-34	WM-SG-35
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	YG22B	YG22A	YG22D	YG22E	YG22C/ ZR58	YJ24C/ YL41D	YJ24B/ YL41C/ ZR58	YL41E	YL41F/ ZR58	YM09A	YJ24A/ YL41A	YL41B/ ZR58	ZP61A	ZP61B	ZP61C/ ZV88A	ZP61D	ZP61E
			04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014
PCBs (µg/kg)																			
Method SW8082A																			
Aroclor 1016					3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U			3.9 U		
Aroclor 1242					3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U			3.9 U		
Aroclor 1248					5.8 U	7.9 U	7.9 U	3.9 U	7.8 U	3.9 U	12 U		5.7 U	4.0 U			20 U		
Aroclor 1254					**15**	**18**	**10**	**6.6**	**17** P	3.9 U	**5.9**		**5.2**	4.0 U			**25**		
Aroclor 1260					**11**	**12**	**7.3**	**4.9**	**11**	3.9 U	3.9 U		**4.5**	4.0 U			**10**		
Aroclor 1221					3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U			3.9 U		
Aroclor 1232					3.9 U	4.0 U	3.9 U	5.8 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U			3.9 U		
Aroclor 1262					3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U					
Aroclor 1268					3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U		3.8 U	4.0 U					
Total PCBs	130	1,000			**26**	**30**	**17.3**	**11.5**	**28**	ND	**5.9**		**9.7**	ND			**35**		
PCBs by Congener Analysis																			
Method SW1668A																			
Total PCBs (µg/kg)	130	1,000					**18.0**		**17.5**		**5.2**			**0.7**			**54.1**		
PCB - TEQ (pg/g) (a),(b)							**0.2**		**0.5**		**0.2**			**0.01**			**1.4**		
SEMIVOLATILES (µg/kg)																			
Method SW8270D																			
Phenol	420	1,200			20 U	**91**	**180**												
1,3-Dichlorobenzene					20 U	20 U	58 U												
1,4-Dichlorobenzene	110	110			20 U	20 U	58 U												
Benzyl Alcohol	57	72			20 U	20 U	58 U												
1,2-Dichlorobenzene	35	50			20 U	20 U	58 U												
2-Methylphenol	63	63			20 U	20 U	58 U												
4-Methylphenol	670	670			**55**	**70**	**70**												
Hexachloroethane					20 U	20 UJ	58 U												
2,4-Dimethylphenol	29	29			98 U	100 U	290 U												
Benzoic Acid	650	650			200 U	200 U	580 U												
1,2,4-Trichlorobenzene	31	51			20 U	20 U	58 U												
Naphthalene	2,100	2,100			**90**	**62**	**44** J												
Hexachlorobutadiene	11	120			20 U	20 U	58 U												
2-Methylnaphthalene	670	670			**31**	**19** J	**29** J												
Dimethylphthalate	71	160			20 U	20 U	**29** J												
Acenaphthylene	1,300	1,300			**29**	**30**	**32** J												
Acenaphthene	500	500			**26**	**13** J	58 U												
Dibenzofuran	540	540			**45**	**27**	**35** J												
Diethylphthalate	200	1,200			20 U	20 U	58 U												
Fluorene	540	540			**46**	**26**	**41** J												
N-Nitrosodiphenylamine	28	40			20 U	20 U	58 U												
Hexachlorobenzene	22	70			20 U	20 U	58 U												
Pentachlorophenol	360	690			98 U	100 U	290 U												
Phenanthrene	1,500	1,500			**240**	**120**	**160**												
Anthracene	960	960			**87**	**50**	**100**												
Di-n-Butylphthalate	1,400	5,100			20 U	20 U	58 U												
Fluoranthene	1,700	2,500			**420**	**240**	**470**												
Pyrene	2,600	3,300			**720**	**540**	**540**												
Butylbenzylphthalate	63	900			20 U	20 U	58 U												
Benzo(a)anthracene	1,300	1,600			**190**	**120**	**270**												
bis(2-Ethylhexyl)phthalate	1,300	3,100			51 U	150 U	240 U												
Chrysene	1,400	2,800			**290**	**230**	**420**												
Di-n-Octyl phthalate	6,200	6,200			20 U	20 U	58 U												
Benzo(a)pyrene	1,600	1,600			**200**	**160**	**200**												
Indeno(1,2,3-cd)pyrene	600	690			**96**	**53**	**110**												
Dibenz(a,h)anthracene	230	230			**33**	**20**	**38** J												
Benzo(g,h,i)perylene	670	720			**100**	**58** J	**120**												
1-Methylnaphthalene					**20**	**19** J	**32** J												
Total Benzofluoranthenes	3,200	3,600			**390**	**360**	**590**												
cPAHs (TEQ)					**274**	**218**	**305**												

TABLE 12
ANALYTICAL RESULTS – SURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	WAC 173-204 Dry Weight Equivalents of SMS Criteria		WM-SG-16	WM-SG-17	WM-SG-18	WM-SG-19	WM-SG-20	WM-SG-21	WM-SG-22	WM-SG-23	WM-SG-24	WM-SG-25	WM-SG-26	WM-SG-27	WM-SG-29	WM-SG-30	WM-SG-31	WM-SG-34	WM-SG-35
	Dry Weight SQS Equivalent	Dry Weight CSL Equivalent	YG22B	YG22A	YG22D	YG22E	YG22C/ ZR58	YJ24C/ YL41D	YJ24B/ YL41C/ ZR58	YL41E	YL41F/ ZR58	YM09A	YJ24A/ YL41A	YL41B/ ZR58	ZP61A	ZP61B	ZP61C/ ZV88A	ZP61D	ZP61E
			04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014	12/15/2014
BULK ORGANOTINS (µg/kg)																			
KRONE88																			
Tributyltin Ion															**160**	**100**	**65**	**52**	**88**
Dibutyltin Ion															**120**	**120**	**91**	**64**	**59**
Butyltin															**14**	**17**	**12**	**15**	**8.8**
POREWATER ORGANOTINS (µg/L)																			
KRONE89																			
Tributyltin Ion																			
Dibutyltin Ion																			
Butyltin																			
CONVENTIONALS																			
Total Solids (%) (SM2540B)			**80.00**	**66.90**	**38.39**	**50.75**	**38.87**	**75.77**	**42.50**	**74.11**	**41.49**	**75.12**	**66.77**	**74.88**	**48.30**	**63.99**	**51.68**	**45.44**	**47.73**
Preserved Total Solids (%) (SM2540B/G)			**79.98**	**63.31**	**31.69**	**42.82**	**49.21**								**45.35**	**63.07**	**45.48**	**45.54**	**50.00**
Total Volatile Solids (%) (SM2540E/G)			**1.63**	**3.09**	**8.53**	**4.32**	**8.29**								**5.05**	**3.04**	**4.58**	**5.89**	**8.47**
Ammonia (NH3) as Nitrogen (N) (mg/kg) (EPA350.1M)			**1.47**	**13.5**	**24.7**	**8.33**	**20.0**								**9.83**	**3.90**	**9.48**	**31.2** J	**12.4**
Sulfide (mg/kg) (EPA376.2/SM4500-S2D)			**476**	**507**	**944**	**443**	**236**								**536**	**179**	**116**	**1,210**	**1,340**
Total Organic Carbon (%) (PLUMB81TC)			**0.55**	**0.855**	**3.20**	**0.71**	**2.07**	**0.31**	**2.07**	**0.548**	**1.37**	**0.36** J	**0.907** J	**0.48**	**0.885**	**0.559**	**0.873**	**1.63**	**1.88**
GRAIN Size (%)																			
PSEP-PS																			
Particle/Grain Size, Phi Scale <-1			**63.2**	**10.3**	**1.6**	**0.5**	**0.9**								**1.3**	**0.3**	**2.9**	**2.2**	**14.2**
Particle/Grain Size, Phi Scale -1 to 0			**5.4**	**2.0**	**2.4**	**0.8**	**0.5**								**0.8**	**0.5**	**0.8**	**0.6**	**4.1**
Particle/Grain Size, Phi Scale 0 to 1			**8.4**	**1.2**	**1.1**	**0.7**	**0.6**								**0.8**	**0.6**	**0.6**	**0.6**	**2.8**
Particle/Grain Size, Phi Scale 1 to 2			**8.3**	**3.1**	**0.6**	**0.6**	**2.0**								**1.5**	**1.2**	**0.5**	**1.1**	**3.2**
Particle/Grain Size, Phi Scale 2 to 3			**7.7**	**33.2**	**2.4**	**9.5**	**29.8**								**15.3**	**25.7**	**12.5**	**8.3**	**14.1**
Particle/Grain Size, Phi Scale 3 to 4			**4.2**	**28.8**	**5.2**	**36.6**	**36.2**								**32.6**	**47.8**	**36.6**	**26.3**	**21.2**
Particle/Grain Size, Phi Scale 4 to 5			**0.4**	**1.8**	**5.1**	**10.4**	**8.7**								**9.3**	**6.1**	**10.2**	**12.1**	**8.5**
Particle/Grain Size, Phi Scale 5 to 6			**0.4**	**2.2**	**11.7**	**6.9**	**3.6**								**6.5**	**2.7**	**6.4**	**10.6**	**11.9**
Particle/Grain Size, Phi Scale 6 to 7			**0.3**	**2.6**	**15.1**	**5.2**	**3.1**								**7.3**	**2.8**	**5.8**	**12.1**	**5.3**
Particle/Grain Size, Phi Scale 7 to 8			**0.2**	**2.0**	**13.6**	**7.7**	**2.6**								**5.4**	**2.4**	**5.3**	**5.2**	**2.2**
Particle/Grain Size, Phi Scale 8 to 9			**0.5**	**3.2**	**13.5**	**6.0**	**3.1**								**4.6**	**2.3**	**4.5**	**4.4**	**2.5**
Particle/Grain Size, Phi Scale 9 to 10			**0.4**	**2.8**	**9.7**	**4.9**	**2.8**								**5.2**	**2.5**	**4.8**	**5.6**	**3.5**
Particle/Grain Size, Phi Scale >10			**0.7**	**6.7**	**17.8**	**10.2**	**6.1**								**9.5**	**5.1**	**9.2**	**11.0**	**6.5**
Particle/Grain Size, Fines (Silt/Clay)			**2.7**	**21.3**	**86.6**	**51.3**	**30.0**								**47.8**	**23.8**	**46.2**	**60.8**	**40.5**

U = The compound was not detected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
P = The analyte was detected on both chromatographic columns but the quantified values differ by 40% RPD with no obvious chromatographic interference. The higher of the two values is reported by the laboratory.
Bold = Detected compound.
TEQ = Toxicity Equivalency Quotient, WAC 173-340-708(e).
(a) = PCB - TEQ calculated using World Health Organization Toxicity Equivalency Factors to relate toxicity to 2,3,7,8-TCDD.
(b) = Non-detected constituents assumed present at one-half detection limit; Estimated Maximum Potential Concentrations (EMPCs) assumed present at maximum value.
Brown shaded total organic carbon results are outside the range of 0.5 to 3.5; consider dry-weight equivalent values for Apparent Effects Threshold.

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SG-01 XJ39D 10/08/2013	WM-SG-02 XJ39K 10/08/2013	WM-SG-03 XJ39L 10/08/2013	WM-SG-04 XJ39B 10/08/2013	WM-SG-05 XJ39E 10/08/2013	Dup of WM-SG-05 WM-SG-DUP XJ39P 10/08/2013	WM-SG-06 XJ39F 10/08/2013	WM-SG-07 XJ39A 10/08/2013	WM-SG-08 XJ39N 10/08/2013	WM-SG-09 XJ39M 10/08/2013	WM-SG-10 XJ39J 10/08/2013	WM-SG-11 XJ39I 10/08/2013	WM-SG-12 XJ39G 10/08/2013	WM-SG-13 XJ39H 10/08/2013	WM-SG-14 XJ39C 10/08/2013
	SCO (a)	CSL (b)															
TOTAL METALS (mg/kg-dry wt)																	
Methods SW6010C/SW7471A																	
Arsenic	57	93	**30**	**12**	20 U	6 U	7 U	7 U	7 U	20 U	**10**	**10**	**12**	**10**	**12**	8 U	**20**
Cadmium	5.1	6.7	0.7 U	**0.4**	0.7 U	0.3 U	0.3 U	0.3 U	0.3 U	0.7 U	**0.9**	**0.8**	**0.9**	**0.8**	**1.0**	**0.6**	0.7 U
Chromium	260	270	**25**	**27.7**	**14**	**13.7**	**17.7**	**14.6**	**15.0**	**10**	**27**	**28**	**26.4**	**23.2**	**28.0**	**18.8**	**69**
Copper	390	390	**1,670**	**715**	**609**	**95.4**	**173**	**209** J	**105**	**47.0**	**144**	**51.9**	**795**	**47.2**	**122**	**31.1**	**6,930**
Lead	450	530	**88**	**19**	**124**	**6**	**10**	**12**	**11**	7 U	**11**	**8**	**17**	**9**	**10**	**5**	**44**
Mercury	0.41	0.59	**0.91**	**0.32**	**0.15**	**0.07**	**0.08**	**0.10**	**0.05**	**0.12**	**0.12**	**0.07**	**0.12**	**0.06**	**0.08**	**0.05**	**0.32**
Silver	6.1	6.1	1 U	0.6 U	1 U	0.4 U	0.4 U	0.4 U	0.4 U	1 U	0.6 U	0.6 U	0.6 U	0.5 U	0.6 U	0.5 U	1 U
Zinc	410	960	**1,250**	**263**	**443**	**59**	**90** J	**249** J	**89**	**64**	**108**	**81**	**308**	**72**	**127**	**50**	**1,980**
BULK ORGANOTINS (µg/kg-dry wt)																	
KRONE88																	
Tributyltin Ion	238 (c)	738 (c)	**4,500**	**520**	**1,600**	**72**	**290** J	**160** J	**74**	**140**	**300**	**20**	**640**	**200**	**34**	**170**	**2,900**
Dibutyltin Ion	---	---	**2,200**	**290**	**2,100**	**45**	**80**	**65** J	**66**	**86**	**95**	**41**	**720**	**82**	**61**	**50**	**1,300**
Butyltin Ion	---	---	**240**	**47**	**400**	**20**	**26**	**23** J	**16**	**22**	**14**	**10**	**190**	**13**	**11**	**12**	**170**
POREWATER ORGANOTINS (µg/L)																	
KRONE88																	
Tributyltin Ion	0.05 (d)	0.15 (d)	**0.71**	**0.084**	**0.27**	**0.011**	**0.022**	**0.025**	**0.009**	**0.005** J	**0.032**	**0.015**	**0.19**	**0.014**	**0.024**	**0.029**	**0.70**
Dibutyltin Ion	---	---	**0.078**	**0.011**	**0.12**	**0.012**	**0.021**	**0.023**	**0.011**	**0.006** J	**0.014**	**0.014**	**0.027**	**0.006** J	**0.010**	**0.007** J	**0.067**
Butyltin Ion	---	---	**0.025** J	**0.023** J	**0.056** J	0.015 UJ	**0.044** J	**0.041** J	0.012 UJ	0.010 UJ	0.020 UJ	**0.023** J	0.020 UJ	0.014 UJ	**0.025** J	**0.022** J	**0.025** J
PAHs (mg/kg OC) (e)																	
Method SW8270D																	
Naphthalene	99	170	**3.8**	**2.1**	**0.56**	**0.23** J	**3.2**	**2.7**	**0.82** J	**0.59** J	**2.0**	**3.4**	**6.9**	**6.4**	**7.0**	**5.1**	**2.9**
Acenaphthylene	66	66	**4.0** J	**2.1** J	**0.70** J	**0.21** J	**2.1** J	**1.3** J	**0.67** J	**0.55** J	**1.7** J	**1.2** J	**3.0** J	**5.4** J	**3.5** J	**1.8** J	**5.6** J
Acenaphthene	16	57	**3.8**	**1.1**	**1.0**	**0.25** J	**1.9**	**0.99**	0.92 U	0.66 U	**0.61** J	1.6 U	**2.3**	**1.5** J	**1.6**	**1.3** J	**6.1**
Fluorene	23	79	**3.7**	**1.4**	**0.87**	**0.23** J	**1.9**	**1.3**	**0.56** J	**0.73**	**1.5**	**1.4** J	**0.88** J	**2.1**	**4.4**	**2.9**	**6.6**
Phenanthrene	100	480	**32**	**14**	**9.5**	**1.5**	**51** J	**7.1** J	**5.6**	**5.2**	**9.0**	**7.8**	**25**	**11**	**22**	**16**	**56**
Anthracene	220	1,200	**12**	**6.0**	**2.5**	**0.61**	**4.1**	**3.1** J	**1.7**	**1.0**	**3.9**	**2.9**	**8.8**	**15**	**6.6**	**5.1**	**19**
2-Methylnaphthalene	38	64	**2.8**	1.0 U	**0.34** J	0.41 U	**1.2** J	**1.1**	**0.51** J	**0.35** J	**0.74** J	1.6 U	**1.6**	**1.5** J	**1.9**	**1.8** J	**1.3**
LPAH (f, g)	370	780	**60**	**26**	**15**	**3.1** J	**64**	**16**	**9.4** J	**8.1** J	**19** J	**17** J	**47** J	**41** J	**45**	**33** J	**96**
Fluoranthene	160	1,200	**101**	**70**	**25**	**5.9**	**101** J	**20** J	**17**	**7.6**	**23**	**16**	**48**	**73**	**46**	**38**	**332** J
Pyrene	1,000	1,400	**203**	**65**	**26**	**5.0**	**71** J	**24** J	**14**	**7.3**	**25**	**17**	**58**	**75**	**51**	**34**	**179** J
Benzo(a)anthracene	110	270	**36**	**28**	**10**	**1.9**	**11**	**7.7** J	**8**	**2.8**	**8.2**	**7.2**	**19**	**49**	**16**	**12**	**92**
Chrysene	110	460	**80**	**50**	**18**	**4.8**	**37** J	**18** J	**18**	**4.2**	**22**	**13**	**34**	**109**	**26**	**21**	**122**
Total Benzofluoranthenes (f, h)	230	450	**181**	**90**	**34**	**6.3**	**53** J	**26** J	**26**	**6.2**	**29**	**17**	**49**	**164**	**42**	**28**	**179**
Benzo(a)pyrene	99	210	**48**	**23**	**12**	**2.1**	**14**	**8.8** J	**11**	**2.7**	**7.8**	**6.7**	**19**	**75**	**16**	**11**	**51**
Indeno(1,2,3-cd)pyrene	34	88	**29**	**10**	**5.6**	**1.2**	**10** J	**3.7** J	**8.2**	**1.5**	**3.8**	**2.8**	**8.2**	**23**	**8.0**	**5.7**	**28**
Dibenz(a,h)anthracene	12	33	**7.2**	**3.1**	**1.6**	**0.41** J	**2.5**	**1.4** J	**2.3**	**0.48** J	**1.0**	**0.9** J	**2.5**	**9.1**	**2.4**	**1.7** J	**8.2**
Benzo(g,h,i)perylene	31	78	**28**	**8.5**	**5.6**	**1.4**	**11**	**5.3**	**9.2**	**1.8**	**3.6**	**2.8**	**8.2**	**22**	**8.8**	**5.7**	**28**
HPAH (f, i)	960	5,300	**713**	**346**	**138**	**29**	**310** J	**115** J	**114**	**34**	**124**	**84**	**247**	**598**	**216**	**158**	**1018**
SVOCs (mg/kg OC) (e)																	
Method SW8270D																	
1,2-Dichlorobenzene	2.3	2.3	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
1,3-Dichlorobenzene	---	---	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
1,4-Dichlorobenzene	3.1	9	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
1,2,4-Trichlorobenzene	0.81	1.8	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
Hexachlorobenzene	0.38	2.3	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
Dimethylphthalate	53	53	**4.1**	**3.0**	**0.42**	**0.23**	**0.94**	**0.47**	**0.14** J	**0.25**	**0.61**	**0.50**	**2.3**	**0.73**	**1.0**	**0.44** J	**3.6**
Diethylphthalate	61	110	2.8 U	1.0 U	0.53 U	0.41 U	1.3 U	0.99 U	0.92 U	0.66 U	9.4 U	6.1 U	1.3 U	1.8 U	3.5 U	1.9 U	0.97 U
Di-n-Butylphthalate	220	1,700	**3.0**	**0.60** J	**3.6**	**0.43**	**0.86** J	0.99 U	0.92 U	**0.45** J	**0.66** J	1.6 U	1.2 U	1.8 U	1.5 U	1.9 U	**3.4**
Butylbenzylphthalate	4.9	64	**1.0**	**0.70**	**0.39**	**0.07** J	**0.79**	**0.34**	**0.29**	**0.31**	0.19 U	0.38 U	**0.35**	0.45 U	**0.67**	0.49 U	**1.1**
bis(2-Ethylhexyl)phthalate	47	78	**87**	**21**	**5.0**	**1.8**	**4.7**	**6.0** J	**4.9**	**6.6**	**7.0**	**3.0** J	**11**	**3.2** J	**8.8**	**12**	**66**
Di-n-Octyl phthalate	58	4,500	2.8 U	1.0 U	0.53 U	0.41 U	1.3 U	0.99 U	**0.82** J	0.66 U	0.78 U	1.6 U	1.2 U	1.8 U	**1.2** J	1.9 U	0.97 U
Dibenzofuran	15	58	**3.1**	**1.0**	**0.48** J	0.41 U	**2.0**	**1.2**	0.92 U	0.66 U	**0.90**	**0.93** J	**2.6**	**1.9**	**2.2**	**1.8** J	**3.4**
Hexachlorobutadiene	3.9	6.2	0.34 U	0.25 U	0.13 U	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	0.24 U
N-Nitrosodiphenylamine	11	11	**2.0**	**0.23** J	**0.39**	0.10 U	0.33 U	0.25 U	0.24 U	0.16 U	0.19 U	0.38 U	0.30 U	0.45 U	0.38 U	0.49 U	**1.1**

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards							Dup of WM-SG-05									
	SCO (a)	CSL (b)	WM-SG-01 XJ39D 10/08/2013	WM-SG-02 XJ39K 10/08/2013	WM-SG-03 XJ39L 10/08/2013	WM-SG-04 XJ39B 10/08/2013	WM-SG-05 XJ39E 10/08/2013	WM-SG-DUP XJ39P 10/08/2013	WM-SG-06 XJ39F 10/08/2013	WM-SG-07 XJ39A 10/08/2013	WM-SG-08 XJ39N 10/08/2013	WM-SG-09 XJ39M 10/08/2013	WM-SG-10 XJ39J 10/08/2013	WM-SG-11 XJ39I 10/08/2013	WM-SG-12 XJ39G 10/08/2013	WM-SG-13 XJ39H 10/08/2013	WM-SG-14 XJ39C 10/08/2013
SVOCs (µg/kg)																	
Method SW8270D																	
Phenol	420	1,200	24 J	170	36	20	45 J	190 J	510	19 U	39	22	49	17 J	42	11 J	110
2-Methylphenol	63	63	3.6 J	4.7 J	4.7 U	4.6 U	4.6 U	4.6 U	4.6 U	4.7 U	4.4 J	3.1 J	4.6 J	5.0 U	4.7 U	4.8 U	16
4-Methylphenol	670	670	38 U	24	82	18 U	16 J	41	15 J	19 U	43	46	86	130	74	27	24
2,4-Dimethylphenol	29	29	24 U	24 U	23 U	23 U	23 U	23 U	23 U	24 U	24 U	24 U	24 U	25 U	24 U	24 U	11 J
Pentachlorophenol	360	690	58 J	54 J	19 UJ	18 UJ	18 UJ	12 J	18 UJ	19 UJ	13 J	20 UJ	35 J	20 UJ	14 J	19 UJ	270 J
Benzyl Alcohol	57	73	16 J	41	19 U	18 U	18 U	18 U	18 U	19 U	12 J	14 J	19	20 U	21	19 U	50
Benzoic Acid	650	650	380 U	200 UJ	190 UJ	180 UJ	180 UJ	180 U	180 UJ	190 UJ	160 J	200 UJ	150 J	200 UJ	200 J	190 UJ	280 J
Total PCBs (f) (mg/kg OC)																	
Method SW8082A																	
Total PCBs	12	65	45	1.5	4.6 (I)	0.68	1.8	1.2	0.63	0.37	1.1	3.7	6.9	2.2	1.8	0.66	3.1
CONVENTIONALS																	
Total Organic Carbon (%) (PLUMB81TC)			1.38	2.00	3.57	4.41	1.39	1.82	1.95	2.89	2.44	1.29	1.59	1.10	1.25	0.977	1.96
PERSISTENT BIOACCUMULATIVE TOXINS																	
	SCO (j)	CSL (k)															
cPAHs (TEQ) (µg/kg)																	
Method SW8270DSIM																	
cPAHs (TEQ)	40	400	1,026	721	610	137	311	235	310	111	298	124	432	1,111	289	158	1,625
PCBs (µg/kg)																	
Method SW8082A																	
Total PCBs	6	53	620	30.4	163	29.8	25.5	21.5	12.2	10.8	26.5	48	109	23.9	23.1	6.4	60
PCBs by Congener Analysis																	
PCB - TEQ (pg/g) (a),(b)																	
Method SW1668A																	
PCB-TEQ	0.2	2															
Method SW1668A																	
Total PCBs (µg/kg)	6	53															
BULK ORGANOTINS (µg/kg-dry wt)																	
KRONE88																	
Tributyltin Ion	238	738	4,500	520	1,600	72	290 J	160 J	74	140	300	20	640	200	34	170	2,900
TOTAL METALS (mg/kg-dry wt)																	
Methods SW6010C/SW7471A	**Natural Background**																
Arsenic	11		30	12	20 U	6 U	7 U	7 U	7 U	20 U	10	10	12	10	12	8 U	20
Cadmium	1		0.7 U	0.4	0.7 U	0.3 U	0.3 U	0.3 U	0.3 U	0.7 U	0.9	0.8	0.9	0.8	1.0	0.6	0.7 U
Lead	21		88	19	124	6	10	12	11	7 U	11	8	17	9	10	5	44
Mercury	0.20		0.91	0.32	0.15	0.07	0.08	0.10	0.05	0.12	0.12	0.07	0.12	0.06	0.08	0.05	0.32

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SG-15	WM-SG-16	WM-SG-17	WM-SG-18	WM-SG-19	WM-SG-20	WM-SG-21	WM-SG-22	WM-SG-23	WM-SG-24	WM-SG-25	WM-SG-26	WM-SG-27	WM-SG-29
	SCO (a)	CSL (b)	XJ39O	YG22B	YG22A	YG22D	YG22E	YG22C	YJ24C/YL41D	YJ24B/YL41C	YL41E	YL41F	YM09A	YJ24A/YL41A	YL41B	ZP61A
			10/08/2013	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	04/10/2014	12/15/2014
TOTAL METALS (mg/kg-dry wt)																
Methods SW6010C/SW7471A																
Arsenic	57	93	**40**													
Cadmium	5.1	6.7	**1.5**	**0.2**	**0.6**											
Chromium	260	270	**663** J	**30**	**19.7**											
Copper	390	390	**13,100** J	**838**	**73.2**											**155** J
Lead	450	530	**133** J	**58.1**	**8.7**											
Mercury	0.41	0.59	**0.14** J													
Silver	6.1	6.1	1 U													
Zinc	410	960	**1,170** J	**960**	**107**											**141** J
BULK ORGANOTINS (µg/kg-dry wt)																
KRONE88																
Tributyltin Ion	238 (c)	738 (c)	**31**													**160**
Dibutyltin Ion	---	---	**30** J													**120**
Butyltin Ion	---	---	**8.7** J													**14**
POREWATER ORGANOTINS (µg/L)																
KRONE88																
Tributyltin Ion	0.05 (d)	0.15 (d)	**0.006**													
Dibutyltin Ion	---	---	**0.005** J													
Butyltin Ion	---	---	0.016 UJ													
PAHs (mg/kg OC) (e)																
Method SW8270D																
Naphthalene	99	170	**3.2**			**2.8**	**8.7**	**2.1** J	**4.2**	**0.97**	**2.2**	**3.7**	**11.52**	**8.0**	**5.0**	
Acenaphthylene	66	66	**1.0** J			**0.91**	**4.2**	**1.5** J	**3.2**	**0.68**	0.86 U	**1.1**	**3.4**	**3.4**	**9.1**	
Acenaphthene	16	57	**1.2** J			**0.81**	**1.8** J	**2.8** U	1.5 U	**0.38**	0.86 U	1.0 U	1.3 U	**3.3**	**4.0**	
Fluorene	23	79	**1.9** J			**1.4**	**3.7**	**2.0** J	**2.1**	**0.87**	0.86 U	**1.5**	1.3 U	**6.7**	**14**	
Phenanthrene	100	480	**19** J			**7.5**	**17**	**7.7**	**10**	**6.3**	**3.6**	**6.2**	**11**	**43**	**98**	
Anthracene	220	1,200	**3.5** J			**2.7**	**7.1**	**4.8**	**6.2**	**2.1**	**0.99**	**1.9**	**1.9**	**9.2**	**18**	
2-Methylnaphthalene	38	64	**2.8** J			**0.97**	**2.7** J	**1.4** J	1.5 U	**1.0**	**0.99**	**73**	**2.1**	**2.3**	**2.9**	
LPAH (f, g)	370	780	**29**			**16**	**42**	**21**	**26**	**11**	**6.8**	**14**	**28**	**74**	**148**	
Fluoranthene	160	1,200	**34** J			**13**	**34**	**23**	**143**	**33**	**4.4**	**13**	**13**	**176**	**96**	
Pyrene	1,000	1,400	**31** J			**23**	**76**	**26**	**101**	**24**	**3.3**	**12**	**13**	**143**	**83**	
Benzo(a)anthracene	110	270	**13** J			**5.9**	**17**	**13**	**20**	**5.8**	0.9 U	**4.4**	**1.8**	**22**	**29**	
Chrysene	110	460	**22** J			**9.1**	**32**	**20**	**65**	**14**	**1.3**	**6.8**	**2.5**	**42**	**33**	
Total Benzofluoranthenes (f, h)	230	450	**37** J			**12**	**51**	**29**	**52**	**20**	**2.0**	**15**	**3.9**	**61**	**42**	
Benzo(a)pyrene	99	210	**13** J			**6.3**	**23**	**10**	**13**	**5.3**	0.9 U	**4.9**	**2.0**	**21**	**29**	
Indeno(1,2,3-cd)pyrene	34	88	**5.2** J			**3.0**	**7.5**	**5.3**	**5.8**	**2.8**	0.9 U	**2.3**	1.3 U	**11**	**14**	
Dibenz(a,h)anthracene	12	33	**1.8** J			**1.0**	**2.5**	**1.8** J	**1.8**	**0.8**	0.9 U	1.0 U	1.3 U	**2.6**	**4.0**	
Benzo(g,h,i)perylene	31	78	**5.6** J			**3.1**	**8.2**	**5.8**	**7.1**	**3.3**	**1.0**	**3.4**	**2.1**	**13**	**18**	
HPAH (f, i)	960	5,300	**162**			**76**	**251**	**133**	**408**	**110**	**12**	**61**	**38**	**492**	**347**	
SVOCs (mg/kg OC) (e)																
Method SW8270D																
1,2-Dichlorobenzene	2.3	2.3	0.21 U			0.15 U	0.71 U	0.72 U								
1,3-Dichlorobenzene	---	---	0.21 U			0.15 U	0.71 U	0.72 U								
1,4-Dichlorobenzene	3.1	9	0.21 U			0.15 U	0.38 U	0.72 U								
1,2,4-Trichlorobenzene	0.81	1.8	0.21 U			0.15 U	0.71 U	0.72 U								
Hexachlorobenzene	0.38	2.3	0.21 U			0.15 U	0.71 U	0.72 U								
Dimethylphthalate	53	53	**5.2** J			0.11 U	0.89 U	**1.3** J								
Diethylphthalate	61	110	1.1 U			0.63 U	2.8 U	2.8 U								
Di-n-Butylphthalate	220	1,700	0.82 U			0.63 U	2.8 U	2.8 U								
Butylbenzylphthalate	4.9	64	**0.56**			0.15 U	0.78 U	0.58 U								
bis(2-Ethylhexyl)phthalate	47	78	**3.6** J			1.6 U	21 U	12 U								
Di-n-Octyl phthalate	58	4,500	0.82 U			0.63 U	2.8 U	2.8 U								
Dibenzofuran	15	58	**1.6** J			**1.4**	**3.8**	**1.7** J								
Hexachlorobutadiene	3.9	6.2	0.21 U			0.15 U	0.71 U	0.72 U								
N-Nitrosodiphenylamine	11	11	0.21 UJ			0.12 U	0.37 U	0.72 U								

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SG-15	WM-SG-16	WM-SG-17	WM-SG-18	WM-SG-19	WM-SG-20	WM-SG-21	WM-SG-22	WM-SG-23	WM-SG-24	WM-SG-25	WM-SG-26	WM-SG-27	WM-SG-29
	SCO (a)	CSL (b)	XJ39O 10/08/2013	YG22B 04/10/2014	YG22A 04/10/2014	YG22D 04/10/2014	YG22E 04/10/2014	YG22C 04/10/2014	YJ24C/YL41D 04/10/2014	YJ24B/YL41C 04/10/2014	YL41E 04/10/2014	YL41F 04/10/2014	YM09A 04/10/2014	YJ24A/YL41A 04/10/2014	YL41B 04/10/2014	ZP61A 12/15/2014
SVOCs (µg/kg)																
Method SW8270D																
Phenol	420	1,200	19 U			20 U	**91**	**180**								
2-Methylphenol	63	63	**4.3** J			20 U	20 U	58 U								
4-Methylphenol	670	670	**43**			**55**	**70**	**70**								
2,4-Dimethylphenol	29	29	24 U			98 U	100 U	290 U								
Pentachlorophenol	360	690	**20** J			98 U	100 U	290 U								
Benzyl Alcohol	57	73	19 U			20 U	20 U	58 U								
Benzoic Acid	650	650	190 U			200 U	200 U	580 U								
Total PCBs (f) (mg/kg OC)																
Method SW8082A																
Total PCBs	12	65	**1.7**			**0.81**	**4.2**	**0.84**	**3.7**	**1.4**	ND	**0.43**		**1.07**	ND	
CONVENTIONALS																
Total Organic Carbon (%) (PLUMB81TC)			**2.32** J	**0.55**	**0.855**	**3.20**	**0.71**	**2.07**	**0.31**	**2.07**	**0.548**	**1.37**	**0.36** J	**0.907** J	**0.48**	**0.885**
PERSISTENT BIOACCUMULATIVE TOXINS																
	SCO (j)	CSL (k)														
cPAHs (TEQ) (µg/kg)																
Method SW8270DSIM																
cPAHs (TEQ)	40	400	**446**			**274**	**218**	**305**	**66**	**174**	**1.2**	**97**	**9.3**	**281**	**184**	
PCBs (µg/kg)																
Method SW8082A																
Total PCBs	6	53	**39**			**26**	**30**	**17.3**	**11.5**	**28**	ND	**5.9**		**9.7**	ND	
PCBs by Congener Analysis																
PCB - TEQ (pg/g) (a),(b)																
Method SW1668A																
PCB-TEQ	0.2	2						**0.2**		**0.5**		**0.2**			**0.01**	
Method SW1668A																
Total PCBs (µg/kg)	6	53						**18.0**		**17.5**		**5.2**			**0.7**	
BULK ORGANOTINS (µg/kg-dry wt)																
KRONE88																
Tributyltin Ion	238	738	**31**													**160**
TOTAL METALS (mg/kg-dry wt)																
Methods SW6010C/SW7471A	**Natural Background**															
Arsenic	11		**40**													
Cadmium	1		**1.5**	**0.2**	**0.6**											
Lead	21		**133** J	**58.1**	**8.7**											
Mercury	0.20		**0.14** J													

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SG-30	WM-SG-31	WM-SG-34	WM-SG-35
	SCO (a)	CSL (b)	ZP61B 12/15/2014	ZP61C/ZV88A 12/15/2014	ZP61D 12/15/2014	ZP61E 12/15/2014
TOTAL METALS (mg/kg-dry wt)						
Methods SW6010C/SW7471A						
Arsenic	57	93				
Cadmium	5.1	6.7				
Chromium	260	270				
Copper	390	390	**84.6**	**94.1**	**169**	**118**
Lead	450	530				
Mercury	0.41	0.59				
Silver	6.1	6.1				
Zinc	410	960	**51**	**93**	**141**	**125**
BULK ORGANOTINS (µg/kg-dry wt)						
KRONE88						
Tributyltin Ion	238 (c)	738 (c)	**100**	**65**	**52**	**88**
Dibutyltin Ion	---	---	**120**	**91**	**64**	**59**
Butyltin Ion	---	---	**17**	**12**	**15**	**8.8**
POREWATER ORGANOTINS (µg/L)						
KRONE88						
Tributyltin Ion	0.05 (d)	0.15 (d)				
Dibutyltin Ion	---	---				
Butyltin Ion	---	---				
PAHs (mg/kg OC) (e)						
Method SW8270D						
Naphthalene	99	170				
Acenaphthylene	66	66				
Acenaphthene	16	57				
Fluorene	23	79				
Phenanthrene	100	480				
Anthracene	220	1,200				
2-Methylnaphthalene	38	64				
LPAH (f, g)	370	780				
Fluoranthene	160	1,200				
Pyrene	1,000	1,400				
Benzo(a)anthracene	110	270				
Chrysene	110	460				
Total Benzofluoranthenes (f, h)	230	450				
Benzo(a)pyrene	99	210				
Indeno(1,2,3-cd)pyrene	34	88				
Dibenz(a,h)anthracene	12	33				
Benzo(g,h,i)perylene	31	78				
HPAH (f, i)	960	5,300				
SVOCs (mg/kg OC) (e)						
Method SW8270D						
1,2-Dichlorobenzene	2.3	2.3				
1,3-Dichlorobenzene	---	---				
1,4-Dichlorobenzene	3.1	9				
1,2,4-Trichlorobenzene	0.81	1.8				
Hexachlorobenzene	0.38	2.3				
Dimethylphthalate	53	53				
Diethylphthalate	61	110				
Di-n-Butylphthalate	220	1,700				
Butylbenzylphthalate	4.9	64				
bis(2-Ethylhexyl)phthalate	47	78				
Di-n-Octyl phthalate	58	4,500				
Dibenzofuran	15	58				
Hexachlorobutadiene	3.9	6.2				
N-Nitrosodiphenylamine	11	11				

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SG-30	WM-SG-31	WM-SG-34	WM-SG-35
	SCO (a)	CSL (b)	ZP61B 12/15/2014	ZP61C/ZV88A 12/15/2014	ZP61D 12/15/2014	ZP61E 12/15/2014
SVOCs (µg/kg)						
Method SW8270D						
Phenol	420	1,200				
2-Methylphenol	63	63				
4-Methylphenol	670	670				
2,4-Dimethylphenol	29	29				
Pentachlorophenol	360	690				
Benzyl Alcohol	57	73				
Benzoic Acid	650	650				
Total PCBs (f) (mg/kg OC)						
Method SW8082A						
Total PCBs	12	65		**4.01**		
CONVENTIONALS						
Total Organic Carbon (%) (PLUMB81TC)			**0.559**	**0.873**	**1.63**	**1.88**
PERSISTENT BIOACCUMULATIVE TOXINS						
	SCO (j)	CSL (k)				
cPAHs (TEQ) (µg/kg)						
Method SW8270DSIM						
cPAHs (TEQ)	40	400				
PCBs (µg/kg)						
Method SW8082A						
Total PCBs	6	53		**35**		
PCBs by Congener Analysis						
PCB - TEQ (pg/g) (a),(b)						
Method SW1668A						
PCB-TEQ	0.2	2		**1.4**		
Method SW1668A						
Total PCBs (µg/kg)	6	53		**54.1**		
BULK ORGANOTINS (µg/kg-dry wt)						
KRONE88						
Tributyltin Ion	238	738	**100**	**65**	**52**	**88**
TOTAL METALS (mg/kg-dry wt)						
Methods SW6010C/SW7471A	**Natural Background**					
Arsenic	11					
Cadmium	1					
Lead	21					
Mercury	0.20					

TABLE 13
ANALYTICAL RESULTS – SURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

PCBs = Polychlorinated Biphenyls
SQS = Sediment Quality Standards
CSL = Cleanup Screening Level
PBT = Persistent Bioaccumulative Toxins
SMS = Sediment Management Standards
TBT = Tributyltin
PSDDA = Puget Sound Dredged Disposal Analysis

U = The compound was not detected at the reported concentration.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
P = The analyte was detected on both chromatographic columns but the quantified values differ by 40% RPD with no obvious chromatographic interference. The higher of the two values is reported by the laboratory.
Bold = Detected compound.
Boxed results exceed the SQS.
Brown shaded total organic carbon results are outside the range of 0.5 to 3.5; consider dry-weight equivalent values for Apparent Effects Threshold.
Gray shaded results exceed the benthic-based CSL.
Yellow shaded results exceed the PBT CSL or PBT screening level (for metals).

(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) 238 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT SQS.
738 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT CSL.
(d) TBT porewater screening level established by PSDDA.
(e) All organic data (except phenols, benzyl alcohol, and benzoic acid) are normalized to total organic carbon; this involves dividing the dry weight concentration of the constituent by the fraction of total organic carbon present.
(f) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:
  (i) Where chemical analyses identify an undetected value for every individual compound/isomer, then the single highest detection limit shall represent the sum of the respective compounds/isomers.
  (ii) Where chemical analyses detect one or more individual compounds/isomers, only the detected concentrations will be added to represent the group sum.
(g) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds listed.
(h) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.
(i) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.
(j) Risk-based SCO developed based on protection of human health through seafood consumption (see Appendix E).
(k) Risk-based CSL developed based on protection of human health through seafood consumption (see Appendix E).
(l) Total PCBs exceeds the SCO at WM-SG-03 based on dry-weight AET (Low TOC at this sample location).

TABLE 14
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

			WM-SC-1	WM-SC-1	WM-SC-1	WM-SC-2	WM-SC-2	WM-SC-2	WM-SC-3	WM-SC-3	WM-SC-4	WM-SC-4	WM-SC-6	WM-SC-6	WM-SC-10	WM-SC-10	WM-SC-29	WM-SC-30	WM-SC-31
	WAC 173-204		(1-2.5)	(2.5-4)	(4-5.5)	(1-2)	(2-3.5)	(3.5-5)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(3-4.5)	(2-3.5)	(1-2.5)	(1.5-3)
	Dry Weight Equivalents		YG58G	YJ78D	YM32A	YG58E	YG58F	YJ78C	YG58H	YJ78E	YG58D	YJ78B	YG58C	YJ78A	YG58A	YG58B	ZP77A	ZP77C	ZP77B
	SQS	CSL	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	12/17/2014	12/17/2014	12/17/2014
TOTAL METALS (mg/kg)																			
Methods 200.8/SW7471A																			
Arsenic	57	93	**2.7**			**3.7** J	**3.1**		**3.1**		**2.8**		**2.7**		**4.8**	**5.5**			
Cadmium	5.1	6.7	**0.3**			**0.2**	**0.3**		**0.4**		**0.2**		**0.3**		**0.5**	**0.2**			
Chromium	260	270	**10.7**			**12.1** J	**11.4**		**11.6**		**10.7**		**10.7**		**25.7**	**32.0**			
Copper	390	390	**149**			**253** J	**239**		**186**		**66.0**		**20.3**		**48.1**	**41.4**			
Lead	450	530	**2.9**			**19.2** J	**7.9**		**6.5**		**3.5**		**4.8**		**10.3**	**4.7**			
Mercury	0.41	0.59	0.02 U			**0.36** J	**0.26**	**0.13** J	**0.06**		**0.04**		**0.03**		**0.17**	**0.04**			
Silver	6.1	6.1	0.2 U			0.2 U	0.2 U		0.2 U		0.3 U		0.2 U		0.3 U	0.3 U			
Zinc	410	960	**132**			**174** J	**137**		**100**		**45**		**81**		**78**	**72**			
PAHs (µg/kg)																			
Method SW8270DSIM																			
Dibenz(a,h)anthracene	230	230	**3.5** J			**47**	**17**		**17**		**8.1**		**9.1**		**24**	5.0 U			
1,4-Dichlorobenzene	110	110	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
1,2,4-Trichlorobenzene	31	51	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
Hexachlorobenzene	22	70	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
Hexachlorobutadiene	11	120	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
Dimethylphthalate	71	160	4.7 U			**16**	**2.4** J		**3.4** J		**3.6** J		5.0 U		4.9 U	5.0 U			
Butylbenzylphthalate	63	900	4.7 U			**2.6** J	4.9 U		4.9 U		4.9 U		5.0 U		**3.6** J	**2.6** J			
2-Methylphenol	63	63	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
2,4-Dimethylphenol	29	29	24 U			25 U	24 U		24 U		24 U		25 U		25 U	25 U			
N-Nitrosodiphenylamine	28	40	4.7 U			**17**	**12**		4.9 U		4.9 U		5.0 U		**9.3**	5.0 U			
Benzyl Alcohol	57	72	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
Pentachlorophenol	360	690	19 U			**36** J	20 U		20 U		20 U		20 U		**23** J	20 U			
1,2-Dichlorobenzene	35	50	4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
1,3-Dichlorobenzene			4.7 U			5.1 U	4.9 U		4.9 U		4.9 U		5.0 U		4.9 U	5.0 U			
PCBs (µg/kg)																			
Method SW8082A																			
Aroclor 1016			3.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Aroclor 1242			3.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Aroclor 1248			3.8 U			**65**	**16**	**14**	8.0 U	3.9 U	4.0 U		3.8 U	3.9 U	**34**	3.8 U	3.7 U	3.7 U	12 U
Aroclor 1254			3.8 U			**68**	**15**	**10**	**18**	3.9 U	4.0 U		3.8 U	3.9 U	**130** P	3.8 U	3.7 U	3.7 U	**20**
Aroclor 1260			3.8 U			**15** P	**11**	**6.6**	**6.4**	3.9 U	4.0 U		3.8 U	3.9 U	**130**	3.8 U	3.7 U	3.7 U	**18**
Aroclor 1221			3.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Aroclor 1232			4.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	5.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Aroclor 1262			3.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Aroclor 1268			3.8 U			3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U		3.8 U	3.9 U	4.0 U	3.8 U	3.7 U	3.7 U	3.9 U
Total PCBs	130	1,000	ND			**148**	**42**	**30.6**	**24.4**	ND	ND		ND	ND	**294**	ND	ND	ND	**38**
SEMIVOLATILES (µg/kg)																			
Method SW8270D/SW8270D-SIM																			
Phenol	420	1,200	19 U			20 U	20 U		20 U		20 U		**17** J		**59**	**19** J			
1,3-Dichlorobenzene			19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
1,4-Dichlorobenzene	110	110	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
Benzyl Alcohol	57	72	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
1,2-Dichlorobenzene	35	50	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
2-Methylphenol	63	63	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
4-Methylphenol	670	670	19 U			**24**	**80**		20 U		20 U		20 U		**140**	20 U			
Hexachloroethane			19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
2,4-Dimethylphenol	29	29	94 U			100 U	97 U		98 U		98 U		99 U		99 U	99 U			
Benzoic Acid	650	650	190 U			200 U	200 U		200 U		200 U		200 U		200 U	200 U			
1,2,4-Trichlorobenzene	31	51	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
Naphthalene	2,100	2,100	19 U			**74**	**33**		20 U		20 U		20 U		**87**	**15** J			
Hexachlorobutadiene	11	120	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
2-Methylnaphthalene	670	670	19 U			**41**	20 U		20 U		20 U		20 U		**24**	20 U			
Dimethylphthalate	71	160	19 U			**17** J	20 U		20 U		20 U		20 U		20 U	20 U			
Acenaphthylene	1,300	1,300	19 U			**22** J	**13** J		20 U		20 U		20 U		**31**	20 U			
Acenaphthene	500	500	19 U			**57**	20 U		20 U		20 U		20 U		**17** J	20 U			
Dibenzofuran	540	540	19 U			**55**	**18** J		20 U		20 U		20 U		**34**	20 U			
Diethylphthalate	200	1,200	19 U			20 U	**33**		**29**		20 U		20 U		**54**	**44**			
Fluorene	540	540	19 U			**57**	**14** J		20 U		20 U		20 U		**34**	20 U			
N-Nitrosodiphenylamine	28	40	19 U			**16** J	**9.7** J		20 U		20 U		20 U		20 U	20 U			
Hexachlorobenzene	22	70	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			

TABLE 14
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (DRY WEIGHT BASIS)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

			WM-SC-1	WM-SC-1	WM-SC-1	WM-SC-2	WM-SC-2	WM-SC-2	WM-SC-3	WM-SC-3	WM-SC-4	WM-SC-4	WM-SC-6	WM-SC-6	WM-SC-10	WM-SC-10	WM-SC-29	WM-SC-30	WM-SC-31
	WAC 173-204		(1-2.5)	(2.5-4)	(4-5.5)	(1-2)	(2-3.5)	(3.5-5)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(3-4.5)	(2-3.5)	(1-2.5)	(1.5-3)
	Dry Weight Equivalents		YG58G	YJ78D	YM32A	YG58E	YG58F	YJ78C	YG58H	YJ78E	YG58D	YJ78B	YG58C	YJ78A	YG58A	YG58B	ZP77A	ZP77C	ZP77B
	SQS	CSL	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	12/17/2014	12/17/2014	12/17/2014
Pentachlorophenol	360	690	94 U			100 U	97 U		98 U		98 U		99 U		99 U	99 U			
Phenanthrene	1,500	1,500	19 U			**300**	**61**		**67**		**22**		**25**		**160**	**22**			
Anthracene	960	960	19 U			**74**	**22**		**21**		20 U		20 U		**57**	20 U			
Di-n-Butylphthalate	1,400	5,100	19 U			**20**	20 U		**46**		20 U		20 U		20 U	20 U			
Fluoranthene	1,700	2,500	**27**			**460** J	**140**		**230**		**78**		**54**		**220**	**22**			
Pyrene	2,600	3,300	**73**			**720** J	**350**		**300**		**100**		**64**		**520**	**30**			
Butylbenzylphthalate	63	900	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
Benzo(a)anthracene	1,300	1,600	**21**	**7.0**	4.8 U	**190**	**46**	**110**	**74**	4.8 U	**25**	4.8 U	**23**	4.8 U	**88**	20 U			
bis(2-Ethylhexyl)phthalate	1,300	3,100	**34** J			**130**	**46** J		**75**		**41** J		**38** J		**140**	50 U			
Chrysene	1,400	2,800	**20**	**9.5**	4.8 U	**330** J	**84**	**340**	**160**	4.8 U	**73**	4.8 U	**44**	4.8 U	**130**	**9.9** J			
Di-n-Octyl phthalate	6,200	6,200	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U			
Benzo(a)pyrene	1,600	1,600	**14** J	**6.6**	4.8 U	**230**	**77**	**110**	**93**	4.8 U	**29**	4.8 U	**37**	4.8 U	**140**	**11** J			
Indeno(1,2,3-cd)pyrene	600	690	19 U	4.8 U	4.8 U	**120**	**44**	**49**	**47**	4.8 U	**20**	4.8 U	**27**	4.8 U	**68**	20 U			
Dibenz(a,h)anthracene	230	230	19 U	4.8 U	4.8 U	**43**	20 U	**14**	**15** J	4.8 U	20 U	4.8 U	20 U	4.8 U	20 U	20 U			
Benzo(g,h,i)perylene	670	720	19 U			**130**	**49**		**50**		**20**		**32**		**78**	**9.9** J			
1-Methylnaphthalene			19 U			**27**	20 U		20 U		20 U		20 U		**17** J	20 U			
Total Benzofluoranthenes	3,200	3,600	**53**	**16**	4.8 U	**700**	**230**	**340**	**290**	4.8 U	**110**	4.8 U	**98**	4.8 U	**300**	**16** J			
cPAHs (TEQ)			**22**	**9.0**	ND	**339**	**110**	**163**	**137**	ND	**45**	ND	**52**	ND	**187**	**13**			
BULK ORGANOTINS (µg/kg)																			
Method SW8270DSIM																			
Tributyltin Ion			**75**			**730**	**56**		**520**	**10**	**24**		**24**		**25**	3.8 U			
Dibutyltin Ion			**50**			**360**	**43**		**200**	**5.5**	**20**		**60**		**29** J	5.7 U			
Butyltin			**12**			**42**	**7.6**		**41**	3.6 U	**8.6**		**9.1**		**5.2** J	4.0 U			
CONVENTIONALS																			
Total Solids (%) (SM2540G)			**82.59**	**50.72**		**75.19**	**78.85**	**80.28**	**78.52**	**79.96**	**79.58**	**98.87**	**77.59**	**78.78**	**63.46**	**74.75**	**76.06**	**72.37**	**54.79**
Preserved Total Solids (%) (SM2540G)			**80.63**			**76.38**	**78.86**		**78.39**		**78.23**		**79.58**		**64.56**	**72.66**	**77.85**	**72.10**	**57.19**
Total Volatile Solids (%) (SM2540G)			**1.32**			**2.05**	**1.67**		**1.64**		**1.42**		**1.55**		**3.27**	**2.03**	**2.13**	**2.94**	**3.83**
Ammonia (NH3) as Nitrogen (N) (mg/kg) (EPA350.1M)			**0.34**			**5.75**	**3.72**		**0.44**		**0.50**		**1.39**		**24.1**	**23.2**	**3.97**	**2.97**	**55.2**
Sulfide (mg/kg) (EPA376.2/SM4500-S2D)			**237**			**652**	**167**		**2.97**		**152**		**17.0**		**180**	**3.63**	**18.8**	**34.7**	**90.5** J
Total Organic Carbon (%) (PLUMB81TC)			**0.490**	**0.765**	**0.628**	**0.479**	**0.351**	**0.328**	**0.640**	**0.304**	**0.244**	**0.194**	**0.329**	**0.285**	**0.697** J	**0.202**	**0.362**	**0.128**	**1.24**
GRAIN Size (%)																			
PSEP-PS																			
Particle/Grain Size, Phi Scale <-1			**31.1**	**29.5**		**9.6**	**9.1**	**11.6**	**16.7**	**6.6**	**15.9**	**3.2**	**20.8**	**6.6**	**0.4**	**0.3**	**23.5**	**5**	**3.1**
Particle/Grain Size, Phi Scale -1 to 0			**5.6**	**5.1**		**4.1**	**3.0**	**4.2**	**4.2**	**1.1**	**3.1**	**0.9**	**3.8**	**1.7**	**0.4**	**0.2**	**4.9**	**2.0**	**0.6**
Particle/Grain Size, Phi Scale 0 to 1			**3.1**	**2.2**		**4.0**	**2.1**	**2.0**	**2.5**	**0.6**	**2.0**	**0.4**	**1.8**	**0.8**	**0.4**	**0.1**	**2.2**	**1.1**	**0.5**
Particle/Grain Size, Phi Scale 1 to 2			**3.5**	**2.6**		**5.8**	**3.6**	**2.9**	**3.2**	**2.5**	**3.7**	**3.4**	**2.9**	**3.0**	**0.5**	**0.2**	**3.1**	**2.4**	**0.6**
Particle/Grain Size, Phi Scale 2 to 3			**29.8**	**40.5**		**33.7**	**38.3**	**43.9**	**36.6**	**38.6**	**33.8**	**40.0**	**29.2**	**31.3**	**9.0**	**1.9**	**27.9**	**28.1**	**2.1**
Particle/Grain Size, Phi Scale 3 to 4			**16.0**	**13.9**		**25.7**	**30.7**	**25.6**	**25.4**	**40.4**	**31.9**	**39.9**	**30.9**	**40.9**	**37.1**	**6.6**	**18.2**	**40.8**	**11.7**
Particle/Grain Size, Phi Scale 4 to 5			**4.1**	**0.2**		**4.8**	**4.3**	**2.9**	**3.1**	**2.2**	**2.3**	**3.0**	**2.1**	**3.6**	**15.6**	**11.7**	**4.6**	**5.1**	**11.0**
Particle/Grain Size, Phi Scale 5 to 6			**1.0**	**0.5**		**1.7**	**1.3**	**0.7**	**0.9**	**1.4**	**1.0**	**1.4**	**0.8**	**1.7**	**6.4**	**11.9**	**2.2**	**2.5**	**8.6**
Particle/Grain Size, Phi Scale 6 to 7			**0.8**	**0.7**		**1.9**	**1.2**	**1.1**	**0.9**	**1.2**	**1.0**	**1.4**	**1.2**	**1.8**	**5.8**	**11.3**	**2.2**	**2.7**	**11.6**
Particle/Grain Size, Phi Scale 7 to 8			**1.7**	**1.5**		**1.6**	**1.2**	**1.5**	**1.7**	**1.2**	**1.1**	**1.4**	**1.4**	**2.1**	**5.0**	**11.2**	**3.0**	**3.8**	**11.8**
Particle/Grain Size, Phi Scale 8 to 9			**1.3**	**1.1**		**1.7**	**1.3**	**0.9**	**1.5**	**1.2**	**1.2**	**1.1**	**1.4**	**1.6**	**4.9**	**11.0**	**2.6**	**2.7**	**10.7**
Particle/Grain Size, Phi Scale 9 to 10			**0.8**	**0.9**		**1.7**	**1.3**	**0.9**	**1.2**	**1.0**	**1.1**	**1.2**	**1.1**	**2.0**	**2.9**	**8.4**	**1.8**	**1.8**	**7.9**
Particle/Grain Size, Phi Scale >10			**1.4**	**1.3**		**3.6**	**2.5**	**1.5**	**2.2**	**2.0**	**1.9**	**2.6**	**2.5**	**3.1**	**11.4**	**25.2**	**4.0**	**2.1**	**19.7**
Particle/Grain Size, Fines (Silt/Clay)			**11.0**	**6.3**		**17.0**	**13.3**	**9.7**	**11.5**	**10.2**	**9.6**	**12.1**	**10.6**	**15.8**	**52.1**	**90.7**	**20.3**	**20.7**	**81.4**

U = The compound was not detected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
J = The analyte was positively identified; the associated numerical value
is the approximate concentration of the analyte in the sample.
P = The analyte was detected on both chromatographic columns but the quantified values differ by 40% RPD with no obvious chromatographic
interference. The higher of the two values is reported by the laboratory.
Bold = Detected compound.
(a) = Average TOC of WM-SC-1(1-2.5) and WM-SC-1((2.5-4).
TEQ = Toxicity Equivalency Quotient, WAC 173-340-708(e).

TABLE 15
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards		WM-SC-1	WM-SC-1	WM-SC-1	WM-SC-2	WM-SC-2	WM-SC-2	WM-SC-3	WM-SC-3	WM-SC-4	WM-SC-4	WM-SC-6	WM-SC-6	WM-SC-10	WM-SC-10
	Screening Levels		(1-2.5)	(2.5-4)	(4-5.5)	(1-2)	(2-3.5)	(3.5-5)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(2.5-4)	(1-2.5)	(3-4.5)
	SCO (a)	CSL (b)	YG58G	YJ78D	YM32A	YG58E	YG58F	YJ78C	YG58H	YJ78E	YG58D	YJ78B	YG58C	YJ78A	YG58A	YG58B
			04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014	04/14/2014
TOTAL METALS (mg/kg-dry wt)																
Methods 200.8/SW7471A																
Arsenic	57	93	**2.7**			**3.7**	**3.1**		**3.1**		**2.8**		**2.7**		**4.8**	**5.5**
Cadmium	5.1	6.7	**0.3**			**0.2**	**0.3**		**0.4**		**0.2**		**0.3**		**0.5**	**0.2**
Chromium	260	270	**10.7**			**12.1**	**11.4**		**11.6**		**10.7**		**10.7**		**25.7**	**32.0**
Copper	390	390	**149**			**253**	**239**		**186**		**66.0**		**20.3**		**48.1**	**41.4**
Lead	450	530	**2.9**			**19.2**	**7.9**		**6.5**		**3.5**		**4.8**		**10.3**	**4.7**
Mercury	0.41	0.59	0.02 U			**0.36**	**0.26**	**0.13** J	**0.06**		**0.04**		**0.03**		**0.17**	**0.04**
Silver	6.1	6.1	0.2 U			0.2 U	0.2 U		0.2 U		0.3 U		0.2 U		0.3 U	0.3 U
Zinc	410	960	**132**			**174**	**137**		**100**		**45**		**81**		**78**	**72**
BULK ORGANOTINS (µg/kg-dry wt)																
Method SW8270DSIM																
Tributyltin Ion	238 (c)	738 (c)	**75**			**730**	**56**		**520**	**10**	**24**		**24**		**25**	3.8 U
Dibutyltin Ion	---	---	**50**			**360**	**43**		**200**	**5.5**	**20**		**60**		**29**	5.7 U
Butyltin Ion	---	---	**12**			**42**	**7.6**		**41**	3.6 U	**8.6**		**9.1**		**5.2**	4.0 U
PAHs (mg/kg OC) (e)																
Method SW8270D																
Naphthalene	99	170	3.9 U			**15**	**9.4**		3.1 U		8.2 U		6.1 U		**12**	**7.4** J
Acenaphthylene	66	66	3.9 U			**4.6**	**3.7** J		3.1 U		8.2 U		6.1 U		**4.4**	9.9 U
Acenaphthene	16	57	3.9 U			**12**	5.7 U		3.1 U		8.2 U		6.1 U		**2.4** J	9.9 U
Fluorene	23	79	3.9 U			**12**	**4.0** J		3.1 U		8.2 U		6.1 U		**4.9**	9.9 U
Phenanthrene	100	480	3.9 U			**63**	**17**		**10**		**9.0**		**7.6**		**23**	**11**
Anthracene	220	1,200	3.9 U			**15**	**6.3**		**3.3**		8.2 U		6.1 U		**8.2**	9.9 U
2-Methylnaphthalene	38	64	3.9 U			**8.6**	5.7 U		3.1 U		8.2 U		6.1 U		**3.4**	9.9 U
LPAH (f, g)	370	780	ND			**122**	**41**		**14**		**9.0**		**7.6**		**55**	**18**
Fluoranthene	160	1,200	**5.5**			**96**	**40**		**36**		**32**		**16**		**32**	**11**
Pyrene	1,000	1,400	**15**			**150**	**100**		**47**		**41**		**19**		**75**	**15**
Benzo(a)anthracene	110	270	**4.3**	**0.9**	0.8 U	**40**	**13**	**14**	**12**	0.63 U	**10**	0.63 U	**7.0**	0.63 U	**13**	9.9 U
Chrysene	110	460	**4.1**	**1.2**	0.8 U	**69**	**24**	**44**	**25**	0.63 U	**30**	0.63 U	**13**	0.63 U	**19**	**4.9** J
Total Benzofluoranthenes (f, h)	230	450	**11**	**2.1**	0.8 U	**146**	**66**	**44**	**45**	0.63 U	**45**	0.63 U	**30**	0.63 U	**43**	**7.9** J
Benzo(a)pyrene	99	210	**2.9** J	**0.9**	0.8 U	**48**	**22**	**14**	**15**	0.63 U	**12**	0.63 U	**11**	0.63 U	**20**	**5.4** J
Indeno(1,2,3-cd)pyrene	34	88	3.9 U	0.6 U	0.8 U	**25**	**13**	**6.4**	**7.3**	0.63 U	**8.2**	0.63 U	**8.2**	0.63 U	**9.8**	9.9 U
Dibenz(a,h)anthracene	12	33	0.7 U	0.6 U	0.8 U	**9.8**	4.8 U	**1.8**	**2.7** J	0.63 U	3.3 U	0.63 U	2.8 U	0.63 U	3.4 U	2.5 U
Benzo(g,h,i)perylene	31	78	3.9 U			**27**	**14**		**7.8**		**8.2**		**9.7**		**11**	**4.9** J
HPAH (f, i)	960	5,300	**42**	**5.1**	ND	**611**	**291**	**126**	**197**	ND	**186**	ND	**115**	ND	**222**	**49**
SVOCs (mg/kg OC) (e)																
1,2-Dichlorobenzene	2.3	2.3	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
1,3-Dichlorobenzene	---	---	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
1,4-Dichlorobenzene	3.1	9	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
1,2,4-Trichlorobenzene	0.81	1.8	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
Hexachlorobenzene	0.38	2.3	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
Dimethylphthalate	53	53	0.96 U			**3.3** J	0.68 U		0.53 U		1.5 U		1.5 U		0.70 U	2.5 U
Diethylphthalate	61	110	3.9 U			4.2 U	**9.4**		**4.5**		8.2 U		6.1 U		**7.7**	**22**
Di-n-Butylphthalate	220	1,700	3.9 U			**4.2**	5.7 U		**7.2**		8.2 U		6.1 U		2.9 U	9.9 U
Butylbenzylphthalate	4.9	64	0.96 U			0.54 U	1.4 U		0.77 U		2.0 U		1.5 U		0.52 U	1.3 U
bis(2-Ethylhexyl)phthalate	47	78	**6.9** J			**27**	**13** J		**12**		**17** J		**12** J		**20**	25 U
Di-n-Octyl phthalate	58	4,500	3.9 U			4.2 U	5.7 U		3.1 U		8.2 U		6.1 U		2.9 U	9.9 U
Dibenzofuran	15	58	3.9 U			**11**	**5.1** J		3.1 U		8.2 U		6.1 U		**4.9**	9.9 U
Hexachlorobutadiene	3.9	6.2	0.96 U			1.1 U	1.4 U		0.77 U		2.0 U		1.5 U		0.70 U	2.5 U
N-Nitrosodiphenylamine	11	11	0.96 U			**3.5** J	**3.4** J		0.77 U		2.0 U		1.5 U		1.3 U	2.5 U
SVOCs (µg/kg)																
Phenol	420	1,200	19 U			20 U	20 U		20 U		20 U		**17** J		**59**	**19** J
2-Methylphenol	63	63	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U
4-Methylphenol	670	670	19 U			**24**	**80**		20 U		20 U		20 U		**140**	20 U
2,4-Dimethylphenol	29	29	94 U			100 U	97 U		98 U		98 U		99 U		99 U	99 U
Pentachlorophenol	360	690	94 U			100 U	97 U		98 U		98 U		99 U		99 U	99 U
Benzyl Alcohol	57	73	19 U			20 U	20 U		20 U		20 U		20 U		20 U	20 U
Benzoic Acid	650	650	190 U			200 U	200 U		200 U		200 U		200 U		200 U	200 U

TABLE 15
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards Screening Levels SCO (a)	CSL (b)	WM-SC-1 (1-2.5) YG58G 04/14/2014	WM-SC-1 (2.5-4) YJ78D 04/14/2014	WM-SC-1 (4-5.5) YM32A 04/14/2014	WM-SC-2 (1-2) YG58E 04/14/2014	WM-SC-2 (2-3.5) YG58F 04/14/2014	WM-SC-2 (3.5-5) YJ78C 04/14/2014	WM-SC-3 (1-2.5) YG58H 04/14/2014	WM-SC-3 (2.5-4) YJ78E 04/14/2014	WM-SC-4 (1-2.5) YG58D 04/14/2014	WM-SC-4 (2.5-4) YJ78B 04/14/2014	WM-SC-6 (1-2.5) YG58C 04/14/2014	WM-SC-6 (2.5-4) YJ78A 04/14/2014	WM-SC-10 (1-2.5) YG58A 04/14/2014	WM-SC-10 (3-4.5) YG58B 04/14/2014
Total PCBs (f) (mg/kg OC)																
Method SW8082A																
Total PCBs	12	65	ND			31	12	9.3	3.8	ND	ND		ND	ND	42	ND
CONVENTIONALS																
Total Organic Carbon (%) (PLUMB81TC)			0.49	0.765	0.628	0.479	0.351	0.328	0.64	0.304	0.244	0.194	0.329	0.285	0.697	0.202
PERSISTENT BIOACCUMULATIVE TOXINS																
	SCO (j)	CSL (k)														
cPAHs (TEQ) (µg/kg)																
Method SW8270DSIM																
cPAHs (TEQ)	40	400	22	9.0		339	110	163	137	ND	45	ND	52	ND	187	13
PCBs (µg/kg)																
Method SW8082A																
Total PCBs	6	53	ND			148	42	30.6	24.4	ND	ND		ND	ND	294	ND
TOTAL METALS (mg/kg-dry wt)																
Methods SW6010C/SW7471A																
Cadmium	1	1	0.3			0.2	0.3		0.4		0.2		0.3		0.5	0.2
Lead	21	21	2.9			19.2 J	7.9		6.5		3.5		4.8		10.3	4.7
Mercury	0.20	0.20	0.02 U			0.36 J	0.26	0.13 J	0.06		0.04		0.03		0.17	0.04
Arsenic	11	11	2.7			3.7	3.1		3.1		2.8		2.7		4.8	5.5
BULK ORGANOTINS (µg/kg-dry wt)																
Method SW8270DSIM																
Tributyltin Ion	238	738	75			730	56		520	10	24		24		25	3.8 U

TABLE 15
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards Screening Levels		WM-SC-29 (2-3.5)	WM-SC-30 (1-2.5)	WM-SC-31 (1.5-3)
	SCO (a)	CSL (b)	ZP77A 12/17/2014	ZP77C 12/17/2014	ZP77B 12/17/2014
TOTAL METALS (mg/kg-dry wt)					
Methods 200.8/SW7471A					
Arsenic	57	93			
Cadmium	5.1	6.7			
Chromium	260	270			
Copper	390	390			
Lead	450	530			
Mercury	0.41	0.59			
Silver	6.1	6.1			
Zinc	410	960			
BULK ORGANOTINS (µg/kg-dry wt)					
Method SW8270DSIM					
Tributyltin Ion	238 (c)	738 (c)			
Dibutyltin Ion	---	---			
Butyltin Ion	---	---			
PAHs (mg/kg OC) (e)					
Method SW8270D					
Naphthalene	99	170			
Acenaphthylene	66	66			
Acenaphthene	16	57			
Fluorene	23	79			
Phenanthrene	100	480			
Anthracene	220	1,200			
2-Methylnaphthalene	38	64			
LPAH (f, g)	370	780			
Fluoranthene	160	1,200			
Pyrene	1,000	1,400			
Benzo(a)anthracene	110	270			
Chrysene	110	460			
Total Benzofluoranthenes (f, h)	230	450			
Benzo(a)pyrene	99	210			
Indeno(1,2,3-cd)pyrene	34	88			
Dibenz(a,h)anthracene	12	33			
Benzo(g,h,i)perylene	31	78			
HPAH (f, i)	960	5,300			
SVOCs (mg/kg OC) (e)					
1,2-Dichlorobenzene	2.3	2.3			
1,3-Dichlorobenzene	---	---			
1,4-Dichlorobenzene	3.1	9			
1,2,4-Trichlorobenzene	0.81	1.8			
Hexachlorobenzene	0.38	2.3			
Dimethylphthalate	53	53			
Diethylphthalate	61	110			
Di-n-Butylphthalate	220	1,700			
Butylbenzylphthalate	4.9	64			
bis(2-Ethylhexyl)phthalate	47	78			
Di-n-Octyl phthalate	58	4,500			
Dibenzofuran	15	58			
Hexachlorobutadiene	3.9	6.2			
N-Nitrosodiphenylamine	11	11			
SVOCs (µg/kg)					
Phenol	420	1,200			
2-Methylphenol	63	63			
4-Methylphenol	670	670			
2,4-Dimethylphenol	29	29			
Pentachlorophenol	360	690			
Benzyl Alcohol	57	73			
Benzoic Acid	650	650			

TABLE 15
ANALYTICAL RESULTS – SUBSURFACE SEDIMENT (CARBON-NORMALIZED)
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Sediment Management Standards Screening Levels		WM-SC-29 (2-3.5) ZP77A 12/17/2014	WM-SC-30 (1-2.5) ZP77C 12/17/2014	WM-SC-31 (1.5-3) ZP77B 12/17/2014
	SCO (a)	CSL (b)			
Total PCBs (f) (mg/kg OC)					
Method SW8082A					
Total PCBs	12	65	ND	ND	**3.1**
CONVENTIONALS					
Total Organic Carbon (%) (PLUMB81TC)			**0.362**	**0.128**	**1.24**
PERSISTENT BIOACCUMULATIVE TOXINS					
	SCO (j)	CSL (k)			
cPAHs (TEQ) (µg/kg)					
Method SW8270DSIM					
cPAHs (TEQ)	40	400			
PCBs (µg/kg)					
Method SW8082A					
Total PCBs	6	53	ND	ND	**38**
TOTAL METALS (mg/kg-dry wt)					
Methods SW6010C/SW7471A					
Cadmium	1	1			
Lead	21	21			
Mercury	0.20	0.20			
Arsenic	11	11			
BULK ORGANOTINS (µg/kg-dry wt)					
Method SW8270DSIM					
Tributyltin Ion	238	738			

PCBs = Polychlorinated Biphenyls
SQS = Sediment Quality Standards
CSL = Cleanup Screening Level
PBT = Persistent Bioaccumulative Toxins
SMS = Sediment Management Standards
TBT = Tributyltin
PSDDA = Puget Sound Dredged Disposal Analysis

U = The compound was not detected at the reported concentration.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.
P = The analyte was detected on both chromatographic columns but the quantified values differ by 40% RPD with no obvious chromatographic interference. The higher of the two values is reported by the laboratory.
Bold = Detected compound.
Boxed results exceed the SQS.
Brown shaded total organic carbon results are outside the range of 0.5 to 3.5; consider dry-weight equivalent values for Apparent Effects Threshold.
Gray shaded results exceed the benthic-based CSL.
Yellow shaded results exceed the PBT CSL or PBT screening level (for metals).

(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) 238 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT SQS. 738 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT CSL.
(d) TBT porewater screening level established by PSDDA.
(e) All organic data (except phenols, benzyl alcohol, and benzoic acid) are normalized to total organic carbon; this involves dividing the dry weight concentration of the constituent by the fraction of total organic carbon present.
(f) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:
  (i) Where chemical analyses identify an undetected value for every individual compound/isomer, then the single highest detection limit shall represent the sum of the respective compounds/isomers.
  (ii) Where chemical analyses detect one or more individual compounds/isomers, only the detected concentrations will be added to represent the group sum.
(g) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds listed.
(h) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.
(i) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.
(j) Risk-based SCO developed based on protection of human health through seafood consumption (see Appendix F).
(k) Risk-based CSL developed based on protection of human health through seafood consumption (see Appendix F).

TABLE 16
SUMMARY STATISTICS – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Number of Samples	Number of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection
TOTAL METALS (mg/kg)							
Chromium	25	25	100%	All Detects	All Detects	10	69
Copper	30	30	100%	All Detects	All Detects	20.3	6,930
Zinc	30	30	100%	All Detects	All Detects	45	1,980
Lead	25	24	96%	7	7	2.9	58.1
Mercury	24	23	96%	0.02	0.02	0.03	0.91
Arsenic	22	16	73%	6	20	2.7	20
Cadmium	25	18	72%	0.3	0.7	0.2	1.0
Silver	23	0	0%	0.2	1	No Detects	No Detects
ORGANOTINS (µg/kg)							
Dibutyltin Ion	29	28	97%	5.7	5.7	5.5	2,200
Tributyltin Ion	29	28	97%	3.8	3.8	10	4,500
Butyltin	29	27	93%	3.6	4	5.2	400
POREWATER ORGANOTINS (µg/L)							
Dibutyltin Ion	15	15	100%	All Detects	All Detects	0.005	0.12
Tributyltin Ion	15	15	100%	All Detects	All Detects	0.005	0.71
Butyltin	15	8	53%	0.01	0.02	0.022	0.056
PCBS (µg/kg)							
Aroclor 1254	40	30	75%	3.7	4	5.2	240
Aroclor 1260	40	27	68%	3.7	20	3.8	130
Aroclor 1248	40	7	18%	3.7	39	14	380
Aroclor 1262	39	1	3%	3.7	4	6.2	6.2
Aroclor 1016	40	0	0%	3.7	4	No Detects	No Detects
Aroclor 1221	40	0	0%	3.7	4	No Detects	No Detects
Aroclor 1232	40	0	0%	3.7	5.8	No Detects	No Detects
Aroclor 1242	40	0	0%	3.7	4	No Detects	No Detects
Aroclor 1268	39	0	0%	3.7	4	No Detects	No Detects
Total PCBs	40	30	75%	3.7	39	5.9	620
PCB-TEQ	5	5	100%	All Detects	All Detects	0.01	1.4
SVOCS (µg/kg)							
Benzo(a)pyrene	26	26	100%	All Detects	All Detects	11	1,000
Chrysene	26	26	100%	All Detects	All Detects	9.9	2,400
Fluoranthene	26	26	100%	All Detects	All Detects	22	6,500
Pyrene	26	26	100%	All Detects	All Detects	30	3,500
Total Benzofluoranthenes	26	26	100%	All Detects	All Detects	16	3,500
Benzo(a)anthracene	26	25	96%	20	20	21	1,800
Benzo(g,h,i)perylene	26	25	96%	19	19	9.9	550
Phenanthrene	26	25	96%	19	19	22	1,100
Indeno(1,2,3-cd)pyrene	26	24	92%	19	20	20	540
Anthracene	26	22	85%	19	20	21	370
bis(2-Ethylhexyl)phthalate	26	22	85%	50	240	34	1,300
Naphthalene	26	22	85%	19	20	10	110
Acenaphthylene	26	21	81%	19	20	9.2	110
Fluorene	26	21	81%	19	20	10	130
Dibenz(a,h)anthracene	26	20	77%	19	20	11	170
4-Methylphenol	26	18	69%	18	38	15	140
Dibenzofuran	26	18	69%	18	20	12	66
Phenol	26	18	69%	19	20	11	510
2-Methylnaphthalene	26	17	65%	18	20	10	66

TABLE 16
SUMMARY STATISTICS – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Number of Samples	Number of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection
Acenaphthene	26	16	62%	18	58	11	120
1-Methylnaphthalene	26	15	58%	18	20	10	36
Dimethylphthalate	26	10	38%	18	20	12	98
Di-n-Butylphthalate	26	10	38%	18	58	12	130
Butylbenzylphthalate	26	6	23%	18	58	10	110
Benzoic Acid	26	4	15%	180	580	150	280
Diethylphthalate	26	4	15%	18	230	29	54
N-Nitrosodiphenylamine	26	4	15%	18	58	9.7	30
Benzyl Alcohol	26	3	12%	18	58	19	49
Pentachlorophenol	26	3	12%	91	290	48	350
Di-n-Octyl phthalate	26	2	8%	18	58	15	16
2-Methylphenol	26	1	4%	18	58	15	15
1,2,4-Trichlorobenzene	26	0	0%	18	58	No Detects	No Detects
1,2-Dichlorobenzene	26	0	0%	18	58	No Detects	No Detects
1,3-Dichlorobenzene	26	0	0%	18	58	No Detects	No Detects
1,4-Dichlorobenzene	26	0	0%	18	58	No Detects	No Detects
2,4-Dimethylphenol	26	0	0%	91	290	No Detects	No Detects
Hexachlorobenzene	26	0	0%	18	58	No Detects	No Detects
Hexachlorobutadiene	26	0	0%	18	58	No Detects	No Detects
Hexachloroethane	26	0	0%	18	58	No Detects	No Detects
SVOC-SIM (µg/kg)							
Anthracene	7	7	100%	All Detects	All Detects	5.4	88
Benzo(g,h,i)perylene	7	7	100%	All Detects	All Detects	5.4	120
Naphthalene	7	7	100%	All Detects	All Detects	12	73
Phenanthrene	7	7	100%	All Detects	All Detects	20	470
Pyrene	7	7	100%	All Detects	All Detects	18	1,300
2-Methylnaphthalene	7	6	86%	4.7	4.7	5.4	1,000
Dibenzofuran	7	6	86%	4.7	4.7	6	35
Fluoranthene	14	12	86%	4.7	4.8	6.4	1,600
Dimethylphthalate	26	22	85%	4.7	5	2.4	120
Acenaphthylene	6	5	83%	4.7	4.7	12	44
Dibenz(a,h)anthracene	39	30	77%	4.7	14	3.5	160
Chrysene	13	9	69%	4.8	4.8	7	380
Total Benzofluoranthenes	13	9	69%	4.8	4.8	11	550
Benzo(a)anthracene	13	8	62%	4.7	4.8	6.4	200
Benzo(a)pyrene	13	8	62%	4.7	4.8	6.6	190
Butylbenzylphthalate	26	16	62%	4.7	5	2.6	22
Acenaphthene	8	4	50%	4.7	14	7.9	30
Indeno(1,2,3-cd)pyrene	13	6	46%	4.7	4.8	18	100
1-Methylnaphthalene	7	3	43%	4.7	14	9.2	18
2-Methylphenol	26	10	38%	4.6	5.1	3	16
N-Nitrosodiphenylamine	26	9	35%	4.6	15	2.6	28
Pentachlorophenol	26	9	35%	18	58	13	270
Benzyl Alcohol	26	8	31%	18	20	12	73
1,4-Dichlorobenzene	26	1	4%	4.6	15	2.7	2.7
2,4-Dimethylphenol	26	1	4%	23	73	11	11
1,2,4-Trichlorobenzene	26	0	0%	4.6	15	No Detects	No Detects
1,2-Dichlorobenzene	26	0	0%	4.6	15	No Detects	No Detects
1,3-Dichlorobenzene	26	0	0%	4.6	15	No Detects	No Detects
Hexachlorobenzene	26	0	0%	4.6	15	No Detects	No Detects
Hexachlorobutadiene	26	0	0%	4.6	15	No Detects	No Detects

TABLE 16
SUMMARY STATISTICS – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Number of Samples	Number of Detects	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Minimum Detection	Maximum Detection
CONVENTIONALS							
Ammonia (NH3) as N (mg/kg)	36	36	100%	All Detects	All Detects	0.34	55.2
Sulfide (mg/kg)	36	36	100%	All Detects	All Detects	2.97	2710
Total Organic Carbon (%)	48	48	100%	All Detects	All Detects	0.128	4.41

TABLE 17
SEDIMENT SCREENING LEVEL EXCEEDANCE STATISTICS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Benthic Screening Levels				
	SCO (a)	CSL (b)	No. of Samples	SCO Exceedances	CSL Exceedances
TOTAL METALS (mg/kg-dry wt)					
Methods SW6010C/SW7471A					
Arsenic	57	93	22	0	0
Cadmium	5.1	6.7	25	0	0
Chromium	260	270	25	0	0
Copper	390	390	30	6	6
Lead	450	530	25	0	0
Mercury	0.41	0.59	24	1	1
Silver	6.1	6.1	23	0	0
Zinc	410	960	30	4	2
BULK ORGANOTINS (µg/kg-dry wt)					
KRONE88					
Tributyltin Ion	238 (c)	738 (c)	29	9	3
Dibutyltin Ion	---	---	29	N/A	N/A
Butyltin Ion	---	---	29	N/A	N/A
POREWATER ORGANOTINS (µg/L)					
KRONE88					
Tributyltin Ion	0.05 (d)	0.15 (d)	15	5	4
Dibutyltin Ion	---	---	15	N/A	N/A
Butyltin Ion	---	---	15	N/A	N/A
PAHs (mg/kg OC)					
Method SW8270D					
Naphthalene	99	170	36	0	0
Acenaphthylene	66	66	36	0	0
Acenaphthene	16	57	36	0	0
Fluorene	23	79	36	0	0
Phenanthrene	100	480	36	0	0
Anthracene	220	1,200	36	0	0
2-Methylnaphthalene	38	64	36	1	1
LPAH (f, g)	370	780	36	0	0
Fluoranthene	160	1,200	36	2	0
Pyrene	1,000	1,400	36	0	0
Benzo(a)anthracene	110	270	36	0	0
Chrysene	110	460	36	1	0
Total Benzofluoranthenes (f, h)	230	450	36	0	0
Benzo(a)pyrene	99	210	36	0	0
Indeno(1,2,3-cd)pyrene	34	88	36	0	0
Dibenz(a,h)anthracene	12	33	36	0	0
Benzo(g,h,i)perylene	31	78	36	0	0
HPAH (f, i)	960	5,300	36	1	0

TABLE 17
SEDIMENT SCREENING LEVEL EXCEEDANCE STATISTICS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

	Benthic Screening Levels				
	SCO (a)	CSL (b)	No. of Samples	SCO Exceedances	CSL Exceedances
SVOCs (mg/kg OC)					
Method SW8270D					
1,2-Dichlorobenzene	2.3	2.3	26	0	0
1,3-Dichlorobenzene	---	---	26	N/A	N/A
1,4-Dichlorobenzene	3.1	9	26	0	0
1,2,4-Trichlorobenzene	0.81	1.8	26	0	0
Hexachlorobenzene	0.38	2.3	26	0	0
Dimethylphthalate	53	53	26	0	0
Diethylphthalate	61	110	26	0	0
Di-n-Butylphthalate	220	1,700	26	0	0
Butylbenzylphthalate	4.9	64	26	0	0
bis(2-Ethylhexyl)phthalate	47	78	26	2	1
Di-n-Octyl phthalate	58	4,500	26	0	0
Dibenzofuran	15	58	26	0	0
Hexachlorobutadiene	3.9	6.2	26	0	0
N-Nitrosodiphenylamine	11	11	26	0	0
SVOCs (µg/kg)					
Method SW8270D					
Phenol	420	1,200	26	1	0
2-Methylphenol	63	63	26	0	0
4-Methylphenol	670	670	26	0	0
2,4-Dimethylphenol	29	29	26	0	0
Pentachlorophenol	360	690	26	0	0
Benzyl Alcohol	57	73	26	0	0
Benzoic Acid	650	650	26	0	0
Total PCBs (mg/kg OC)					
Method SW8082A					
Total PCBs	12	65	40	3	0

TABLE 17
SEDIMENT SCREENING LEVEL EXCEEDANCE STATISTICS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Persistent Bioaccumulative Toxins	PBT Screening Levels SCO (e)	PBT Screening Levels CSL (f)	No. of Samples	SCO Exceedances	CSL Exceedances
cPAHs (TEQ) (µg/kg)					
Method SW8270DSIM					
cPAHs (TEQ)	40	400	36	31	7
PCBs (µg/kg)					
Method SW8082A					
Total PCBs	6	53	40	30	6
PCBs by Congener Analysis					
PCB - TEQ (pg/g)					
Method SW1668A					
PCB-TEQ	0.2	2	5	2	0
Method SW1668A					
Total PCBs (µg/kg)	6	53	5	3	1
BULK ORGANOTINS (µg/kg-dry wt)					
KRONE88					
Tributyltin Ion	238	738	29	9	3
TOTAL METALS (mg/kg-dry wt)					
Methods SW6010C/SW7471A					
Arsenic	11	11	22	5	5
Cadmium	1	1	25	0	0
Lead	21	21	25	4	4
Mercury	0.20	0.20	24	5	5

N/A = Not Applicable
PCBs = Polychlorinated Biphenyls
SCO = Sediment Cleanup Objective
CSL = Cleanup Screening Level
PBT = Persistent Bioaccumulative Toxins
SMS = Sediment Management Standards
TBT = Tributyltin
PSDDA = Puget Sound Dredged Disposal Analysis
(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) 238 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT SQS.
738 µg/kg is the equivalent bulk sediment screening level based on Site-specific correlation to porewater TBT CSL.
(d) TBT porewater screening level established by PSDDA.
(j) Risk-based SCO developed based on protection of human health through seafood consumption (see Appendix F).
(k) Risk-based CSL developed based on protection of human health through seafood consumption (see Appendix F).

TABLE 18
INDICATOR HAZARDOUS SUBSTANCE EVALUATION – SOIL AND GROUNDWATER
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	Number of Samples	Screening Level	Number of SL Exceedances	Frequency of Exceedances	Maximum Detection	IHS?	Proposed Cleanup Level	Notes
GROUNDWATER (a) **Dissolved Metals (µg/L)**								
Arsenic	12	5	3	25%	9	No	-	Not related to Site releases
Copper	12	2.4	1	8%	2.5	No	-	Low frequency of SL exceedance
SOIL **Total Metals (mg/kg)**								
Arsenic	101	20	3	3%	82.7	**Yes**	20	
Copper	138	3,200	1	1%	3,920	**Yes**	3,200	
Mercury	113	2	7	6%	17.7	**Yes**	2	
TPH (mg/kg)								
Diesel Range Organics	53	2,000	1	2%	4,000	No	-	Few exceedances; co-located with IHS
Lube Oil	53	2,000	1	2%	3,000	No	-	Few exceedances; co-located with IHS
Gasoline Range Organics	40	100	1	3%	110	No	-	Few exceedances; co-located with IHS
PCBs (µg/kg)								
Total Aroclor PCBs	11	160	1	9%	350	**Yes**	160	
SVOC (µg/kg)								
cPAHs	115	140	17	15%	1,794	**Yes**	140	

(a) Groundwater grab samples collected from direct-push borings are excluded.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons
IHS = indicator hazardous substance
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = milligrams per liter

PCBs = polychlorinated biphenyls
SL = screening level
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons

TABLE 19
INDICATOR HAZARDOUS SUBSTANCE EVALUATION – SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Analyte	Number of Samples	Protection of Benthic Organisms				Protection of Human Health				IHS?
		SCO Exceedances		CSL Exceedances		SCO Exceedances		CSL Exceedances		
		Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency	
SEDIMENT (a) **Total Metals**										
Copper	30	6	20%	6	20%	N/A	N/A	N/A	N/A	**Yes**
Zinc	30	4	13%	2	7%	N/A	N/A	N/A	N/A	**Yes**
Mercury	24	1	4%	1	4%	5	21%	5	21%	**Yes**
Arsenic	22	0	0%	0	0%	5	23%	5	23%	**Yes**
Lead	25	0	0%	0	0%	4	16%	4	16%	No
Cadmium	25	0	0%	0	0%	0	0%	0	0%	No
Organotins										
Tributyltin Ion	29	9	31%	3	10%	9	31%	3	10%	**Yes**
Total Aroclor PCBs										
Total PCBs	40	3	8%	0	0%	30	75%	6	15%	**Yes**
Dioxin-Like PCBs										
PCB-TEQ	5	N/A	N/A	N/A	N/A	2	40%	0	0%	**Yes**
SVOCS										
bis(2-Ethylhexyl)phthalate	26	2	8%	1	4%	N/A	N/A	N/A	N/A	No
Phenol	26	1	4%	0	0%	N/A	N/A	N/A	N/A	No
2-Methylnaphthalene	26	1	4%	1	4%	N/A	N/A	N/A	N/A	No
HPAHs	26	1	4%	0	0%	N/A	N/A	N/A	N/A	No
cPAHs	36	N/A	N/A	N/A	N/A	31	86%	7	19%	**Yes**

(a) Sediment samples collected at WM-SG-15 are excluded.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons
CSL = cleanup screening level
HPAHs = high molecular weight polycyclic aromatic hydrocarbons
IHS = indicator hazardous substance
N/A = not applicable
PCBs = polychlorinated biphenyls
SCO = sediment cleanup objective
SVOCs = semivolatile organic compounds
TEQ = toxicity equivalency

TABLE 20
SUMMARY OF INDICATOR HAZARDOUS SUBSTANCES
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Affected Media	Indicator Hazardous Substances
Soil	Arsenic
	Copper
	Mercury
	Polychlorinated Biphenyls
	Carcinogenic Polycyclic Aromatic Hydrocarbons
Sediment	Copper
	Zinc
	Mercury
	Arsenic
	Tributyltin Ion
	Polychlorinated Biphenyls
	Carcinogenic Polycyclic Aromatic Hydrocarbons

TABLE 21
PROPOSED SEDIMENT CLEANUP LEVELS
WESTMAN MARINE INC. SITE
BLAINE, WASHINGTON

Analyte	RI Screening Levels SCO	RI Screening Levels CSL	Proposed Cleanup Level
Benthic Criteria			
TOTAL METALS (mg/kg-dry wt) **Methods SW6010C/SW7471A**			
Arsenic	57	93	(see below)
Copper	390	390	390
Mercury	0.41	0.59	(see below)
Zinc	410	960	410
BULK ORGANOTINS (µg/kg-dry wt) **KRONE88**			
Tributyltin Ion	238	738	238
POREWATER ORGANOTINS (µg/L) **KRONE88**			
Tributyltin Ion	0.05	0.15	0.05
Persistent Bioaccumulative Toxins			
cPAHs (µg/kg) **Method SW8270DSIM**			
cPAHs (TEQ)	40	400	400
PCBs (pg/g) **Method SW8082A**			
Total PCBs	6	53	18
Dioxin-Like PCBs (TEQ)	0.2	2	0.9
TOTAL METALS (mg/kg-dry wt) **Methods SW6010C/SW7471A**	**Natural Background SCO / CSL**		
Arsenic	11		11
Mercury	0.2		0.2
Cadmium	1		1
Lead	21		21

cPAHs = carcinogenic polycyclic aromatic hydrocarbons
CSL = cleanup screening level
µg/kg = micrograms per kilogram
µg/kg-dry wt = micrograms per kilogram dry weight
µg/L = micrograms per liter
mg/kg-dry wt = milligrams per kilogram dry weight
pg/g = picograms per gram
PCBs = polychlorinated biphenyls
RI = remedial investigation
SCO = sediment cleanup objective
SIM = selected ion monitoring
TEQ = toxicity equivalency

TABLE 22
ALTERNATIVE COMPONENTS AND COST ESTIMATE SUMMARY
WESTMAN MARINE SITE
BLAINE, WASHINGTON

Alternative Number	Alternative Name and Components	Estimated Cost $^{(a,b)}$
Upland Site Unit - Cleanup Alternatives		
Alternative U-1	**Extended near-surface excavation and offsite disposal of contaminated soil, and containment**	$1,100,000
	Remove marine side rails and foundations.	
	Excavation and offsite disposal of top 2 foot of soil within the areas of contamination.	
	Install and maintain clean soil containment layer and stormwater management.	
	Institutional controls (restritive covenants) and long-term operation and maintenance (assume 30 years)	
Alternative U-2	**Near-surface excavation and offsite disposal of contaminated soil, and containment**	$1,200,000
	Remove marine side rails and foundations.	
	Excavation and offsite disposal of top 1 foot of soil within the areas of contamination.	
	Install and maintain asphalt containment layer and stormwater management.	
	Institutional controls (restritive covenants) and long-term operation and maintenance (assume 30 years)	
Alternative U-3	**Site-wide excavation and removal of contaminated soil**	$2,100,000
	Excavation of contaminated soils (entire Upland Site Unit) and offsite disposal.	
	Site restoration.	
Marine Site Unit - Cleanup Alternatives		
Alternative M-1	**Sediment dredging and EMNR in SMA-1 and MNR in SMA-2**	NA
Alternative M-2	**Sediment dredging in SMA-1 and MNR in SMA-2**	$5,000,000
	Replace existing bulkhead within dredging area	
	Temporarily remove the marine railway system and replace following dredging.	
	Remove contaminated sediment from throughout SMA-1 and dispose of the removed materials at an upland offsite disposal facility.	
	Implement MNR in SMA-2 until cleanup standards are achieved.	
Alternative M-3	**Sediment dredging in SMA-1 and EMNR in SMA-2**	$5,400,000
	Replace existing bulkhead within dredging area	
	Temporarily remove the marine railway system and replace following dredging.	
	Remove contaminated sediment from throughout SMA-1 and dispose of the removed materials at an upland offsite disposal facility.	
	EMNR in SMA-2 (6 inches of sand to reduce area-weighted average PCB concentration to below the SCO.	
	Conduct compliance monitoring to confirm cleanup standards are achieved and maintained.	
Alternative M-4	**Harbor-wide contaminated sediment removal**	$11,300,000
	Replace existing bulkhead within dredging area	
	Temporarily remove the marine railway system and replace following dredging.	
	Removal of sediment throughout the harbor with concentrations of IHSs greater than SCOs and disposal at a Subtitle D solid waste facility.	

(a) All estimated costs represent present worth based on a discount rate of 3% for long-term operation, monitoring, and maintenance tasks, and are considered order of magnitude estimates with a relative accuracy range of -30 to +50 percent. Use should be limited to the comparative evaluation of alternatives. More accurate costs will be developed during the design and implementation phases of the cleanup.

(b) A detailed breakdown of estimated costs is provided in Appendix I.

TABLE 23
SUMMARY OF MODEL TOXICS CONTROL ACT ALTERNATIVES EVALUATION AND DISPROPORTIONATE COST ANALYSIS RANKING – UPLAND SITE UNIT
WESTMAN MARINE – BLAINE, WASHINGTON

Alternative Number ===>	Alternative U-1	Alternative U-2	Alternative U-3
Alternative Name ===>	**Shallow Soil Excavation and Offsite Disposal of Contaminated Soil, Containment by Soil Capping and Institutional Controls**	**Near-Surface Excavation and Offsite Disposal of Contaminated Soil, Containment by Asphalt Capping and Institutional Controls**	**Site-Wide Excavation and Removal of Contaminated Soil**
Descriptive Summary ===>	Remove marine side rails east and west of Marine Railway Excavation and offsite dispsoal of top 2 feet of soil in contaminated areas. Site restoration, including returning site to existing grades using imported clean fill, contoured to provide drainage to facilititate stormwater control.	Remove marine side rails and adjacent soil east and west of Marine Railway Excavation and offsite dispsoal of top 1 foot of soil east of Marine Railway. Install base course and pavement including 4 inches of asphalt contoured to provide drainage to facilitate stormwater control.	Remove and dispose of contaminated soils (entire Upland Site Unit) and the marine side-rails (both sides of the marine railway). Site restoration, including returning site to existing grades using imported clean fill.
Individual Ranking Criteria			
1 Meets Remedial Action Objectives	Yes	Yes	Yes
2 Compliance With MTCA Threshold Criteria [WAC 173-340-360(2)(a)]			
-Protect human health and the environment	Yes	Yes	Yes
-Comply with cleanup standards	Yes	Yes	Yes
-Comply with applicable state/federal laws	Yes	Yes	Yes
-Provide for compliance monitoring	Yes	Yes	Yes
3 Restoration Time Frame [WAC 173-340-360(2)(b)(ii) and WAC 173-340-360(4)]	1 year	1 year	1 year
-Potential risk to human health and environment	Low	Low	Low
-Practicability of achieving shorter restoration time	See DCA below	See DCA below	See DCA below
-Current use of site, surrounding area, and resources	Industrial - no offsite migration	Industrial - no offsite migration	Industrial - no offsite migration
-Future use of site, surrounding area, and resources	Unrestricted/ Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration
-Availability of alternative water supplies	Yes	Yes	Yes
-Likely effectiveness/reliability of institutional controls	High	High	Not Applicable
-Ability to monitor migration of hazardous substances	High	High	High
-Toxicity of hazardous substances at the site	Moderate	Moderate	Moderate
-Natural processes that reduce concentrations	Yes	Yes	Yes
-Overall Reasonable Restoration Time Frame	Yes	Yes	Yes

4 Relative Benefits Ranking for DCA
[WAC 173-340-360(2)(b)(i) and WAC 173-340-36093)(f)]

Comparative Overall Benefit	U-1 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	U-2 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	U-3 Comparative Benefit Rating	Score	Weighting Factor	Weighted Score
-Overall Protectiveness	Moderate	8	0.3	2.4	Moderate	7	0.3	2.1	High	10	0.3	3.0
-Permanence	Moderate	7	0.2	1.4	Moderate	6	0.2	1.2	High	9	0.2	1.8
-Long Term Effectiveness	Moderate High	7	0.2	1.4	Moderate High	7	0.2	1.4	High	9	0.2	1.8
-Manageability of Short Term Risk	High	8	0.1	0.8	Moderate High	8	0.1	0.8	Moderate	5	0.1	0.5
-Implementability	High	9	0.1	0.9	High	9	0.1	0.9	Moderate	5	0.1	0.5
-Consideration of Public Concerns	High	10	0.1	1.0	High	10	0.1	1.0	High	10	0.1	1.0
Overall Weighted Benefit Score				**7.9**				**7.4**				**8.6**

5 Disproportionate Cost Analysis	Alternative U-1	Alternative U-2	Alternative U-3
Estimated remedy cost	$1,100,000	$1,200,000	$2,100,000
Most permanent solution	No	No	**Yes**
Lowest cost alternative	Yes	No	No
Relative benefit/cost ratio*	7.2	6.2	4.1
Magnitude of relative benefit compared to most permanent alternative	92%	86%	- -
Magnitude of cost compared to lowest cost alternative	- -	109%	191%
Costs Disproportionate to Incremental Benefits	No	No	Yes
Remedy Permanent to the Maximum Extent Practicable?	Yes	No	No
Preferred Alternative	**Yes**	**No**	**No**

* Benefit/Cost Ratio scaled by $1,000,000 in order to compare ranges similar in scale to comparative overall benefit, as presented on Figure 39.

TABLE 24
SUMMARY OF MODEL TOXICS CONTROL ACT ALTERNATIVES EVALUATION AND DISPROPORTIONATE COST ANALYSIS RANKING – MARINE SITE UNIT
WESTMAN MARINE – BLAINE, WASHINGTON

Alternative Number	**Alternative M-2**	**Alternative M-3**	**Alternative M-4**
Alternative Name	**Sediment Dredging in SMA-1 and MNR in SMA-2**	**Sediment Dredging in SMA-1 and EMNR in SMA-2**	**Harbor-Wide Contaminated Sediment Removal**
Alternative Description	Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1. Remove contaminated sediment from throughout SMA-1 (inlcluding SMA-1a and SMA-1b) and dispose of the removed materials at an upland offsite disposal facility. Implement MNR in SMA-2 until cleanup standards are achieved.	Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1. Remove contaminated sediment from throughout SMA-1 (inlcluding SMA-1a and SMA-1b) and dispose the removed materials at an upland offsite disposal facility. EMNR in SMA-2 (6 inches of sand) to reduce area-weighted average PCB concentration to below the SCO.	Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1. Removal of sediment throughout the harbor with concentrations of IHSs greater than PCLs; disposal at an upland offsite disposal facility.
Individual Ranking Criteria			
1 Meets Remedial Action Objectives	Yes	Yes	Yes
2 Compliance With MTCA Threshold Criteria [WAC 173-340-360(2)(a)]			
-Protect human health and the environment	Yes	Yes	Yes
-Comply with cleanup standards	Yes	Yes	Yes
-Comply with applicable state/federal laws	Yes	Yes	Yes
-Provide for compliance monitoring	Yes	Yes	Yes
3 Restoration Time Frame [WAC 173-340-360(2)(b)(ii) and WAC 173-340-360(4)]	2 to 5 Years (After Construction)	2 Years (After Construction)	1 Year (After Construction)
-Potential risk to human health and environment	Low	Low	Low
-Practicability of achieving shorter restoration time	See DCA below	See DCA below	See DCA below
-Current use of site, surrounding area, and resources	Unrestricted/Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration
-Future use of site, surrounding area, and resources	Unrestricted/Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration	Unrestricted/Industrial - no offsite migration
-Availability of alternative water supplies	Not Applicable	Not Applicable	Not Applicable
-Likely effectiveness/reliability of institutional controls	Moderate	High	Not Applicable
-Ability to monitor migration of hazardous substances	High	High	High
-Toxicity of hazardous substances at the site	Moderate	Moderate	Moderate
-Natural processes that reduce concentrations	Yes	Yes	Yes
-Overall Reasonable Restoration Time Frame	Yes	Yes	Yes

4 Relative Benefits Ranking for DCA
[WAC 173-340-360(2)(b)(i) and WAC 173-340-36093)(f)]

Comparative Overall Benefit	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score	Comparative Benefit Rating	Score	Weighting Factor	Weighted Score
-Overall Protectiveness	Moderate High	7	0.3	2.1	High	8	0.3	2.4	High	9	0.3	2.7
-Permanence	Moderate High	8	0.2	1.6	Moderate High	7	0.2	1.4	High	9	0.2	1.8
-Long Term Effectiveness	Moderate High	8	0.1	0.8	Moderate High	7	0.1	0.7	High	9	0.1	0.9
-Manageability of Short Term Risk	Moderate	6	0.1	0.6	Moderate	5	0.1	0.5	Low	3	0.1	0.3
-Implementability	Moderate High	8	0.1	0.8	Moderate High	7	0.1	0.7	Moderate Low	4	0.1	0.4
-Consideration of Public Concerns	High	10	0.1	1.0	High	10	0.1	1.0	High	10	0.1	1.0
-Net Environmental Benefit	Moderate High	7	0.1	0.7	Moderate	6	0.1	0.6	Moderate Low	4	0.1	0.4
Overall Weighted Benefit Score				**7.6**				**7.3**				**7.5**

5 Disproportionate Cost Analysis			
Estimated remedy cost	$5,000,000	$5,400,000	$11,300,000
Most permanent alternative	No	No	Yes
Lowest cost alternative	Yes	No	No
Relative benefit/cost ratio*	1.5	1.4	0.66
Magnitude of relative benefit compared to most permanent alternative	101%	97%	- -
Magnitude of cost compared to lowest cost alternative	-	108%	226%
Costs disproportionate to incremental benefits	No	Yes	Yes
Remedy Permanent to the Maximum Extent Practicable?	Yes	No	No
Preferred Alternative	**Yes**	**No**	**No**

* Benefit/Cost Ratio scaled by $1,000,000 in order to compare ranges similar in scale to comparative overall benefit, as presented on Figure 40.

APPENDIX A

Historical Aerial Photographs

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Westman Marine Site
Blaine Harbor
Blaine, Washington

1949 Aerial Photograph

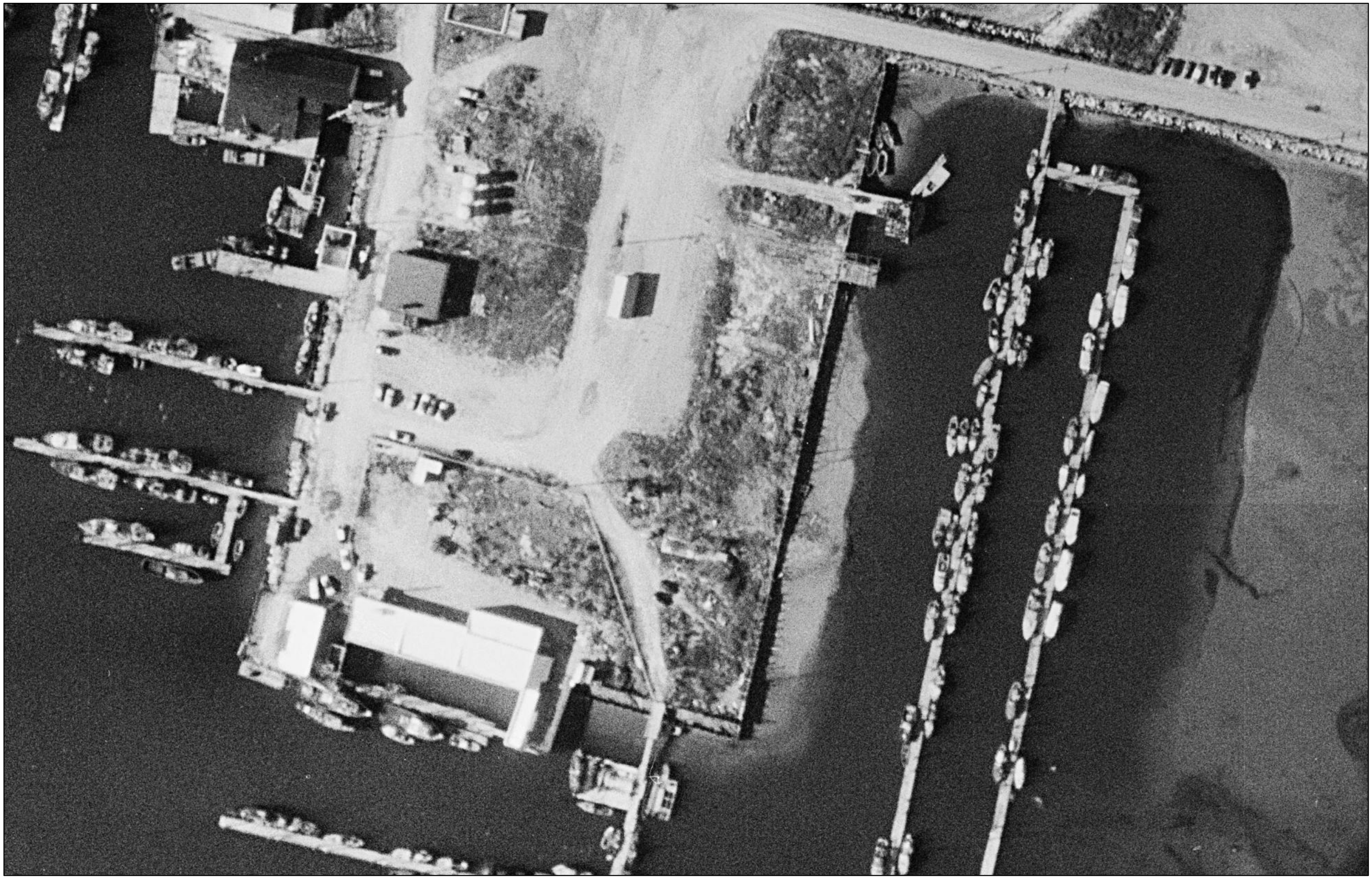
Figure
A-1

Landau Associates

Westman Marine Site
Blaine Harbor
Blaine, Washington

1956 Aerial Photograph

Figure
A-2



Landau Associates

Westman Marine Site
Blaine Harbor
Blaine, Washington

1956 Aerial Photograph – Site Closeup

Figure
A-3

LANDAU ASSOCIATES

Westman Marine Site
Blaine Harbor
Blaine, Washington

2010 Aerial Photograph

Figure
A-4

APPENDIX B

Site Investigation Photographs

1. General layout and conditions; orientation is to the southwest. Gravel working surface in foreground; boat cradle on the right.

2. General layout and conditions; orientation is to the northwest. Marine railway extending upland with a boat shown on the cradle; timber bulkhead around upland perimeter; metal building with white tarp provides covered area for boatyard activities.

LANDAU ASSOCIATES	Westman Marine Site Blaine Harbor Blaine, Washington	**Selected Site Photographs**	Figure B-1

3. Concrete vault structure encountered during the interim action soil removal activities.

4. Soil conditions after excavation of concrete vault structure; no sheen observed on soil or exposed groundwater

5. WM-MW-4. Typical groundwater monitoring well completion in progress in foreground. Direct-push probe rig used for well installation shown in background.

6. Field crew processing surface sediment samples onboard the Carolyn Dow, between the travel-life piers.

LANDAU ASSOCIATES

Westman Marine Site
Blaine Harbor
Blaine, Washington

Selected Site Photographs

Figure
B-3

7. Shoreline conditions at sediment sample location WM-SG-16: mostly rock slope with some gravel and sedimentation. At sample location WM-SG-28 (background, right), insufficient sediment was present on the rock to collect a sample for analysis.

APPENDIX C

Boring Logs and Monitoring Well Construction Details

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS [2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)	○	**GW**	Well-graded gravel; gravel/sand mixture(s); little or no fines
			○	**GP**	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	▥	**GM**	Silty gravel; gravel/sand/silt mixture(s)
			▨	**GC**	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)	░	**SW**	Well-graded sand; gravelly sand; little or no fines
			░	**SP**	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)	▥	**SM**	Silty sand; sand/silt mixture(s)
			▨	**SC**	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)		▥	**ML**	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
			▨	**CL**	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
			≋	**OL**	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)		▥	**MH**	Inorganic silt; micaceous or diatomaceous fine sand
			▨	**CH**	Inorganic clay of high plasticity; fat clay
			▦	**OH**	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL		≈	**PT**	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT	■ ░	**AC** or **PC**	Asphalt concrete pavement or Portland cement pavement
ROCK	▨	**RK**	Rock (See Rock Classification)
WOOD	≋	**WD**	Wood, lumber, wood chips
DEBRIS	◇	**DB**	Construction debris, garbage

Notes:

1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

    Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
    Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
    > 15% and ≤ 30% - "gravelly," "sandy," "silty," etc.
    Additional Constituents: > 5% and ≤ 15% - "with gravel," "with sand," "with silt," etc.
    ≤ 5% - "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.

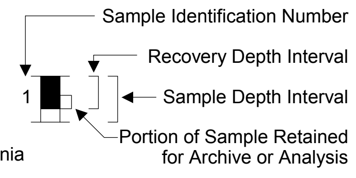
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	2.50-inch O.D., 2.00-inch I.D. WSDOT
h	3.00-inch O.D., 2.375-inch I.D. Mod. California
i	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Vibrocore (Rotosonic/Geoprobe)
5	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

Groundwater

▽ Approximate water level at time of drilling (ATD)
▼ Approximate water level at time other than ATD

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Westman Marine
Blaine, Washington

Soil Classification System and Key

Figure
C-1

HA-1

Drilling Method: Hand Auger

Ground Elevation (ft):

Drilled By: Landau Associates

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol		
0	WM-HA-1-0-0.75	d		0.0		SM	Brown, silty, medium to coarse SAND with abundant gravel and trace fine sand and root debris (loose to medium dense, moist) (no sheen, no odor) **(FILL)**	Groundwater not encountered.
	WM-HA-1-1-1.5	d		0.7		SP	Brown, gravelly medium to coarse SAND with silt and trace fine sand (medium dense, moist) (no odor, no sheen)	
							-- no recovery	
2	WM-HA-1-2-2.5	d		0.2		SP	Gray, fine SAND with silt, abundant shell fragments, and trace medium to coarse sand (medium dense, damp) (no sheen, no odor)	
	WM-HA-1-3-4	d		0.0		CL	Gray, CLAY with trace silt (medium stiff, damp)	
4								

Boring Completed 10/08/13
Total Depth of Boring = 4.0 ft.

6

8

10

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

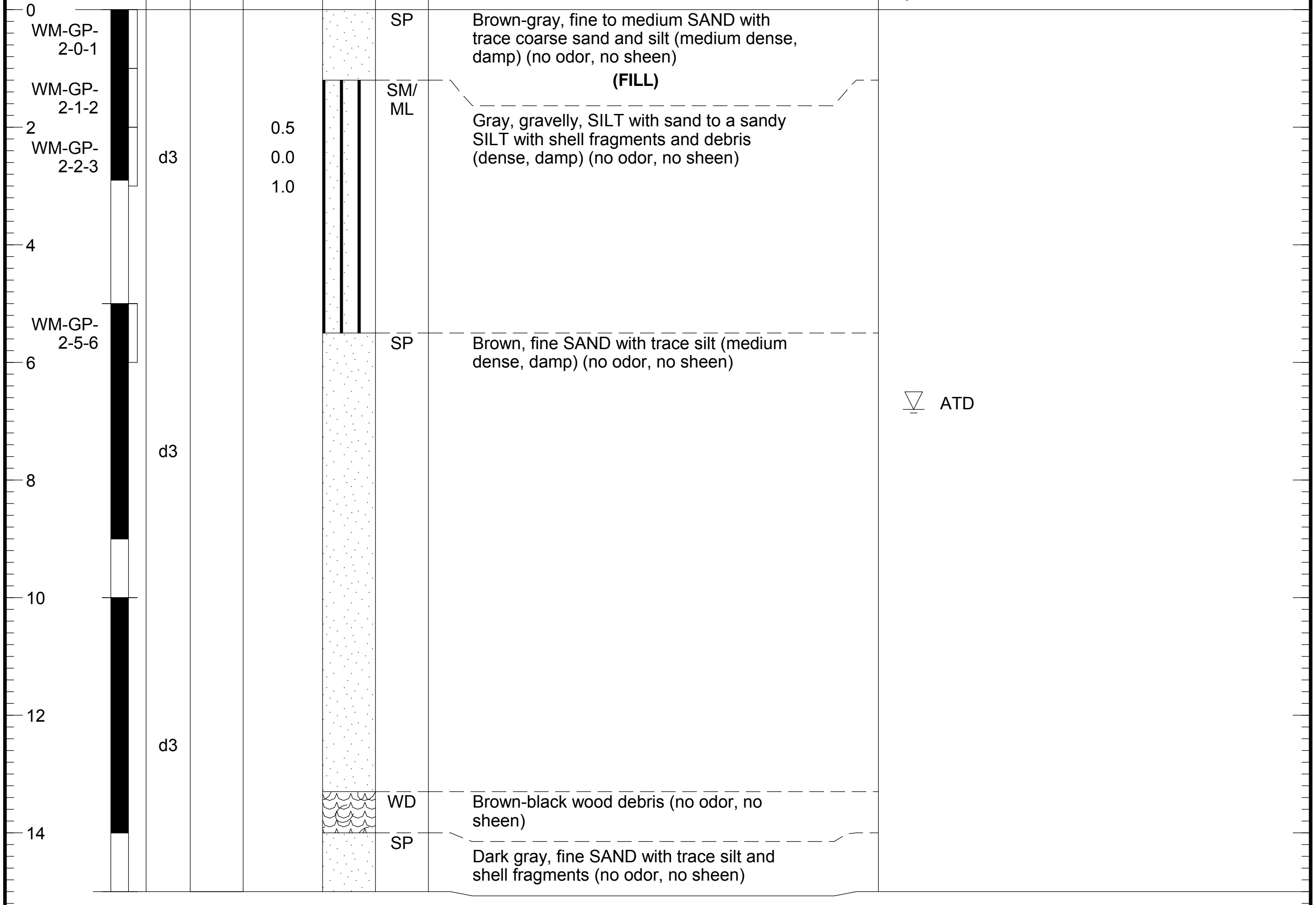
Westman Marine
Blaine, Washington

Log of Boring HA-1

Figure
C-2

WM-GP-2

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level



Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
WM-GP-2-0-1				SP	Brown-gray, fine to medium SAND with trace coarse sand and silt (medium dense, damp) (no odor, no sheen) **(FILL)**	
WM-GP-2-1-2				SM/ML	Gray, gravelly, SILT with sand to a sandy SILT with shell fragments and debris (dense, damp) (no odor, no sheen)	
WM-GP-2-2-3	d3		0.5 0.0 1.0			
WM-GP-2-5-6				SP	Brown, fine SAND with trace silt (medium dense, damp) (no odor, no sheen)	
						∇ ATD
	d3					
	d3					
				WD	Brown-black wood debris (no odor, no sheen)	
				SP	Dark gray, fine SAND with trace silt and shell fragments (no odor, no sheen)	

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

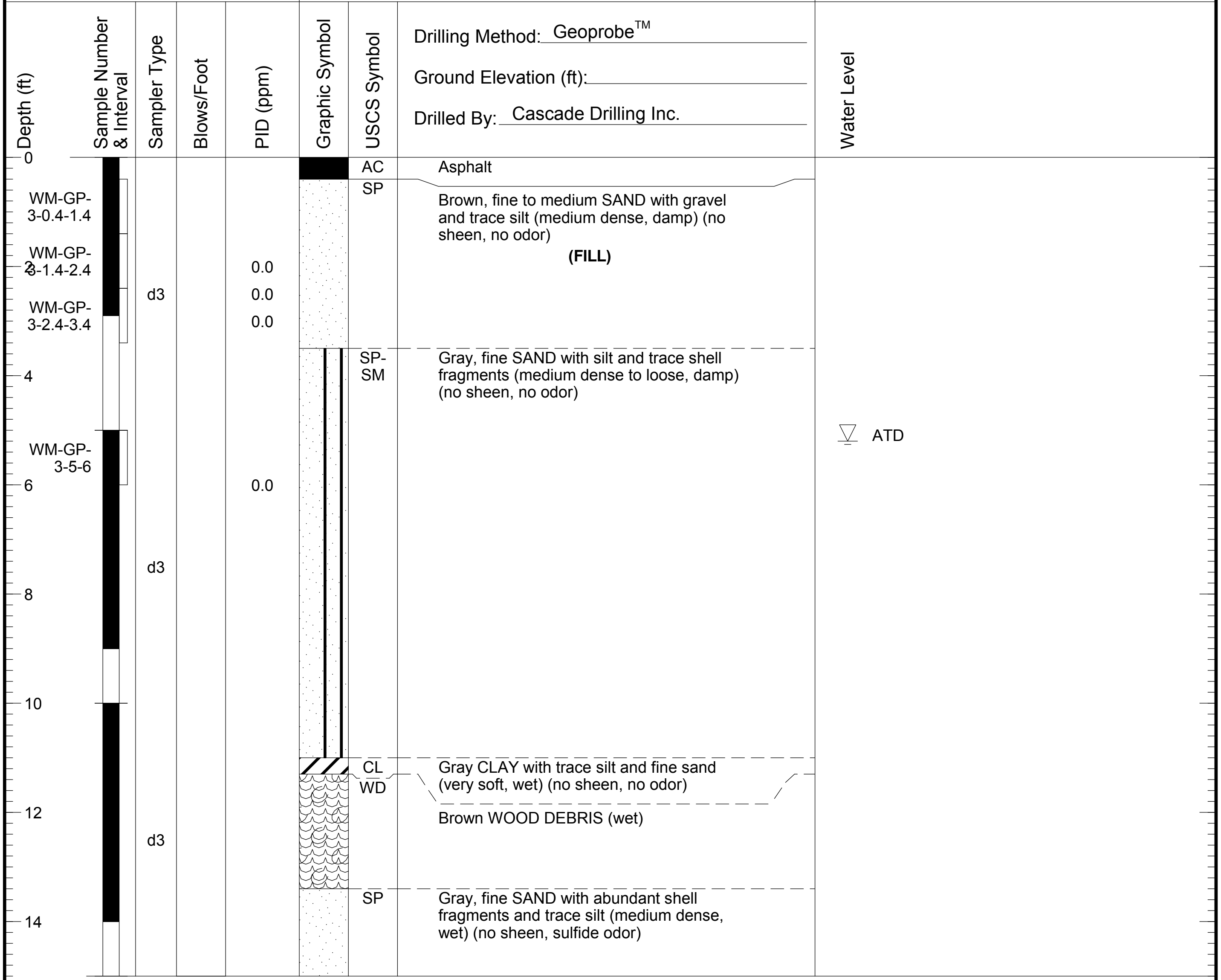
Westman Marine
Blaine, Washington

Log of Boring WM-GP-2

WM-GP-3

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.



Sample Number & Interval	Sampler Type	PID (ppm)
WM-GP-3-0.4-1.4		0.0
WM-GP-3-1.4-2.4	d3	0.0
WM-GP-3-2.4-3.4		0.0
WM-GP-3-5-6		0.0
	d3	
	d3	

USCS Symbol	Description
AC	Asphalt
SP	Brown, fine to medium SAND with gravel and trace silt (medium dense, damp) (no sheen, no odor) **(FILL)**
SP-SM	Gray, fine SAND with silt and trace shell fragments (medium dense to loose, damp) (no sheen, no odor)
CL	Gray CLAY with trace silt and fine sand (very soft, wet) (no sheen, no odor)
WD	Brown WOOD DEBRIS (wet)
SP	Gray, fine SAND with abundant shell fragments and trace silt (medium dense, wet) (no sheen, sulfide odor)

Water Level: ∇ ATD

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-4

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Soil Description	Water Level
0					AC	Asphalt	
	WM-GP-4-0.4-1.4			0.2	SP-SM	Brown, fine to medium SAND with gravel and silt (medium dense, damp) (no sheen, no odor) **(FILL)**	
2	WM-GP-4-1.4-2.4			0.5			
	WM-GP-4-2.4-3.4	d3		0.7	ML	Brown-gray, SILT with trace fine sand (medium stiff, damp) (no sheen, no odor)	
4					SP	Gray, fine SAND with trace silt and shell fragments (medium dense, moist to wet) (no sheen, no odor)	
6	WM-GP-4-5-6			0.7			∇ ATD
8		d3					
10							
12		d3			WD	Wood Debris (loose, wet)	
					SP	Gray, fine to medium SAND with trace shell fragments and trace silt (loose, wet) (no sheen, no odor)	
14						-- no recovery	
16							
18							
20							

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-4

WM-GP-5

SAMPLE DATA | SOIL PROFILE | GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Description	Water Level
0	WM-GP-5-0-1			0.2		SP	Brown, fine to coarse SAND with gravel and trace silt (loose, damp) (no sheen, no odor) **(FILL)**	
	WM-GP-5-1-2			0.5				
2	WM-GP-5-2-3	d3		0.7		SM	Gray-brown, silty, fine SAND with abundant shell fragments (medium dense, damp) (no sheen, no odor)	
	WM-GP-5-3-4					ML-SM	Gray SILT with sand to a silty, fine SAND (soft, moist) (No sheen, no odor)	
4				0.7				
6						SP	Brown, fine SAND with trace silt and shell fragments (medium dense, moist to wet) (no sheen, no odor)	∇ ATD
		d3				WD	WOOD DEBRIS	
8						SP	Gray, fine SAND with trace silt and with shell fragments (medium dense, wet) (no sheen, no odor)	
12		d3				ML	Dark gray, SILT with trace fine sand (soft, wet)	
						WD	WOOD DEBRIS	
14						SP	Gray, fine SAND with trace silt and shell fragments (medium dense, wet) (no sheen, sulfide odor) **(MARINE DEPOSITS)**	

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Westman Marine
Blaine, Washington

Log of Boring WM-GP-5

Figure
C-6

WM-GP-6

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Soil Profile	Water Level
0					AC	Asphalt	
	WM-GP-6-0.5-1.5			2.6	SP	Brown, fine to coarse SAND with trace silt and debris (medium dense, damp) (no sheen, no odor) **(FILL)**	
2	WM-GP-6-1.5-2.5	d3		0.0			
	WM-GP-6-2.5-3.5			0.0			
4	WM-GP-6-3.5-4.3			0.0			
					RK	Black crushed ASPHALT or ROCK debris (dense, wet) (no sheen, no odor)	ATD
6					SP	Brown, fine SAND with trace silt (medium dense, wet) (no sheen, no odor)	
8		d3					
					GP	Black, fine GRAVEL with sand and trace silt (very loose, wet) (no sheen, organic decomposition odor)	
10					ML	Gray, sandy, SILT with trace shell fragments (soft, wet) (no sheen, no odor)	
12		d3			GP-GM	Brown, fine GRAVEL with sand and silt (loose, wet) (no sheen, no odor)	
					WD	Brown WOOD DEBRIS (dense, wet) (no sheen, no odor)	
14					SP	Gray, fine SAND with trace silt and shell fragments (medium dense, wet) (no sheen, no odor)	

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-7

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level
0						AC	Asphalt	
	WM-GP-7-0.5-1.5			0.0		SP	Brown, fine to coarse SAND with gravel (medium dense, damp) (no sheen, no odor) **(FILL)**	
				2.6				
2	WM-GP-7-1.5-2.5					SP-SM	Brown, fine SAND with silt (dense, moist to wet) (no sheen, no odor)	
		g3		0.0				
4								
	WM-GP-7-5-6							
6				0.0				∇ ATD
						SM	Brown to black, silty, fine SAND with trace gravel (loose, wet) (possible sheen, petroleum odor)	
		g3						
8	WM-GP-7-8-9							
10	WM-GP-7-10-11					SP-SM	Gray, fine to medium SAND with silt and trace gravel (medium dense, wet) (no sheen, no odor)	
						SP	Gray, fine SAND with trace silt and abundant shell fragments (medium dense, wet) (no sheen, no odor)	
12							-- no recovery	
		g3						
14								

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

16

18

20

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine Blaine, Washington	Log of Boring WM-GP-7	Figure C-8

WM-GP-8

SAMPLE DATA

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
WM-GP-8-0.7-1.7	g3		0.2
WM-GP-8-1.7-2.7			0.5
WM-GP-8-2.7-3.7			1.0
WM-GP-8-5-6	g3		1.0
	g3		

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

SOIL PROFILE

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.

USCS Symbol	Description
CONC	CONCRETE
SP	Brown, fine to medium SAND with gravel and trace silt (medium dense, moist) (no sheen, no odor) **(FILL)**
ML	Gray, SILT with sand and dispersed bands of red sand and silt (hard, damp) (no sheen, no odor)
SM	Gray, silty, fine SAND wiith trace shell fragments (medium dense, damp) (no sheen, no odor)
SP	Gray, fine SAND with shell fragments and trace silt (medium dense, damp) (no sheen, no odor)
SM	Gray, silty, fine SAND with shell fragments and thin bands of silt (medium dense to loose, damp) (no sheen, no odor)
SP	Gray, fine SAND with silt (medium dense, damp) (no sheen, no odor)
SM	Dark gray, silty, fine SAND with trace shell fragments (loose, wet) (no sheen, no odor)
WD	WOOD DEBRIS(dense, damp) (no sheen, no odor)
SP	Gray, fine SAND with shell debris (medium dense, wet) (no sheen, no odor) **(MARINE DEPOSTS)**

GROUNDWATER

Water Level

∇ ATD

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-8

Figure
C-9

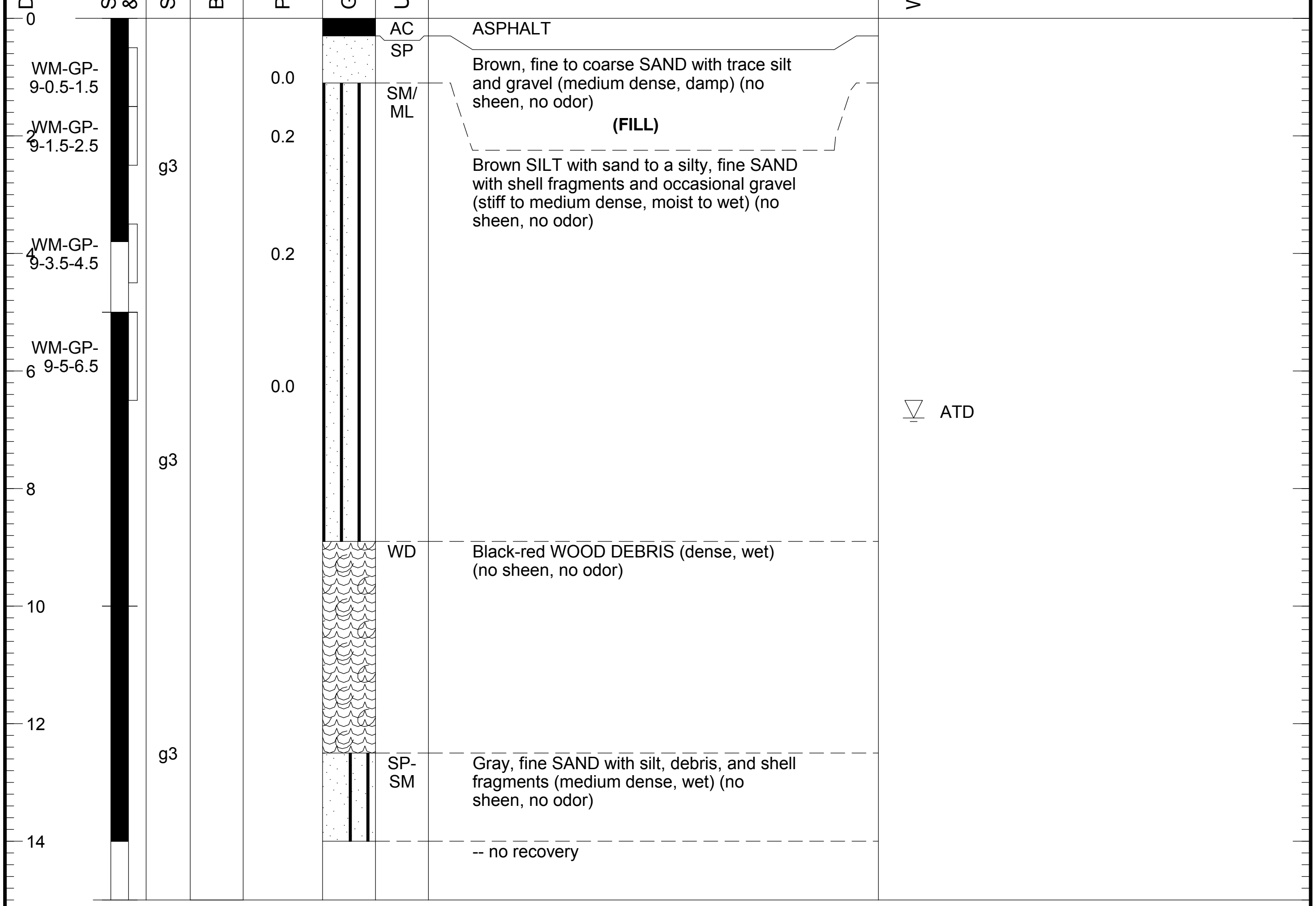
WM-GP-9

SAMPLE DATA	SOIL PROFILE	GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.



Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Description	Water Level
					AC	ASPHALT	
					SP	Brown, fine to coarse SAND with trace silt and gravel (medium dense, damp) (no sheen, no odor) **(FILL)**	
WM-GP-9-0.5-1.5			0.0				
					SM/ML	Brown SILT with sand to a silty, fine SAND with shell fragments and occasional gravel (stiff to medium dense, moist to wet) (no sheen, no odor)	
WM-GP-9-1.5-2.5			0.2				
	g3						
WM-GP-9-3.5-4.5			0.2				
WM-GP-9-5-6.5			0.0				
							∇ ATD
	g3						
					WD	Black-red WOOD DEBRIS (dense, wet) (no sheen, no odor)	
	g3				SP-SM	Gray, fine SAND with silt, debris, and shell fragments (medium dense, wet) (no sheen, no odor)	
						-- no recovery	

Boring Completed 10/08/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

Log of Boring WM-GP-9

Figure
C-10

WM-GP-10

SAMPLE DATA

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
0	WM-GP-10-0-1			0.0
	WM-GP-10-1-2			
2	WM-GP-10-2-3	d3		0.0
	WM-GP-10-3-4			0.0
4				
6		d3		
8				
10				
12		d3		
14				

SOIL PROFILE

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

USCS Symbol	Description
SP	Brown, gravelly, fine to coarse SAND with trace silt (medium dense, damp) (no sheen, no odor) **(FILL)**
SM	Brown, silty, fine SAND with occasional debris (dense, damp) (no sheen, no odor)
RK	White, crushed white rock (dense, dry) (no sheen, no odor)
SM	Brown, silty, fine to coarse SAND with trace gravel (medium dense, damp) (no sheen, no odor)
SP	Brown, gravelly, fine to coarse SAND with debris (medium dense, moist) (no sheen, no odor)
	-- no recovery
WD	Brown WOOD DEBRIS (medium dense, wet) (no sheen, no odor)
	-- no recovery
SM	Brown, silty, gravelly, fine SAND with debris (loose to medium dense, wet) (no sheen, no odor)
WD	Brown WOOD DEBRIS (medium dense, wet) (no sheen, no odor)
SM	Gray, fine SAND with silt and abundant shell fragments (dense, wet) (no sheen, strong sulfide odor) **(MARINE DEPOSITS)**

GROUNDWATER

Water Level: ▽ ATD

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

Notes:
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2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

Log of Boring WM-GP-10

Figure C-11

WM-GP-11

SAMPLE DATA

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
WM-GP-11-0-1			0.0
WM-GP-11-1-2			0.5
WM-GP-11-2-3	d3		0.0
WM-GP-11-3-4			0.0
			11.4
WM-GP-11-5-6			15.0
WM-GP-11-7-8	d3		1.0
			0.5
	d3		

SOIL PROFILE

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

USCS Symbol	Description
SP	Brown, fine to coarse SAND with fine gravel and trace silt (medium dense, damp) (no sheen, no odor) **(FILL)**
ML	Brown, sandy, SILT with tarce gravel and medium to coarse sand (stiff, damp)
SM	Brown, silty, fine SAND with trace gravel (medium dense, damp) (no sheen, no odor)
SP	Gray, fine SAND with trace silt and debris (dense, damp) (no sheen, no odor)
ML	Dark gray SILT (hard, damp) (no sheen, petroleum odor)
SP-SM	Gray, fine SAND with silt (medium dense, damp) (no sheen, no odor)
ML	Gray, fine sandy, SILT with trace shell fragments (very soft, wet) (no sheen, no odor)
SP-SM	Brown, fine to coarse SAND with gravel and silt (loose, wet) (no sheen, no odor)
WD	Dark brown, WOOD DEBRIS with lens of sandy silt (dense, damp) (no sheen, no odor)
SP	Brown, fine SAND with abundant shell fragments and trace silt (medium dense, damp) (no sheen, strong sulfide odor) **(MARINE DEPOSTS)**

GROUNDWATER

Water Level: ∇ ATD

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Westman Marine
Blaine, Washington

Log of Boring WM-GP-11

Figure
C-12

WM-GP-12

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Soil Profile	Water Level
0	WM-GP-12-0-1			0.0	GP	Gray, crushed fine GRAVEL (loose, damp) **(FILL)**	
	WM-GP-12-1-2			0.0	SP-SM	Brown to red-brown fine to coarse SAND with silt and gravel (medium dense, damp)	
2	WM-GP-12-2-3	d3		0.0			
	WM-GP-12-5-6			1.0	SP-SM	Brown, fine SAND with silt and trace corse sand (medium dense, damp) (no sheen, no odor)	∇ ATD
6		d3			SM	Gray, silty, fine SAND with trace shell fragments (loose, wet) (no sheen, no odor)	
10				0.2			
					SP-SM	Gray, fine SAND with silt (medium dense stiff, damp) (no sheen, no odor)	
12		d3			WD	Black WOOD DEBRIS (dense, wet) (no sheen, no odor)	
14					SP-SM	Light gray, fine SAND with silt and shell debris (medium dense to lose, wet) (no sheen, no odor) **(MARINE DEPOSITS)**	

Boring Completed 10/08/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-13

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol		Water Level
0	WM-GP-13-0-1			0.0		GP SP	Dark gray, fine GRAVEL with sand (medium dense to loose, damp) (no sheen, no odor) **(FILL)**	
	WM-GP-13-1-2			0.2		GP-GM	Brown, fine SAND with gravel and trace silt (medium dense, damp) (no sheen, no odor) Gray to brown coarse GRAVEL with sand and silt (very dense, damp) (no sheen, no odor)	
2		d3					-- no recovery	
4								
	WM-GP-13-5-6			0.5		SP	-- increased sand content	
6	WM-GP-13-6-7			0.7		GP	Gray, fine GRAVEL with trace silt and sand (dense, dry) (no odor, no sheen)	▽ ATD
		d3					-- no recovery	
8								
10						SP-SM	Gray, fine SAND with varying amount of silt (loose to medium dense, wet) (no sheen, no odor)	
12		d3						
14							-- no recovery	
16								
18								
20								

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1035010016. 2/25/15 N:\PROJECTS\001035.010.015_BHB.GPJ SOIL BORING LOG

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Blaine, Washington

Log of Boring WM-GP-13

Figure
C-14

WM-GP-14

SAMPLE DATA | SOIL PROFILE | GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
WM-GP-14-0-1	d3		0.0
WM-GP-14-1-2			0.0
			0.0
WM-GP-14-3-4			0.0
WM-GP-14-7-8	d3		
WM-GP-14-10.5-11.5			4.6
	d3		0.0
WM-GP-14-13.5-14.5			

USCS Symbol	Description
GP	Gray-brown, fine to medium GRAVEL with sand and trace silt (medium dense, damp) (no sheen, no odor) **(FILL)**
SP	Brown, fine SAND with gravel and trace silt (medium dense, damp) (no sheen, no odor)
ML	Brown SILT with fine sand (stiff, damp) (no sheen, no odor)
SP	Brown, fine SAND with gravel and trace silt (meidum dense, damp) (no sheen, no odor)
CL	Brown CLAY with pockets of fine sand (medium stiff, damp) (no sheen, no odor)
SM	Brown, silty, fine SAND with shell fragments and debris (medium dense, damp) (no sheen, no odor)
ML	Gray, sandy, SILT (soft, moist) (no sheen, no odor)
SM	Gray, silty, fine SAND (loose to medium dense, wet) (no sheen, no odor)
WD	Black WOOD DEBRIS (dense, wet) (no sheen, organic decomposition odor)
	-- no recovery
ML	Black, sandy, SILT (soft, wet) (no sheen, no odor)
SP	Black-brown, gravelly, fine to coarse SAND with silt (loose, wet) (no sheen, no odor)
WD	Brown WOOD DEBRIS (dense, wet) (no sheen, no odor)
SP-SM	Gray, fine SAND with silt and shell fragments (medium dense, wet) (no sheen, sulfide odor) **(MARINE DEPOSITS)**

Water Level: ▽ ATD

Boring Completed 10/09/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Log of Boring WM-GP-14

Figure
C-15

WM-GP-15

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol		Water Level
0	WM-GP-15-0-1			0.7		SP	Brown, gravelly, fine to coarse SAND with trace silt and wood debris (loose to medium dense, damp) (no sheen, no odor) **(FILL)**	
	WM-GP-15-1-2			1.0				
2	WM-GP-15-2-3	d3		1.0		SP-SM	Light brown, fine SAND with silt and debris (medium dense, damp) (no sheen, no odor)	
	WM-GP-15-3-4			0.7				
4								
6								ATD
		d3				SM	Gray, silty, fine SAND (loose, wet) (no sheen, no odor)	
8						RK	White crushed ROCK debris with sand (dense, damp) (no sheen, no odor)	
						WD	Black WOOD DEBRIS (dense, damp) (no sheen, no odor)	
10						ML	Gray/brown, sandy, SILT with trace coarse sand and pockets of fine sand (soft, wet) (no sheen, no odor)	
						WD	Black WOOD DEBRIS with fine to coarse sand and silt (loose, wet) (no sheen, no odor)	
12		d3						
						SP	Gray, fine SAND with trace silt and shell fragments (dense, wet) (no sheen, no odor) **(MARINE DEPOSTIS)**	
14								

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

16

18

20

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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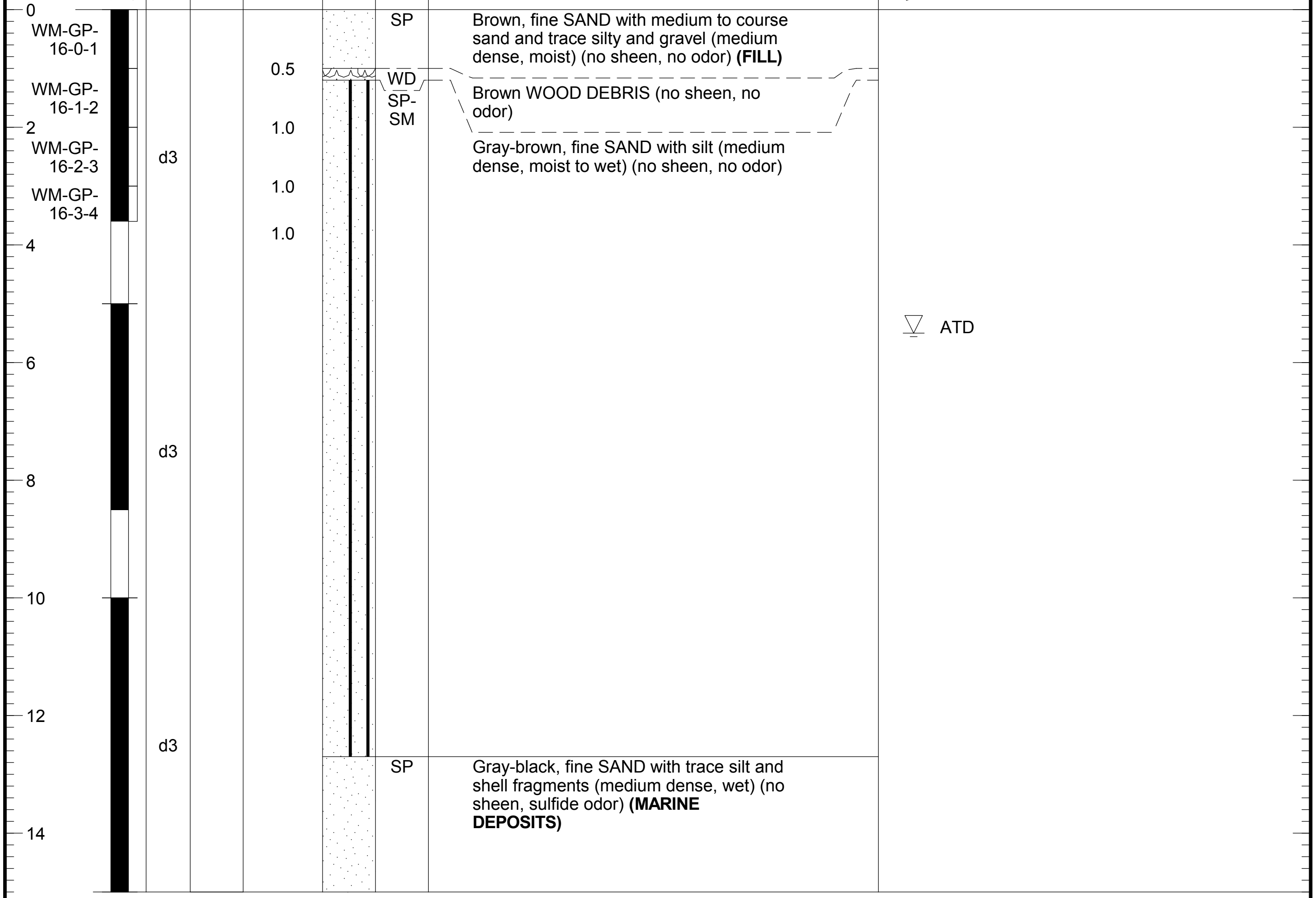
Log of Boring WM-GP-15

Figure
C-16

WM-GP-16

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Water Level

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.



Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0	WM-GP-16-0-1	d3		0.5	SP	Brown, fine SAND with medium to course sand and trace silty and gravel (medium dense, moist) (no sheen, no odor) **(FILL)**	
	WM-GP-16-1-2			1.0	WD	Brown WOOD DEBRIS (no sheen, no odor)	
2	WM-GP-16-2-3			1.0	SP-SM	Gray-brown, fine SAND with silt (medium dense, moist to wet) (no sheen, no odor)	
	WM-GP-16-3-4			1.0			
4–6							ATD
6–10		d3					
10–12.5		d3					
12.5–15					SP	Gray-black, fine SAND with trace silt and shell fragments (medium dense, wet) (no sheen, sulfide odor) **(MARINE DEPOSITS)**	

Boring Completed 10/08/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

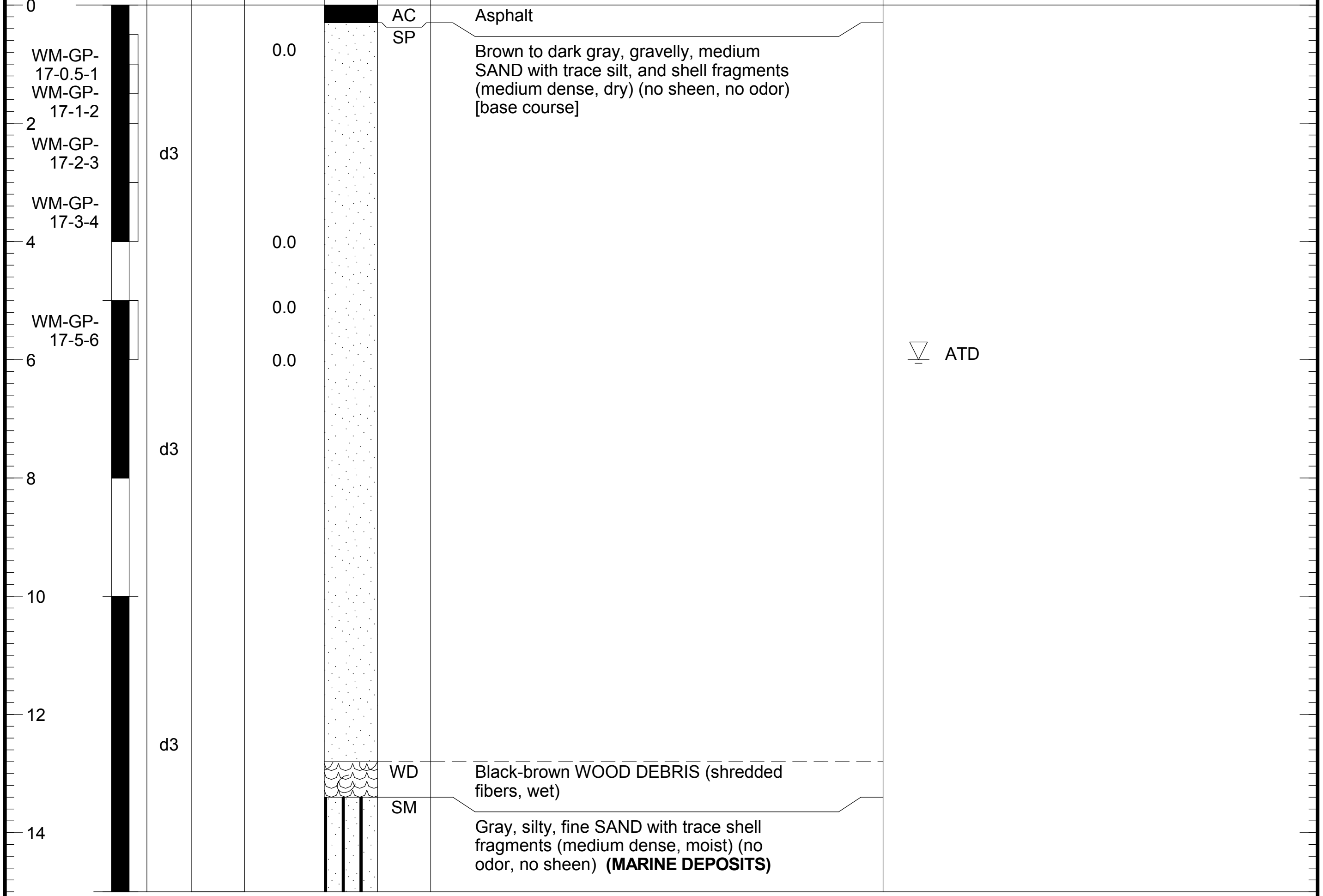
Log of Boring WM-GP-16

Figure
C-17

WM-GP-17

SAMPLE DATA	SOIL PROFILE	GROUNDWATER

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.



Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0					AC	Asphalt	
	WM-GP-17-0.5-1			0.0	SP	Brown to dark gray, gravelly, medium SAND with trace silt, and shell fragments (medium dense, dry) (no sheen, no odor) [base course]	
	WM-GP-17-1-2						
2	WM-GP-17-2-3	d3					
	WM-GP-17-3-4						
4				0.0			
	WM-GP-17-5-6			0.0			
6				0.0			ATD
		d3					
8							
10							
12		d3					
					WD	Black-brown WOOD DEBRIS (shredded fibers, wet)	
					SM	Gray, silty, fine SAND with trace shell fragments (medium dense, moist) (no odor, no sheen) **(MARINE DEPOSITS)**	
14							

Boring Completed 10/08/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Log of Boring WM-GP-17

Figure
C-18

WM-GP-18

SAMPLE DATA					SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Drilling Method: Geoprobe^{TM} Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level
0				0.0 0.0	SP	Brown, gravelly fine to coarse SAND with trace silt (medium dense to loose, damp) (no odor, no sheen)	
2		d3		0.0	SM	Brown, silty, fine SAND with trace sand and debris (medium dense, moist to wet) (no sheen, no odor)	
6							∇ ATD
7		d3			WD	White-yellow WOOD DEBRIS	
8						-- no recovery	
10	WM-GP-18-10-12				SM/ML	Black-brown, fine SAND with silt to a fine sandy SILT (very soft, wet) (no sheen, no odor) Black-brown fine sandy SILT trace course sand	
12		d3		0.0	WD	Brown wood debris	
13				2.2	SP-SM	Gray fine SAND with silt (medium dense, damp) (no sheen, no odor)	

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-19

Drilling Method: Geoprobe™
Ground Elevation (ft):
Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	SOIL PROFILE	Water Level
0					AC	Asphalt	
				0.0	SP	Brown, fine to medium SAND with trace silt (medium dense, moist) (no sheen, no odor) **(FILL)**	
				0.0			
2							
		d3		0.0	SM-ML	Brown, SILT (soft, moist) (no sheen, no odor)	
				0.0	SM	Brown, silty fine SAND (dense, moist) (no sheen, no odor)	
4							
6							
		d3					∇ ATD
					ML	Gray, SILT with sand, wood debris and shell fragments (medium stiff, wet) (no sheen, no odor)	
8				0.0			
10							
	WM-GP-19-11-12			0.0			
12							
		d3			WD	Brown WOOD DEBRIS	
14				0.0	SP	Gray, fine SAND with trace silt and shell fragments (medium dense, wet) (no sheen, no odor)	
16							
18							
20							

Boring Completed 10/10/13
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

Landau Associates

Westman Marine
Blaine, Washington

Log of Boring WM-GP-19

Figure
C-20

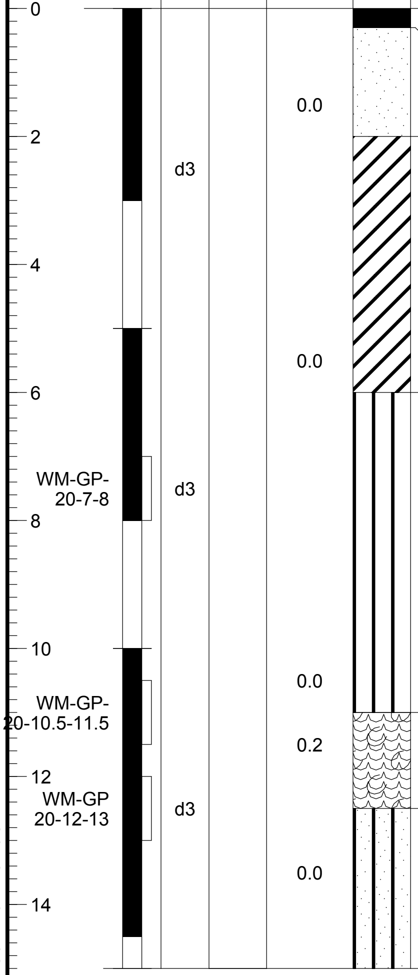
WM-GP-20

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.



Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0					AC	ASPHALT	
				0.0	SP	Brown, fine to medium SAND (loose, moist) (no odor, no sheen) **[FILL]**	
2		d3		0.0	CL	Gray CLAY (medium stiff, moist) (no odor, no sheen)	
6	WM-GP-20-7-8	d3		0.0	ML	Blackish gray, sandy SILT (medium stiff, wet) (hydrogen sulfide like odor, no sheen) -- increase in gravel content	∇ ATD
	WM-GP-20-10.5-11.5			0.2	WD	WOOD DEBRIS (hydrogen sulfide like odor)	
12	WM-GP 20-12-13	d3		0.0	SM	Gray, silty, fine to medium SAND with shell fragments (medium dense, damp) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-21

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0					GM	Brown, silty, fine GRAVEL with clay (loose, moist) (no odor, no sheen) **[FILL]**	
0.5				0.0	SP	Gray, fine to medium SAND (loose, moist) (no odor, no sheen)	
2.5		d3		0.0			
6.5				0.0			
7	WM-GP-21-7-8	d3			WD	Brownish black, WOOD DEBRIS (hydrogen sulfide like odor)	▽ ATD
8				0.0	SM	Brown, silty coarse SAND with brick fragments and wood debris (loose, wet) (hydrogen sulfide like odor, no sheen)	
10	WM-GP-21-10-11						
11.5				113			
12	WM-GP-21-12-13	d3		3.4	SP	Dark gray, fine to medium SAND with shell debris (medium dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-21

WM-GP-22

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0					SP-SM	Grayish brown, gravelly, fine to coarse SAND with silt (medium dense, damp) (no odor, no sheen) **[FILL]**	
				0.0	SP-SM	Brown, fine SAND with trace silt (medium dense, damp) (no odor, no sheen)	
2		d3		0.0	SM	-- with red brick fragments -- with wood debris Gray, silty, fine SAND (medium dense to loose, damp) (no odor, no sheen)	
4					SM	Brown, silty, fine SAND with trace coarse sand and crushed rock (medium dense, moist) (no odor, no sheen)	
6				0.0	RK	Tan, crushed ROCK	
					SM		
		d3			SM	Brown, silty, fine SAND with gravel (medium dense, damp) (no odor, no sheen)	ATD
8	WM-GP-22-7.5-8.5				WD	Black, silty, fine SAND with wood debris (loose, wet) (hydrogen sulfide like odor, no sheen)	
					SM	Brown, fine WOOD DEBRIS (medium dense, wet) (hydrogen sulfide like odor, no sheen)	
10	WM-GP-22-10.5-11.5				WD	Brownish black, gravelly fine to coarse SAND with silt and brick fragments (medium dense, wet) (no odor, no sheen)	
				58.8	SM	Brown WOOD DEBRIS	
12	WM-GP-22-12-13	d3				Gray, fine SAND with silt (medium dense, damp) (no odor, no sheen)	
				3.8		-- with abundant shell debris, grades to gray **[MARINE DEPOSITS]**	
14							

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

16

18

20

Notes:
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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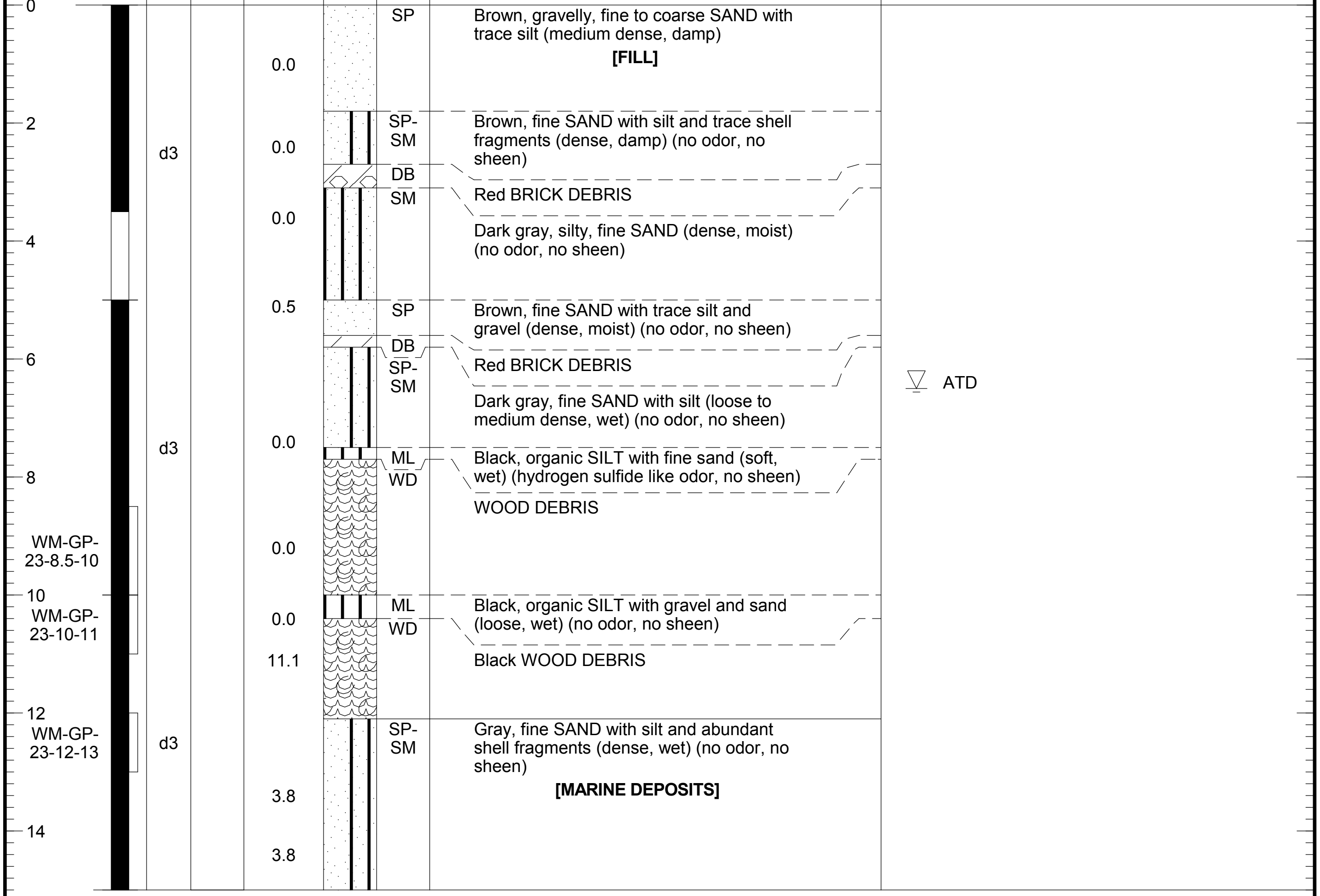
Westman Marine
Blaine, Washington

Log of Boring WM-GP-22

WM-GP-23

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level
			0.0	SP	Brown, gravelly, fine to coarse SAND with trace silt (medium dense, damp) **[FILL]**	
	d3		0.0	SP-SM	Brown, fine SAND with silt and trace shell fragments (dense, damp) (no odor, no sheen)	
				DB	Red BRICK DEBRIS	
			0.0	SM	Dark gray, silty, fine SAND (dense, moist) (no odor, no sheen)	
			0.5	SP	Brown, fine SAND with trace silt and gravel (dense, moist) (no odor, no sheen)	
				DB	Red BRICK DEBRIS	
	d3		0.0	SP-SM	Dark gray, fine SAND with silt (loose to medium dense, wet) (no odor, no sheen)	▽ ATD
				ML	Black, organic SILT with fine sand (soft, wet) (hydrogen sulfide like odor, no sheen)	
WM-GP-23-8.5-10			0.0	WD	WOOD DEBRIS	
WM-GP-23-10-11			0.0	ML	Black, organic SILT with gravel and sand (loose, wet) (no odor, no sheen)	
			11.1	WD	Black WOOD DEBRIS	
WM-GP-23-12-13	d3		3.8 3.8	SP-SM	Gray, fine SAND with silt and abundant shell fragments (dense, wet) (no odor, no sheen) **[MARINE DEPOSITS]**	



Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
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WM-GP-24

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Sample Number & Interval	**Sampler Type**	**Blows/Foot**	**PID (ppm)**	**USCS Symbol**	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	**Water Level**
			0.0	SP	Brown, gravelly, medium to coarse SAND (loose, damp) (no odor, no sheen) **[FILL]**	
WM-GP-24-1-2 WM-GP-24-2-3	d3		0.0	SM	Brown, silty, fine to medium SAND (medium dense, damp) (no odor, no sheen)	
				ML	Gray sandy SILT (medium stiff, damp) (no odor, no sheen)	
			0.0 0.0	SM	Brown, silty, fine to coarse SAND (loose, damp) (no odor, no sheen)	
WM-GP-24-5-6 WM-GP-24-6-7	d3			WD	Brown WOOD DEBRIS	∇ ATD
	d3			SP	Gray, fine SAND with trace silt (medium dense, wet) -- with shell debris **[MARINE DEPOSITS]**	

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

Log of Boring WM-GP-24

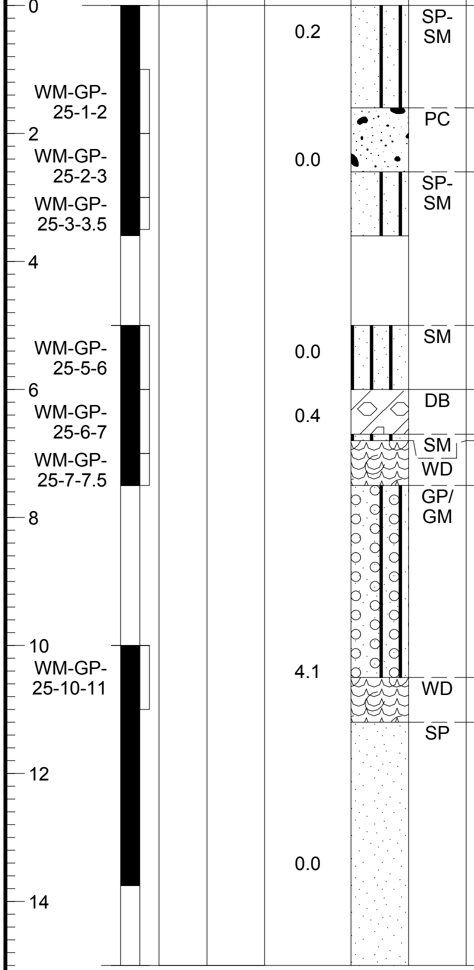
WM-GP-25

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
WM-GP-25-1-2			0.2	SP-SM	Brown, gravelly, fine SAND with silt (medium dense, damp) (no odor, no sheen) **[FILL]**	
WM-GP-25-2-3			0.0	PC	Gray CONCRETE DEBRIS	
WM-GP-25-3-3.5				SP-SM	Grayish brown, gravelly, fine SAND with coarse sand and silt (dense, moist) (no odor, no sheen)	
WM-GP-25-5-6			0.0	SM	Brown, silty, fine to coarse SAND with trace brick fragments and gravel (medium dense, moist) (no odor, no sheen)	
WM-GP-25-6-7			0.4	DB	Red BRICK DEBRIS with crushed rock, trace fine sand, and silt	
WM-GP-25-7-7.5				SM	Brown, silty, fine SAND with wood debris (medium dense, wet) (no odor, no sheen)	∇ ATD
				WD	Brown WOOD DEBRIS	
				GP/GM	Brown, fine GRAVEL with sand and silt (loose, wet) (no odor, no sheen)	
WM-GP-25-10-11			4.1	WD	Brown WOOD DEBRIS	
			0.0	SP	Gray, fine SAND with trace silt and shell fragments (medium dense, wet) (no odor, no sheen) **[MARINE DEPOSITS]**	



Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
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2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Log of Boring WM-GP-25

Figure C-26

WM-GP-26

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol		
0				0.0	GP	GP	Brown, sandy, fine GRAVEL (loose, damp) (no odor, no sheen) **[FILL]**	
	WM-GP-26-1-2				SP	SP	Reddish brown, fine to medium SAND with gravel (loose, moist) (no odor, no sheen)	Groundwater not encountered.
2	WM-GP-26-2-3	d3		0.0				
	WM-GP-26-3.0-3.5							
4								
	WM-GP-26-5-6			0.0				
6		d3						
	WM-GP-26-6-7			0.0	WD	WD	Black WOOD DEBRIS	
							Refusal at 7.0 feet	
8								
10								
12								
14								
16								
18								
20								

Boring Completed 04/15/14
Total Depth of Boring = 7.0 ft.

Notes:
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LANDAU ASSOCIATES

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Blaine, Washington

Log of Boring WM-GP-26

WM-GP-27

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0					GP	Brown, fine GRAVEL (loose, damp) (no odor, no sheen) **[FILL]**	
				0.0	SM	Brown, silty, fine to medium SAND with gravel (loose, damp) (no odor, no sheen)	
2							
				0.0	SM	Gray, silty, fine to medium SAND with trace shell fragments (medium dense, moist) (no odor, no sheen)	
4							
	WM-GP-27-5-6			0.0	SP	Brownish gray, silty, fine to medium SAND (medium dense, moist to wet) (no odor, no sheen)	
6	WM-GP-27-6-7						∇ ATD
					WD	WOOD DEBRIS (hydrogen sulfide like odor)	
					SP	Black, fine to coarse SAND wtih gravel (loose, wet) (no odor, no sheen)	
8							
10				0.0			
					SM	Gray silty fine to medium SAND with shell debris (medium dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	
12				1.8			
14				0.3			

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

16

18

20

Notes:
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-28

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Soil Profile	Water Level
			0.0	SP	Grayish brown, gravelly, fine to coarse SAND (loose, damp) (no odor, no sheen) **[FILL]**	
				SP	Brown, fine to medium SAND (medium dense, moist) (no odor, no sheen)	
	d3			DB	Red BRICK DEBRIS	
			0.0	SP	Gray, gravelly, fine to coarse SAND (loose, moist) (no odor, no sheen)	
				SM	Brown, silty, fine to medium SAND (medium dense, moist) (no odor, no sheen)	
WM-GP-28-5-6				SP	Brown, fine to coarse SAND with brick debris (loose, moist) (no odor, no sheen)	
WM-GP-28-6-7	d3		0.0	SM	Gray, silty, fine to coarse SAND (mediuim dense, wet) (no odor, no sheen)	▽ ATD
			0.0	ML	Gray, sandy, SILT with shell fragments (soft, wet) (no odor, no sheen)	
			0.0	SP	Brown, fine to medium SAND (medium dense, wet) (no odor, no sheen)	
				ML	Brownish gray, SILT with gravel (soft, wet) (no odor, no sheen)	
				SM	Brown, silty, medium to coarse SAND (loose, wet) (no odor, no sheen)	
	d3		4.7	WD	WOOD DEBRIS (hydrogen sulfide like odor)	
			0.3	SM	Gray, silty, fine to medium SAND with shell fragments (medium dense, wet) (no odor, no sheen) **[MARINE DEPOSITS]**	

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

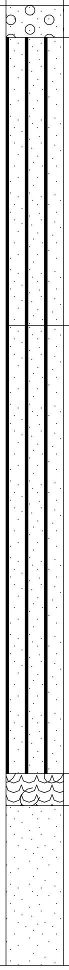
WM-GP-29

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.



Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
0				0.0	GP	Brown, fine GRAVEL (loose, dry) (no odor, no sheen) **[FILL]**	
0.5		d3		0.0	SM	Brown, silty, fine to coarse SAND with gravel (medium dense, moist) (no odor, no sheen) -- with wood debris	
5	WM-GP-29-5-6 WM-GP-29-6-7	d3		0.0 0.0 0.0	SM	Gray, silty, fine to medium SAND (medium dense, moist to wet) (no odor, no sheen) -- with shell fragments	∇ ATD
12		d3		4.6	WD	WOOD DEBRIS	
12.5					SP	Gray, fine to medium SAND with shell fragments (dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1035010016. 2/25/15 N:\PROJECTS\001035.010.015_BHB.GPJ SOIL BORING LOG

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-29

Figure
C-30

WM-GP-30

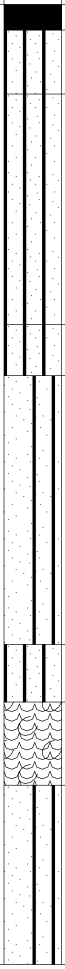
SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description	Water Level
				AC	ASPHALT	
WM-GP-30-1-2	d3		0	SM	Brown, silty, fine to coarse SAND with gravel (dense, moist) (no odor, no sheen) **[FILL]**	
WM-GP-30-3-4				SM	Brown, very silty, fine SAND with trace coarse sand (dense, moist) (no odor, no sheen)	
WM-GP-30-5-6			0	SM	Brownish gray, silty, fine SAND (medium dense, moist) (no odor, no sheen)	
	d3		1.9	SP-SM	Gray, fine SAND with silt (very soft, wet)	∇ ATD
WM-GP-30-10-11				SM	Gray, silty, fine SAND (very loose, wet) (no odor, no sheen)	
			3.7	WD	WOOD DEBRIS (hydrogen sulfide like odor)	
WM-GP-30-12-13 WM-GP-30-14-15	d3			SP-SM	Gray fine SAND with silt and trace shell fragments **[MARINE DEPOSITS]**	

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20



Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Westman Marine
Blaine, Washington

Log of Boring WM-GP-30

Figure
C-31

WM-GP-31

SAMPLE DATA | SOIL PROFILE | GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
			0.0
WM-GP-31-1-2	d3		
WM-GP-31-3-4			
WM-GP-31-5-6			0.0
WM-GP-31-7-8	d3		
WM-GP-31-10-11			
WM-GP-31-11-12			0.0
	d3		

USCS Symbol	Description
SM	Brown, silty, fine to coarse SAND with gravel and shell fragments (loose, moist to wet) (no odor, no sheen) **[FILL]** -- grades to gray
ML	Gray, sandy, SILT with trace coarse sand (soft, wet) (no odor, no sheen)
SM	Black, silty, fine SAND with gravel (medium dense to loose, wet) (no odor, no sheen)
SM	Grayish brown, very silty, fine SAND with trace coarse sand and gravel (loose, wet) (no odor, no sheen)
WD	WOOD DEBRIS
SP-SM	Gray, fine SAND with silt (medium dense, wet) (no odor, no sheen)
SM	Gray, silty fine SAND with trace shell fragments and wood debris (medium dense, wet) (no odor, no sheen)
	No recovery

Water Level: ▽ ATD

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1035010016. 2/25/15 N:\PROJECTS\001035.010.015_BHB.GPJ SOIL BORING LOG

LANDAU ASSOCIATES

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Blaine, Washington

Log of Boring WM-GP-31

WM-GP-32

SAMPLE DATA

SOIL PROFILE

GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
WM-GP-32-1-2			0.0
WM-GP-32-2-3	d3		0.0
WM-GP-32-5-6			0.0
WM-GP-32-7-8	d3		0.0
WM-GP-32-9-10			0.0
			0.0
WM-GP-32-11-12			0.4
WM-GP-32-12-13	d3		
			76.1
WM-GP-32-13.5-15			

USCS Symbol	Description	Water Level
AC	ASPHALT	
SM	Brown, silty, fine to coarse SAND with gravel (medium dense, damp) (no odor, no sheen) **[FILL]**	
SP-SM	Brown, fine SAND with silt and trace shell fragments (dense, damp) (no odor, no sheen) -- grades to grayish brown	
SP	Gray, fine SAND with trace silt (loose, wet) (no odor, no sheen)	▽ ATD
SM	Gray, silty, fine SAND with shell fragments (loose, wet) (no odor, no sheen)	
ML	Gray, SILT (soft, wet) (no odor, no sheen)	
SP-SM	Gray, fine SAND with silt and trace shell fragments (loose, wet) (hydrogen sulfide like odor, no sheen)	
SM	Dark gray, silty, fine SAND with shell fragments (loose, wet) (no odor, no sheen)	
WD	WOOD DEBRIS (hydrogen sulfide like odor)	
SP	Gray, fine SAND with trace silt (medium dense, wet) (no odor, no sheen)	

Depth (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-33

SAMPLE DATA					SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level
0				0.0	SM	Brown, silty, fine to coarse SAND with gravel (medium dense, moist) (no odor, no sheen) **[FILL]**	
				0.0			
2		d3					
				0.0			
6	WM-GP-33-6-7				SM	Gray, silty, fine to medium SAND (medium dense, wet) (no odor, no sheen)	∇ ATD
	WM-GP-33-7-8	d3		0.0			
10	WM-GP-33-10-11			0.0			
				0.0	ML	Gray, sandy, SILT (soft, wet) (no odor, no sheen)	
12		d3		13.2	WD	WOOD DEBRIS (hydrogen sulfide like odor)	
	WM-GP-33-13-14			27.7	SM	Gray, silty, fine to medium SAND with shell fragments (medium dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-33

WM-GP-34

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Drilling Method: Geoprobe™ Ground Elevation (ft): Drilled By: Cascade Drilling Inc.	Water Level
0		d3		0.0 0.0	SP	Brown, gravelly, fine to coarse SAND (medium dense, moist) (no odor, no sheen) **[FILL]**	
				0.0	DB	Red BRICK DEBRIS	
		d3			SM	Gray, silty fine to medium SAND (medium dense, moist to wet) (no odor, no sheen)	
				0.0			ATD
		d3		0.3	ML	Gray, SILT with trace sand (soft, wet) (no odor, no sheen)	
					WD	Brown WOOD DEBRIS	
					SP	Gray, fine to medium SAND with shell fragments (medium dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

WM-GP-35

Drilling Method: Geoprobe™

Ground Elevation (ft):

Drilled By: Cascade Drilling Inc.

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Soil Profile	Water Level
0				0.0	SP	Brown, gravelly fine to coarse SAND (medium dense, moist) (no odor, no sheen) **[FILL]**	
2		d3					
5	WM-GP-35-5-6.5				SM	Brown, silty fine to coarse SAND with brick debris (loose, moist) (no odor, no sheen)	
6				0.0	SM	Brown, silty fine to coarse SAND (loose, moist) (no odor, no sheen)	
					WD	Brownish red WOOD DEBRIS	
10	WM-GP-35-10-11	d3		0.0	ML	Brown, sandy, SILT (medium stiff, wet) (no odor, no sheen)	∇ ATD
					WD	Brown, WOOD DEBRIS with brick fragments	
					SP	Gray, fine to medium SAND with shell fragments (medium dense, wet) (no odor, no sheen)	
12		d3		1.7			

Boring Completed 04/16/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Boring WM-GP-35

Figure
C-36

WM-MW-1

SAMPLE DATA

SOIL PROFILE

GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft): 15.64

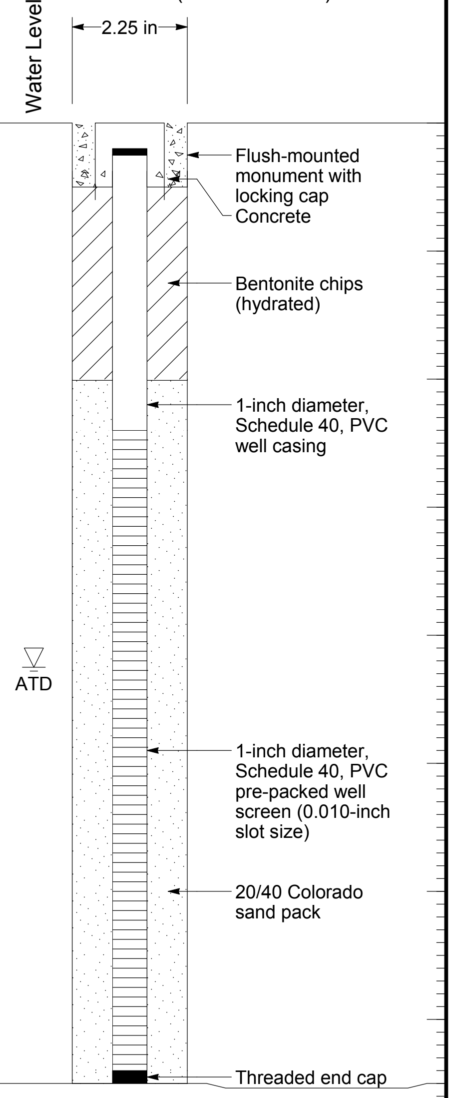
Drilled By: Cascade Drilling Inc.

Depth (ft)	Elevation	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
0–3			d3		0.0
5–9			d3		0.0
10–15			d3		0.0

Graphic Symbol	USCS Symbol	Description
	SP	Brownish gray, fine to medium SAND with gravel (loose, damp) (no odor, no sheen) **[FILL]**
	SM	Gray, silty, fine SAND with shell fragments (loose, moist) (no odor, no sheen)
	CL	Gray, silty CLAY with shell fragments (medium stiff, moist) (no odor, no sheen)
	SM	Grayish brown, silty, fine SAND with shell fragments (loose, moist to wet) (no odor, no sheen)
	WD	Brown WOOD DEBRIS
	SP	Gray, fine to coarse SAND with trace silt (medium dense, wet) (no odor, no sheen)

Water Level: ATD (approx. 8.5 ft)

Monitoring Well Detail
(DOE#: BID310)



Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

Log of Monitoring Well WM-MW-1

Figure
C-37

WM-MW-2

SAMPLE DATA

SOIL PROFILE

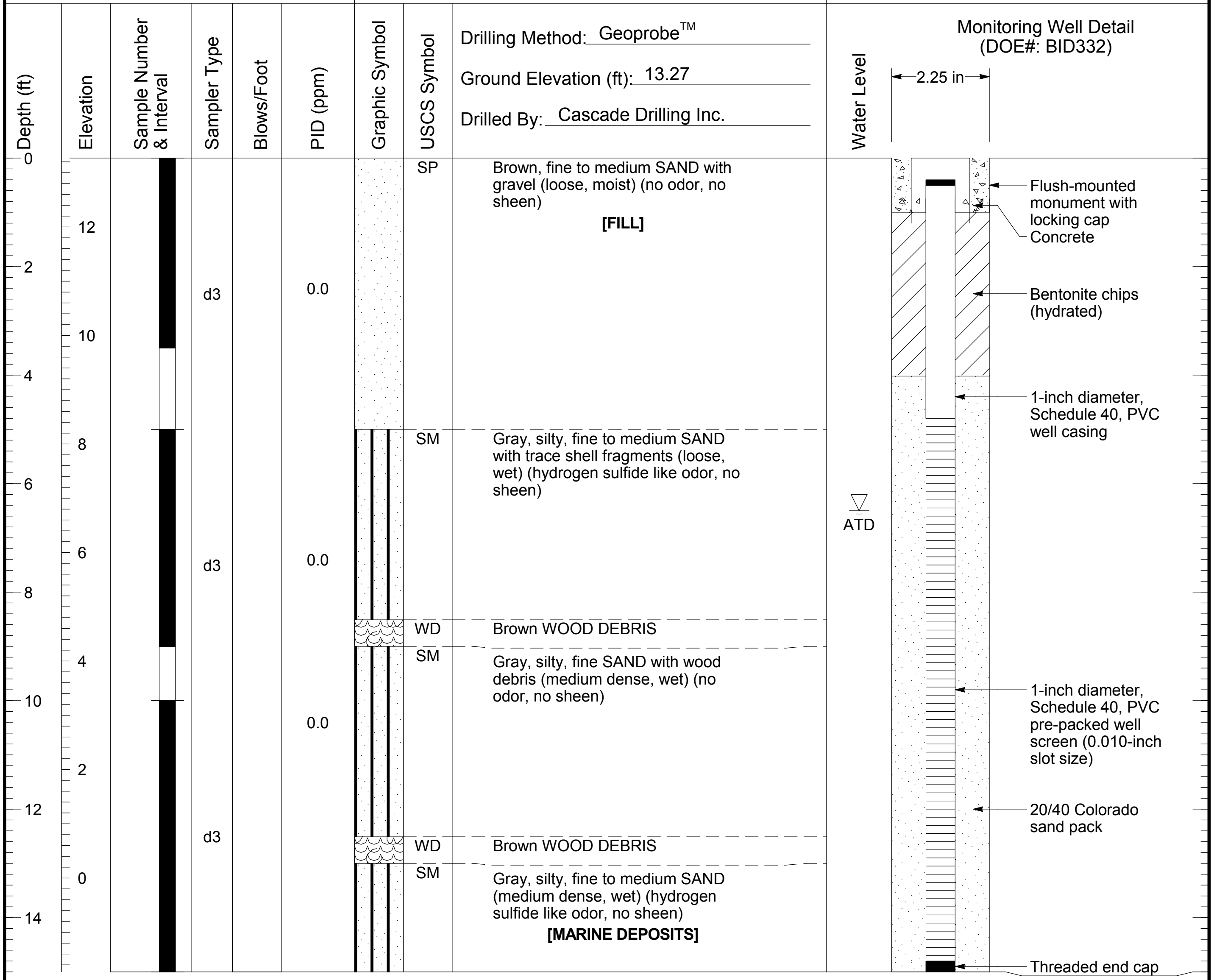
GROUNDWATER

Drilling Method: Geoprobe™

Ground Elevation (ft): 13.27

Drilled By: Cascade Drilling Inc.

Monitoring Well Detail
(DOE#: BID332)



SP — Brown, fine to medium SAND with gravel (loose, moist) (no odor, no sheen)

[FILL]

SM — Gray, silty, fine to medium SAND with trace shell fragments (loose, wet) (hydrogen sulfide like odor, no sheen)

WD — Brown WOOD DEBRIS

SM — Gray, silty, fine SAND with wood debris (medium dense, wet) (no odor, no sheen)

WD — Brown WOOD DEBRIS

SM — Gray, silty, fine to medium SAND (medium dense, wet) (hydrogen sulfide like odor, no sheen)

[MARINE DEPOSITS]

Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Monitoring Well WM-MW-2

Figure
C-38

WM-MW-3

SAMPLE DATA | **SOIL PROFILE** | **GROUNDWATER**

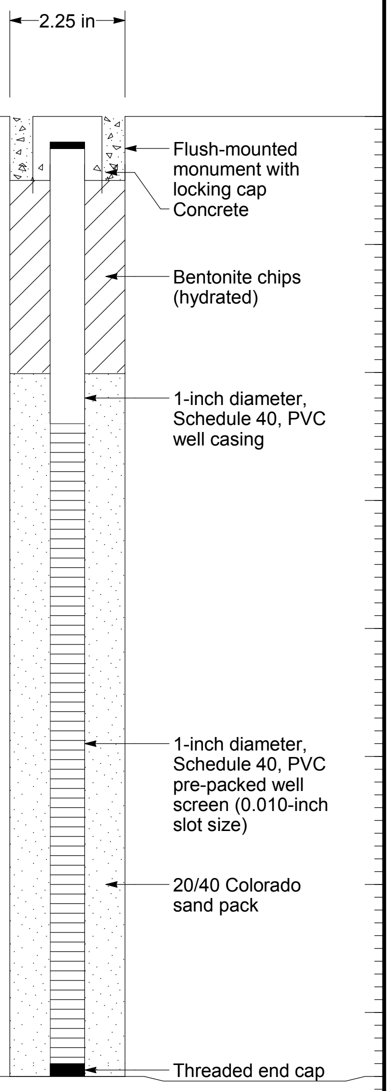
Drilling Method: Geoprobe™

Ground Elevation (ft): 15.32

Drilled By: Cascade Drilling Inc.

Depth (ft)	Elevation	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Description	Water Level
0							SP	Brown, fine to medium SAND with gravel and trace silt (loose, moist) (no odor, no sheen) **[FILL]**	
	14				0.0				
2			d3						
							SP	Gray, fine to medium SAND with trace silt and shell fragments (moist to wet, medium dense) (no odor, no sheen)	
	12								
4									
	10								
6									
	8	WM-MW-3-7-8	d3		0.0				ATD
8									
	6								
10									
	4				0.0				
12			d3						
	2								
14							WD	Brown WOOD DEBRIS (strong hydrogen sulfide like odor)	
16									
18									
20									

Monitoring Well Detail (DOE#: BID329)



Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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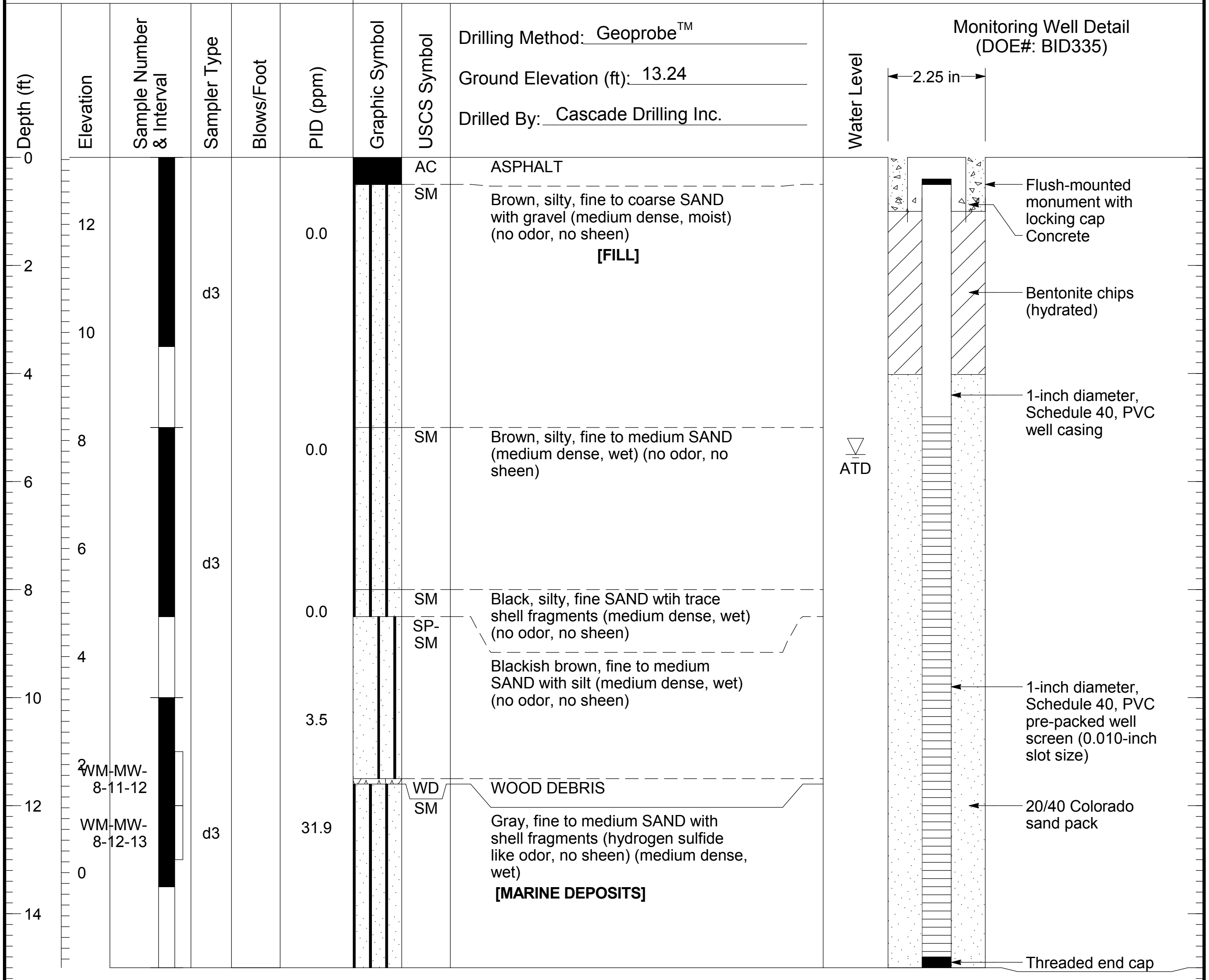
Blaine, Washington

Log of Monitoring Well WM-MW-3

Figure
C-39

WM-MW-4



SAMPLE DATA

Elevation	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)
12				0.0
10		d3		
8				0.0
6		d3		
4				0.0
				3.5
2	WM-MW-8-11-12			
	WM-MW-8-12-13	d3		31.9
0				

SOIL PROFILE

Drilling Method: Geoprobe™

Ground Elevation (ft): 13.24

Drilled By: Cascade Drilling Inc.

USCS Symbol	Description
AC	ASPHALT
SM	Brown, silty, fine to coarse SAND with gravel (medium dense, moist) (no odor, no sheen) **[FILL]**
SM	Brown, silty, fine to medium SAND (medium dense, wet) (no odor, no sheen)
SM	Black, silty, fine SAND wtih trace shell fragments (medium dense, wet) (no odor, no sheen)
SP-SM	Blackish brown, fine to medium SAND with silt (medium dense, wet) (no odor, no sheen)
WD	WOOD DEBRIS
SM	Gray, fine to medium SAND with shell fragments (hydrogen sulfide like odor, no sheen) (medium dense, wet) **[MARINE DEPOSITS]**

GROUNDWATER

Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1035010016. 2/25/15 N:\PROJECTS\001035.010.015_BHB.GPJ WELL LOG W/ ELEVATION

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Westman Marine
Blaine, Washington

Log of Monitoring Well WM-MW-4

Figure
C-40

WM-MW-5

Drilling Method: Geoprobe™

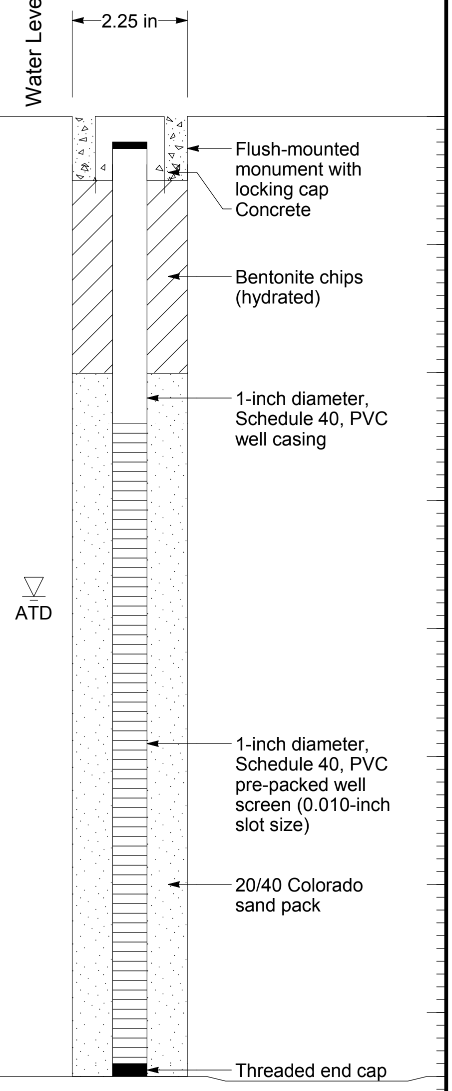
Ground Elevation (ft): 14.18

Drilled By: Cascade Drilling Inc.

SAMPLE DATA						SOIL PROFILE			GROUNDWATER
Depth (ft)	Elevation	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol		Water Level
0	14						AC	ASPHALT	
2	12						SP	Brown, fine to coarse SAND with gravel (loose, moist) (no odor, no sheen) **[FILL]**	
			d3		0.0		ML	Gray, sandy, SILT with shell fragments (medium stiff, moist) (no odor, no sheen)	
4 6	10 8						SP	Gray, fine to medium SAND (medium dense, moist) (no odor, no sheen)	
		WM-MW-5-7-8	d3				SM	Gray, silty, fine to medium SAND with clay (very loose, wet) (no odor, no sheen) -- reduced silt content	ATD
8	6				0.0		WD	Brown WOOD DEBRIS	
10	4						ML	Brown, sandy, SILT with decayed wood debris (soft, wet) (no odor, no sheen)	
							SP	Brown medium to coarse SAND with wood debris (medium dense, wet) (no odor, no sheen)	
12	2						WD	Brown WOOD DEBRIS	
			d3		0.0		SP	Gray, fine to medium SAND (medium dense, wet) (hydrogen sulfur like odor, no sheen)	
							DB	Red BRICK DEBRIS	
14	0						SP-SM	Gray, fine to medium SAND with silt and shell fragments (dense, moist) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**	

Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Monitoring Well Detail
(DOE#: BID330)



Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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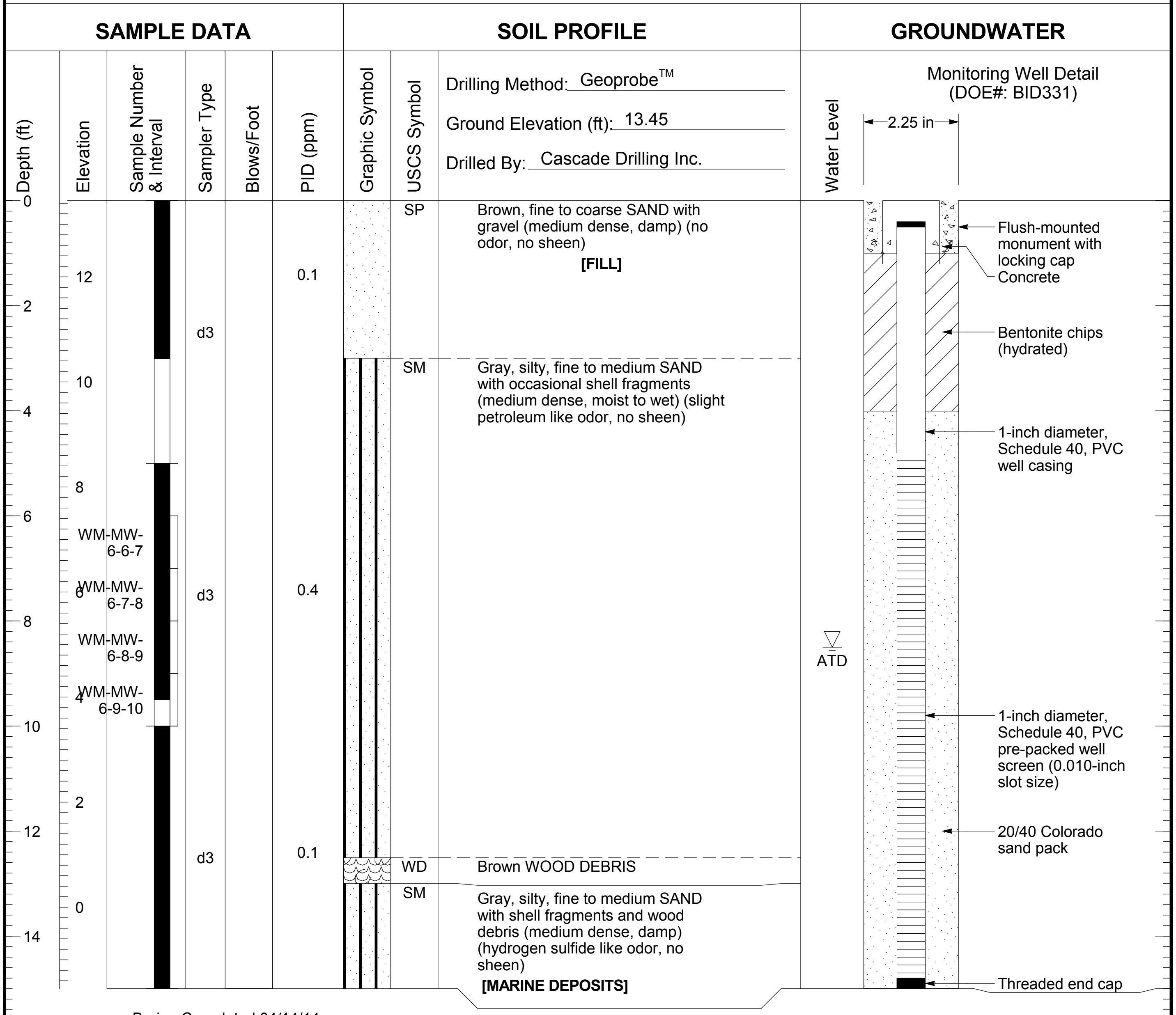
Log of Monitoring Well WM-MW-5

Figure
C-41

WM-MW-6



Drilling Method: Geoprobe™

Ground Elevation (ft): 13.45

Drilled By: Cascade Drilling Inc.

SP — Brown, fine to coarse SAND with gravel (medium dense, damp) (no odor, no sheen)

[FILL]

SM — Gray, silty, fine to medium SAND with occasional shell fragments (medium dense, moist to wet) (slight petroleum like odor, no sheen)

WD — Brown WOOD DEBRIS

SM — Gray, silty, fine to medium SAND with shell fragments and wood debris (medium dense, damp) (hydrogen sulfide like odor, no sheen)

[MARINE DEPOSITS]

Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Blaine, Washington

Log of Monitoring Well WM-MW-6

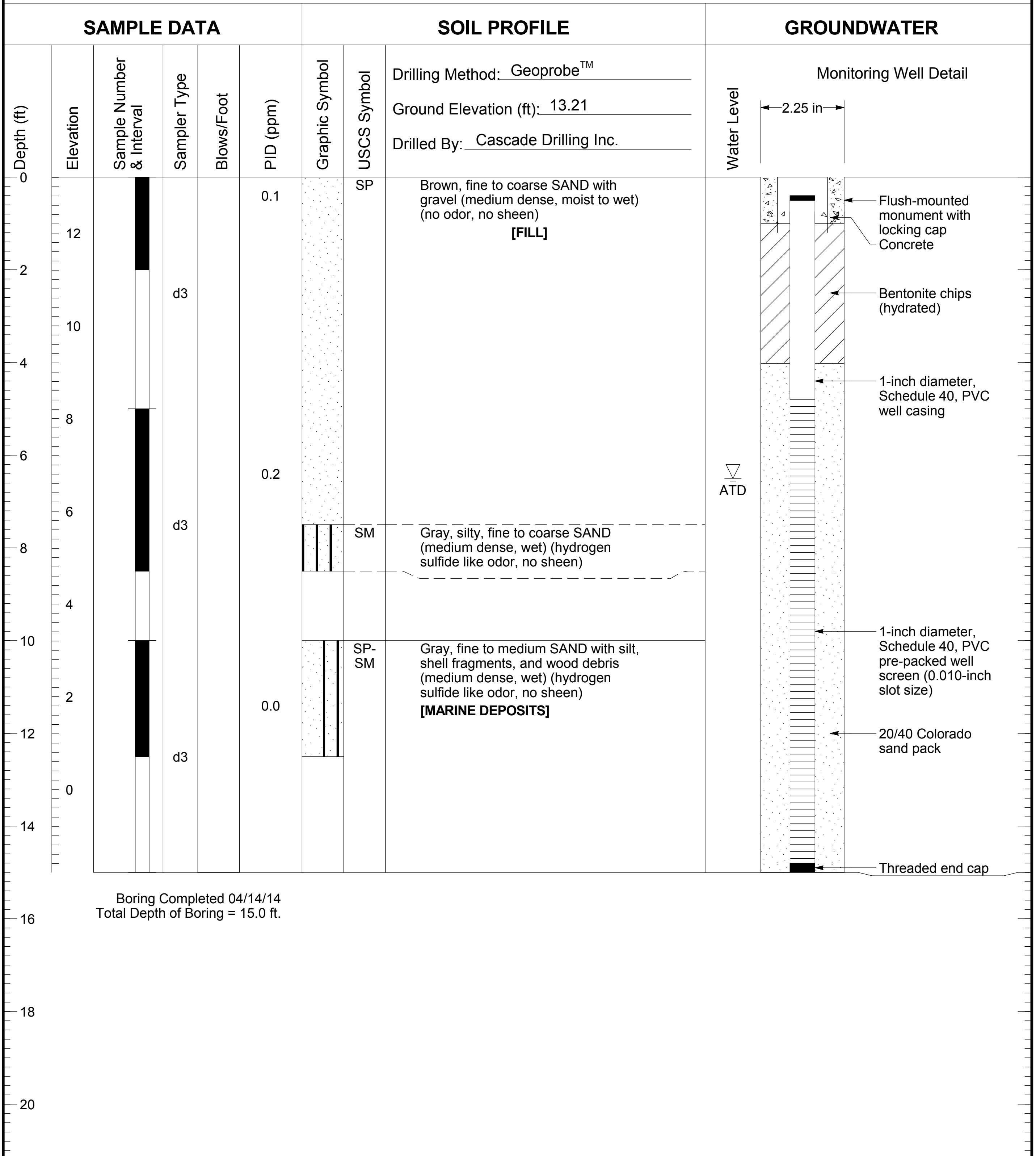
Figure
C-42

WM-MW-7

Drilling Method: Geoprobe™

Ground Elevation (ft): 13.21

Drilled By: Cascade Drilling Inc.



SP — Brown, fine to coarse SAND with gravel (medium dense, moist to wet) (no odor, no sheen)
[FILL]

SM — Gray, silty, fine to coarse SAND (medium dense, wet) (hydrogen sulfide like odor, no sheen)

SP-SM — Gray, fine to medium SAND with silt, shell fragments, and wood debris (medium dense, wet) (hydrogen sulfide like odor, no sheen)
[MARINE DEPOSITS]

Boring Completed 04/14/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1035010016. 2/25/15 N:\PROJECTS\001035.010.015_BHB.GPJ WELL LOG W/ ELEVATION

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Westman Marine
Blaine, Washington

Log of Monitoring Well WM-MW-7

Figure
C-43

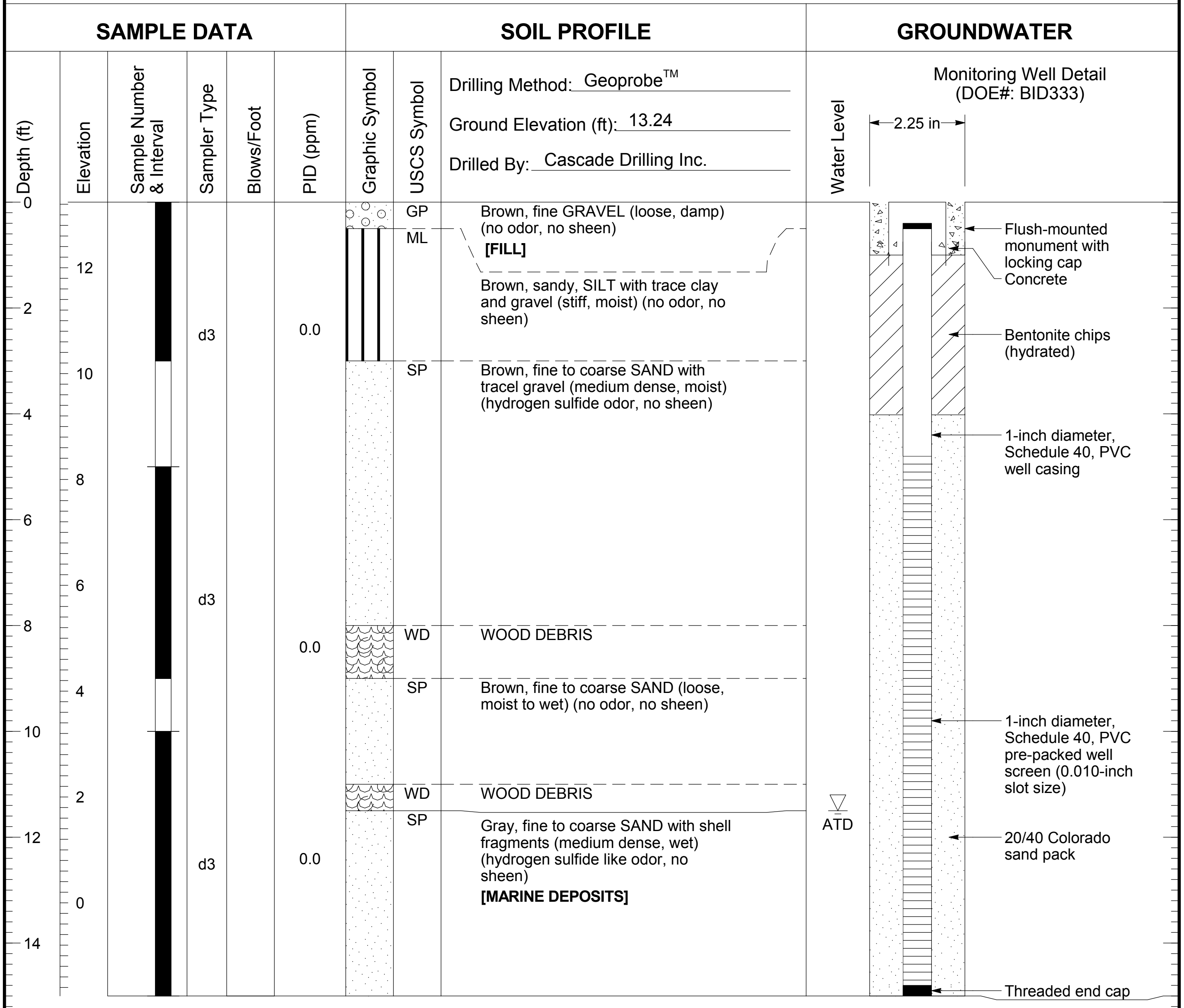
WM-MW-8

Drilling Method: Geoprobe™

Ground Elevation (ft): 13.24

Drilled By: Cascade Drilling Inc.

Monitoring Well Detail
(DOE#: BID333)



USCS Symbol	Description
GP	Brown, fine GRAVEL (loose, damp) (no odor, no sheen) **[FILL]**
ML	Brown, sandy, SILT with trace clay and gravel (stiff, moist) (no odor, no sheen)
SP	Brown, fine to coarse SAND with tracel gravel (medium dense, moist) (hydrogen sulfide odor, no sheen)
WD	WOOD DEBRIS
SP	Brown, fine to coarse SAND (loose, moist to wet) (no odor, no sheen)
WD	WOOD DEBRIS
SP	Gray, fine to coarse SAND with shell fragments (medium dense, wet) (hydrogen sulfide like odor, no sheen) **[MARINE DEPOSITS]**

Boring Completed 04/15/14
Total Depth of Boring = 15.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

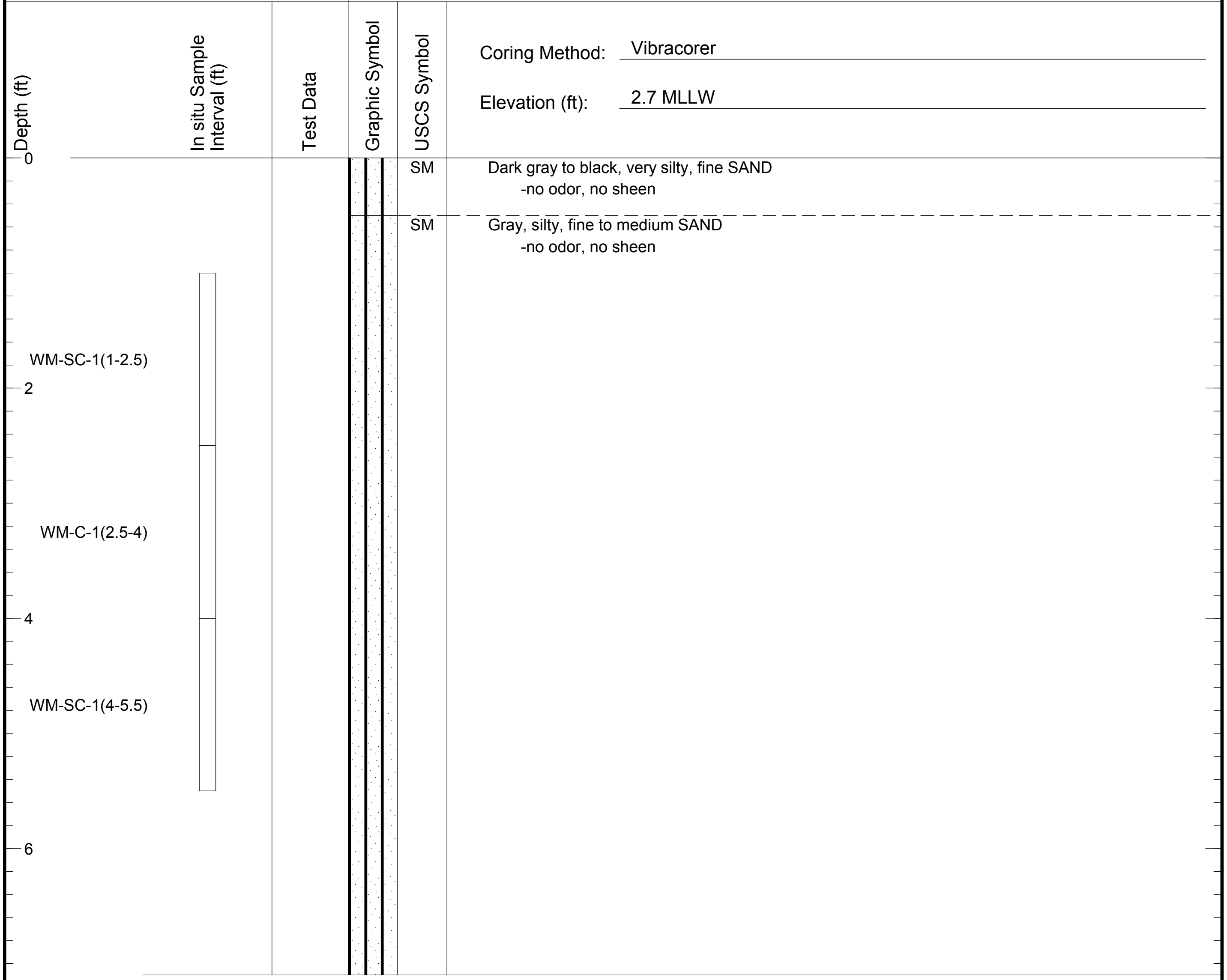
WM-SC-1

SAMPLE DATA

SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): 2.7 MLLW



USCS Symbol	Description
SM	Dark gray to black, very silty, fine SAND -no odor, no sheen
SM	Gray, silty, fine to medium SAND -no odor, no sheen

Coring Completed 04/10/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 7.1 ft.
Recovery = 6.1 ft.
Compaction Factor = 0.86

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

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Westman Marine
Blaine, Washington

Log of Sediment Core WM-SC-1

WM-SC-2

Coring Method: Vibracorer

Elevation (ft): -5.0 MLLW

SAMPLE DATA			SEDIMENT DESCRIPTION	
Depth (ft)	In situ Sample Interval (ft)	Test Data	USCS Symbol	Description
0			SM	Dark gray to black, very silty, fine SAND with trace shells -slight sulfur odor, no sheen
1–2	WM-SC-2(1-2)			
2			SM	Gray, silty, fine SAND with shells -sulfur odor, no sheen
2–4	WM-SC-2(2-3.5)*			
4–6	WM-SC-2(3.5-5)*			

Coring Completed 04/11/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 6.9 ft.
Recovery = 5.2 ft.
Compaction Factor = 0.75

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

LANDAU ASSOCIATES

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Blaine, Washington

Log of Sediment Core WM-SC-2

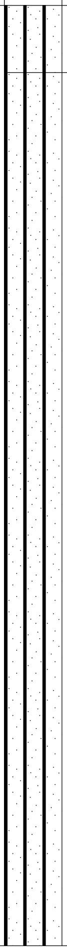
WM-SC-3

SAMPLE DATA

SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): 1.7 MLLW



Depth (ft)	Sample	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Description
0					SM	Dark gray to black, very silty, fine SAND -no odor, no sheen
					SM	Gray, silty, fine SAND with shells -no odor, no sheen
	WM-SC-3(1-2.5)	1-2.5				
2						
	WM-SC-3(2.5-4)	2.5-4				
4						
	WM-SC-3(4-5.5)	4-5.5				
6						
8						
10						

Coring Completed 04/11/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 7.0 ft.
Recovery = 5.3 ft.
Compaction Factor = 0.76

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Sediment Core WM-SC-3

Figure
C-47

WM-SC-4

SAMPLE DATA | **SEDIMENT DESCRIPTION**

Coring Method: Vibracorer

Elevation (ft): -0.6 MLLW

Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Description
0				SM	Gray to black, very silty, fine SAND with shells -no odor, no sheen
2	WM-SC-4(1-2.5)				
	WM-SC-4(2.5-4)				
4	WM-SC-4(4-5.5)				
6					
				CL	Gray CLAY with trace shells -no odor, no sheen **[Native]**
8					
10					

Coring Completed 04/11/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 6.9 ft.
Recovery = 5.2 ft.
Compaction Factor = 0.75

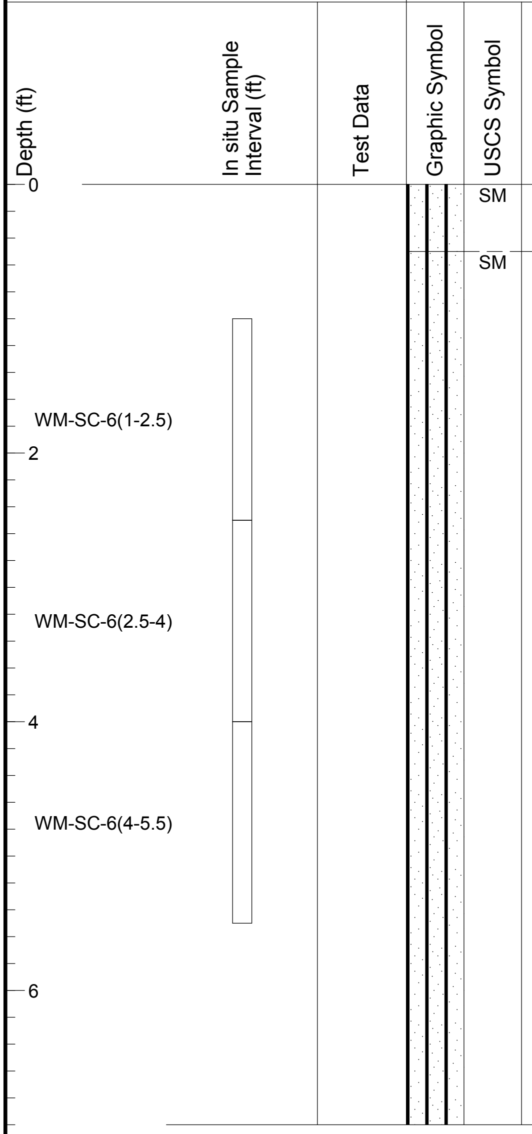
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

WM-SC-6

SAMPLE DATA | **SEDIMENT DESCRIPTION**

Coring Method: Vibracorer

Elevation (ft): -1.0 MLLW



SM Dark gray to black, very silty, fine SAND
-no odor, no sheen

SM Gray, very silty, fine SAND with shells
-slight sulfur odor, no sheen

Coring Completed 04/11/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 7.0 ft.
Recovery = 6.1 ft.
Compaction Factor = 0.87

8

10

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

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Blaine, Washington

Log of Sediment Core WM-SC-6

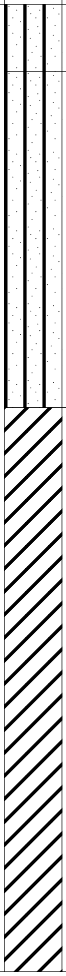
Figure
C-49

WM-SC-10

SAMPLE DATA / SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): -12.2 MLLW



Depth (ft)	In situ Sample Interval (ft)	Test Data	USCS Symbol	Description
0			SM	Dark gray to black, very silty, fine SAND -sulfur odor, no sheen
			SM	Gray, silty, fine SAND -sulfur odor, no sheen
2	WM-SC-10(1-2.5)			
	WM-SC-10(3-4.5)		CL	Gray CLAY with trace shells -no odor, no sheen **[Native]**
4				
6	WM-SC-10(4.5-6)			
8				
10				

Coring Completed 04/11/14
Core logged and sampled by SDS and EHI on 4/14/2014
Total Penetration = 7.2 ft.
Recovery = 6.9 ft.
Compaction Factor = 0.96

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

2/25/15 N:\PROJECTS\001035.010.015_SED.GPJ SEDIMENT LOG W/ COMPACTION FACTOR

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Log of Sediment Core WM-SC-10

Figure
C-50

WM-SC-29

SAMPLE DATA / SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): -13.6

Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Sediment Description
0				SM	Dark gray, very silty, fine SAND with trace shells -no odor, no sheen
2	WM-SC-29(2-3.5)			SM	Dark gray, very silty, fine SAND with abundant shells -strong sulfur odor, no sheen
4	WM-SC-29(4-5.5)			CL	Gray CLAY -no odor, no sheen **[Native]**
6	WM-SC-29(5.5-7)			ML	Gray sandy SILT -no odor, no sheen

Coring Completed 12/16/14
Core logged and sampled by EHI on 12/16/2014
Total Penetration = 7.2 ft.
Recovery = 6.2 ft.
Compaction Factor = 0.86

8

10

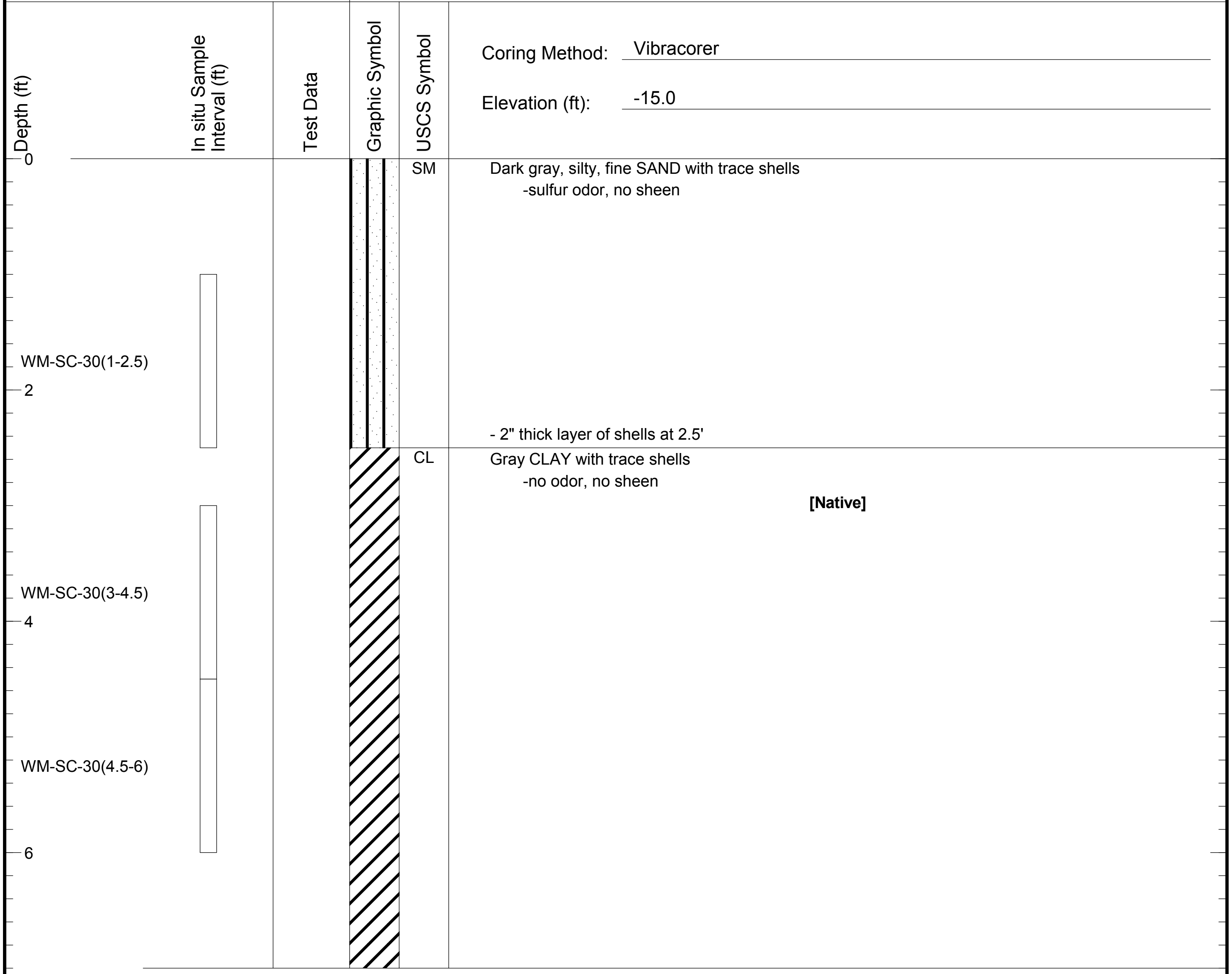
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

WM-SC-30

SAMPLE DATA | **SEDIMENT DESCRIPTION**

Coring Method: Vibracorer

Elevation (ft): -15.0



USCS Symbol	Description
SM	Dark gray, silty, fine SAND with trace shells -sulfur odor, no sheen - 2" thick layer of shells at 2.5'
CL	Gray CLAY with trace shells -no odor, no sheen **[Native]**

Coring Completed 12/16/14
Core logged and sampled by EHI on 12/16/2014
Total Penetration = 7.0 ft.
Recovery = 5.8 ft.
Compaction Factor = 0.83

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

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Log of Sediment Core WM-SC-30

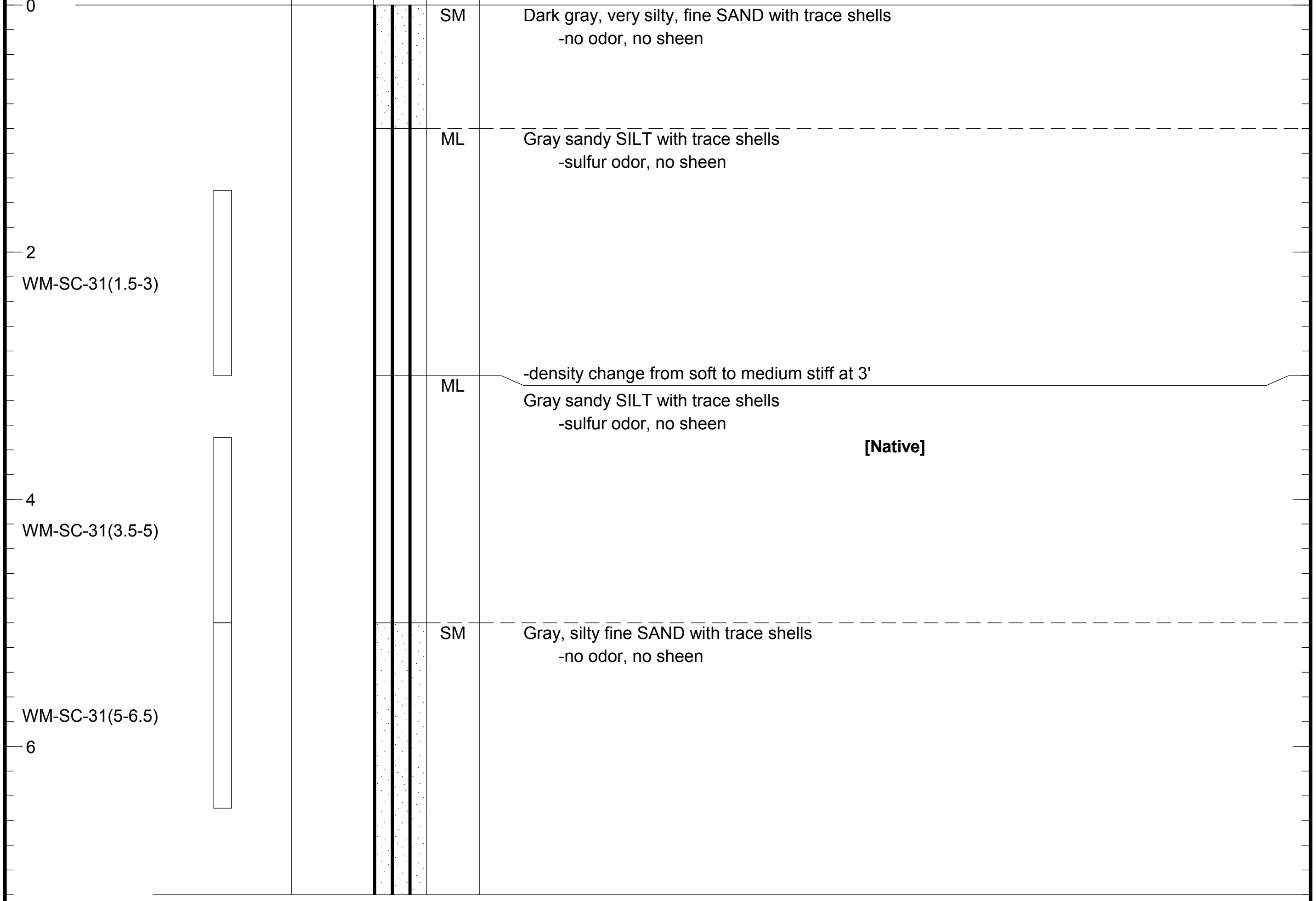
Figure
C-52

WM-SC-31

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	

Coring Method: Vibracorer

Elevation (ft): -13.5



Depth (ft)	USCS Symbol	Sediment Description
0	SM	Dark gray, very silty, fine SAND with trace shells -no odor, no sheen
	ML	Gray sandy SILT with trace shells -sulfur odor, no sheen
		-density change from soft to medium stiff at 3'
	ML	Gray sandy SILT with trace shells -sulfur odor, no sheen **[Native]**
	SM	Gray, silty fine SAND with trace shells -no odor, no sheen

Coring Completed 12/16/14
Core logged and sampled by EHI on 12/16/2014
Total Penetration = 7.2 ft.
Recovery = 6.1 ft.
Compaction Factor = 0.85

8

10

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Sediment Core WM-SC-31

Figure
C-53

WM-SC-32

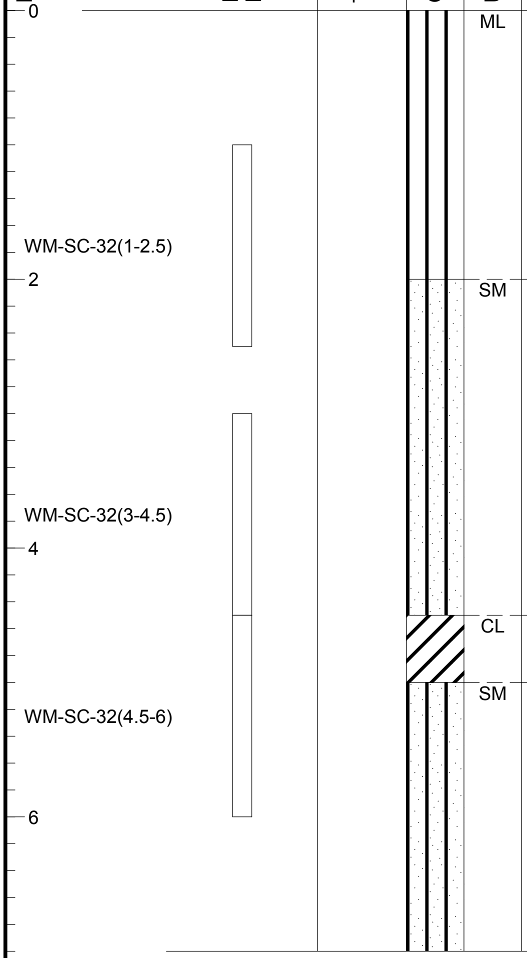
SAMPLE DATA

SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): -13.9

In situ Sample Interval (ft):
- WM-SC-32(1-2.5)
- WM-SC-32(3-4.5)
- WM-SC-32(4.5-6)



USCS Symbol	Sediment Description
ML	Dark gray, very sandy SILT with wood debris and trace shells -sulfur odor, no sheen
SM	Dark gray, silty fine SAND with shells and trace wood debris -sulfur odor, no sheen
CL	Gray CLAY with trace shells -no odor, no sheen
SM	Gray, silty fine to medium SAND -no odor, no sheen

Coring Completed 12/16/14
Core logged and sampled by EHI on 12/16/2014
Total Penetration = 7.0 ft.
Recovery = 6.2 ft.
Compaction Factor = 0.89

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Sediment Core WM-SC-32

Figure
C-54

WM-SC-33

SAMPLE DATA

SEDIMENT DESCRIPTION

Coring Method: Vibracorer

Elevation (ft): -14.0

Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	
0				ML	Dark gray, SILT with sand and trace wood debris and shells -sulfur odor, no sheen
2	WM-SC-33(1-2.5) WM-SC-33(2.5-4)				
4	WM-SC-33(4.5-6)			SM	Dark gray, silty fine SAND with trace shells -no odor, no sheen
6				CL	Gray CLAY -no odor, no sheen
8					
10					

Coring Completed 12/16/14
Core logged and sampled by EHI on 12/16/2014
Total Penetration = 7.2 ft.
Recovery = 6.7 ft.
Compaction Factor = 0.93

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" for explanation of graphics and symbols.

LANDAU ASSOCIATES

Westman Marine
Blaine, Washington

Log of Sediment Core WM-SC-33

Figure
C-55

APPENDIX D

Bathymetric Survey Data – 1997 and 2012

General Notes:

1) Horizontal Datum = Washington State Plane Coordinates, North Zone NAD 83
2) Vertical Datum: MLLW = 0.0ft
3) Basemap information provided by Walker and Assoc. Dated April 19, 1993
4) Drayton Harbor Bathymetric survey provided by Blue Water Engineering 10/19/95.
5) See Section 3.03A of Specifications for Demolition and Preparatory Work.

I: \PROJECTS\H146OO1O\DWGS\DEMO_1. DWG
PLOT/UPDATE: JUN 18 1998 07: 39: 39

HARTMAN CONSULTING CORPORATION

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HOUSTON	(713) 783-2201
SAN FRANCISCO	(415) 771-8950

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DRAWN BY: BGH 8/497
DESIGNED BY: REW 8/4/97
APPROVED BY: GLH 8/4/97
HCG FILE: Demo_1
DATE: 8/4/97

BLAINE HARBOR DREDGING PROJECT

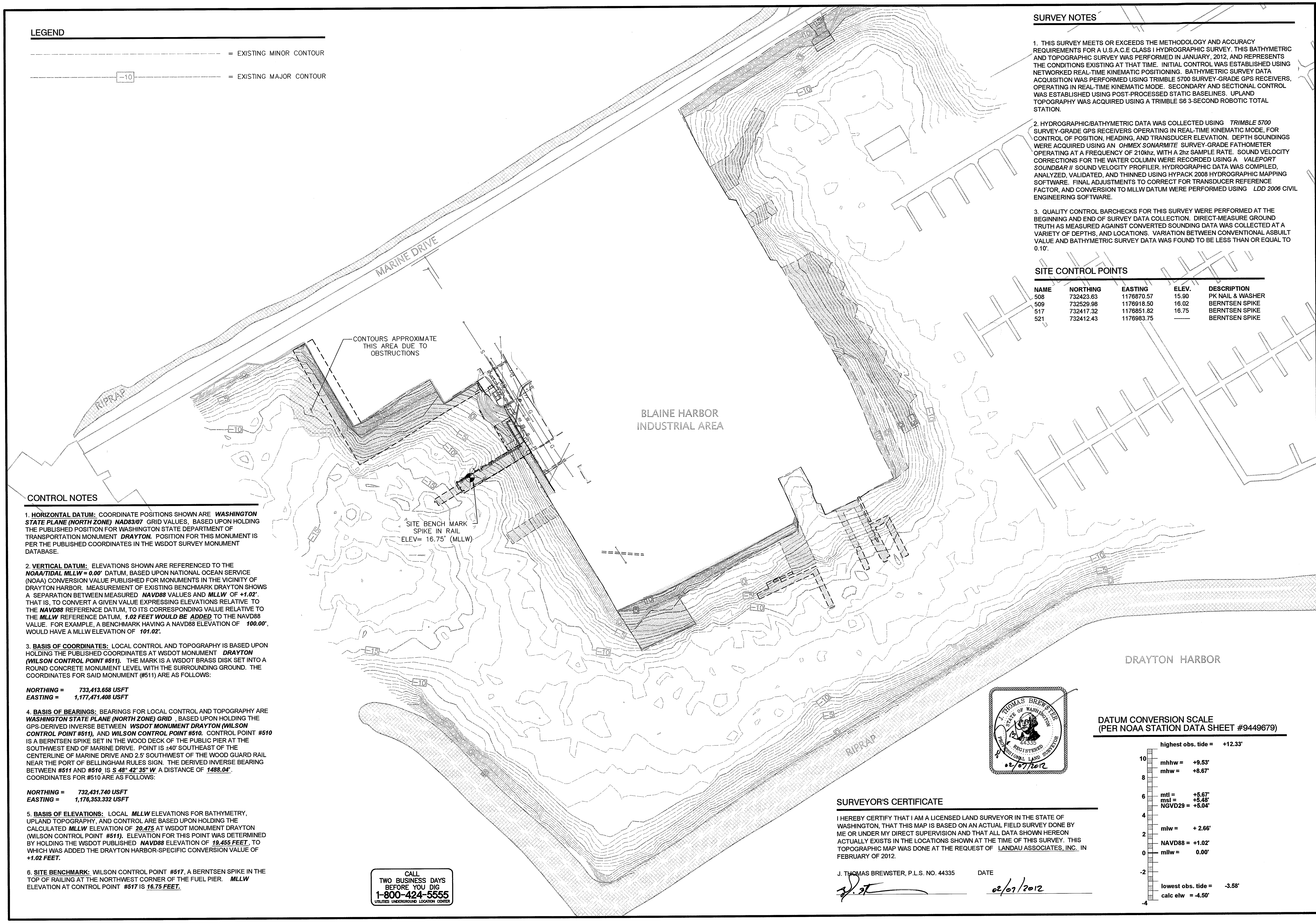
DEMOLITION AND PREPARATORY WORK PLAN VIEW

DRAWING NO. 2
HCG PROJECT NO. 94-146
SHEET NO. 2 OF 6

LEGEND

- - - - - - - - - - - - = EXISTING MINOR CONTOUR

———————— −10 ———— = EXISTING MAJOR CONTOUR



SURVEY NOTES

1. THIS SURVEY MEETS OR EXCEEDS THE METHODOLOGY AND ACCURACY REQUIREMENTS FOR A U.S.A.C.E CLASS I HYDROGRAPHIC SURVEY. THIS BATHYMETRIC AND TOPOGRAPHIC SURVEY WAS PERFORMED IN JANUARY, 2012, AND REPRESENTS THE CONDITIONS EXISTING AT THAT TIME. INITIAL CONTROL WAS ESTABLISHED USING NETWORKED REAL-TIME KINEMATIC POSITIONING. BATHYMETRIC SURVEY DATA ACQUISITION WAS PERFORMED USING TRIMBLE 5700 SURVEY-GRADE GPS RECEIVERS, OPERATING IN REAL-TIME KINEMATIC MODE. SECONDARY AND SECTIONAL CONTROL WAS ESTABLISHED USING POST-PROCESSED STATIC BASELINES. UPLAND TOPOGRAPHY WAS ACQUIRED USING A TRIMBLE S6 3-SECOND ROBOTIC TOTAL STATION.

2. HYDROGRAPHIC/BATHYMETRIC DATA WAS COLLECTED USING *TRIMBLE 5700* SURVEY-GRADE GPS RECEIVERS OPERATING IN REAL-TIME KINEMATIC MODE, FOR CONTROL OF POSITION, HEADING, AND TRANSDUCER ELEVATION. DEPTH SOUNDINGS WERE ACQUIRED USING AN *OHMEX SONARMITE* SURVEY-GRADE FATHOMETER OPERATING AT A FREQUENCY OF 210khz, WITH A 2hz SAMPLE RATE. SOUND VELOCITY CORRECTIONS FOR THE WATER COLUMN WERE RECORDED USING A *VALEPORT SOUNDBAR II* SOUND VELOCITY PROFILER. HYDROGRAPHIC DATA WAS COMPILED, ANALYZED, VALIDATED, AND THINNED USING HYPACK 2008 HYDROGRAPHIC MAPPING SOFTWARE. FINAL ADJUSTMENTS TO CORRECT FOR TRANSDUCER REFERENCE FACTOR, AND CONVERSION TO MLLW DATUM WERE PERFORMED USING *LDD 2006* CIVIL ENGINEERING SOFTWARE.

3. QUALITY CONTROL BARCHECKS FOR THIS SURVEY WERE PERFORMED AT THE BEGINNING AND END OF SURVEY DATA COLLECTION. DIRECT-MEASURE GROUND TRUTH AS MEASURED AGAINST CONVERTED SOUNDING DATA WAS COLLECTED AT A VARIETY OF DEPTHS, AND LOCATIONS. VARIATION BETWEEN CONVENTIONAL ASBUILT VALUE AND BATHYMETRIC SURVEY DATA WAS FOUND TO BE LESS THAN OR EQUAL TO 0.10'.

SITE CONTROL POINTS

NAME	NORTHING	EASTING	ELEV.	DESCRIPTION
508	732423.63	1176870.57	15.90	PK NAIL & WASHER
509	732529.98	1176918.50	16.02	BERNTSEN SPIKE
517	732417.32	1176851.82	16.75	BERNTSEN SPIKE
521	732412.43	1176983.75	———	BERNTSEN SPIKE

CONTROL NOTES

1. **<u>HORIZONTAL DATUM:</u>** COORDINATE POSITIONS SHOWN ARE ***WASHINGTON STATE PLANE (NORTH ZONE) NAD83/07*** GRID VALUES, BASED UPON HOLDING THE PUBLISHED POSITION FOR WASHINGTON STATE DEPARTMENT OF TRANSPORTATION MONUMENT ***DRAYTON.*** POSITION FOR THIS MONUMENT IS PER THE PUBLISHED COORDINATES IN THE WSDOT SURVEY MONUMENT DATABASE.

2. **<u>VERTICAL DATUM:</u>** ELEVATIONS SHOWN ARE REFERENCED TO THE ***NOAA/TIDAL MLLW = 0.00'*** DATUM, BASED UPON NATIONAL OCEAN SERVICE (NOAA) CONVERSION VALUE PUBLISHED FOR MONUMENTS IN THE VICINITY OF DRAYTON HARBOR. MEASUREMENT OF EXISTING BENCHMARK DRAYTON SHOWS A SEPARATION BETWEEN MEASURED ***NAVD88*** VALUES AND ***MLLW*** OF ***+1.02'***. THAT IS, TO CONVERT A GIVEN VALUE EXPRESSING ELEVATIONS RELATIVE TO THE ***NAVD88*** REFERENCE DATUM, TO ITS CORRESPONDING VALUE RELATIVE TO THE ***MLLW*** REFERENCE DATUM, ***1.02 FEET WOULD BE <u>ADDED</u>*** TO THE NAVD88 VALUE. FOR EXAMPLE, A BENCHMARK HAVING A NAVD88 ELEVATION OF ***100.00'***, WOULD HAVE A MLLW ELEVATION OF ***101.02'.***

3. **<u>BASIS OF COORDINATES:</u>** LOCAL CONTROL AND TOPOGRAPHY IS BASED UPON HOLDING THE PUBLISHED COORDINATES AT WSDOT MONUMENT ***DRAYTON (WILSON CONTROL POINT #511).*** THE MARK IS A WSDOT BRASS DISK SET INTO A ROUND CONCRETE MONUMENT LEVEL WITH THE SURROUNDING GROUND. THE COORDINATES FOR SAID MONUMENT (#511) ARE AS FOLLOWS:

NORTHING = 733,413.658 USFT
EASTING = 1,177,471.408 USFT

4. **<u>BASIS OF BEARINGS:</u>** BEARINGS FOR LOCAL CONTROL AND TOPOGRAPHY ARE ***WASHINGTON STATE PLANE (NORTH ZONE) GRID*** , BASED UPON HOLDING THE GPS-DERIVED INVERSE BETWEEN ***WSDOT MONUMENT DRAYTON (WILSON CONTROL POINT #511),*** AND ***WILSON CONTROL POINT #510.*** CONTROL POINT ***#510*** IS A BERNTSEN SPIKE SET IN THE WOOD DECK OF THE PUBLIC PIER AT THE SOUTHWEST END OF MARINE DRIVE. POINT IS ±40' SOUTHEAST OF THE CENTERLINE OF MARINE DRIVE AND 2.5' SOUTHWEST OF THE WOOD GUARD RAIL NEAR THE PORT OF BELLINGHAM RULES SIGN. THE DERIVED INVERSE BEARING BETWEEN ***#511*** AND ***#510*** IS ***<u>S 48° 42' 35" W</u>*** A DISTANCE OF ***<u>1488.04'</u>***. COORDINATES FOR #510 ARE AS FOLLOWS:

NORTHING = 732,431.740 USFT
EASTING = 1,176,353.332 USFT

5. **<u>BASIS OF ELEVATIONS:</u>** LOCAL ***MLLW*** ELEVATIONS FOR BATHYMETRY, UPLAND TOPOGRAPHY, AND CONTROL ARE BASED UPON HOLDING THE CALCULATED ***MLLW*** ELEVATION OF ***<u>20.475</u>*** AT WSDOT MONUMENT DRAYTON (WILSON CONTROL POINT ***#511).*** ELEVATION FOR THIS POINT WAS DETERMINED BY HOLDING THE WSDOT PUBLISHED ***NAVD88*** ELEVATION OF ***<u>19.455 FEET</u>***, TO WHICH WAS ADDED THE DRAYTON HARBOR-SPECIFIC CONVERSION VALUE OF ***+1.02 FEET.***

6. **<u>SITE BENCHMARK:</u>** WILSON CONTROL POINT ***#517***, A BERNTSEN SPIKE IN THE TOP OF RAILING AT THE NORTHWEST CORNER OF THE FUEL PIER. ***MLLW*** ELEVATION AT CONTROL POINT ***#517*** IS ***<u>16.75 FEET.</u>***

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STATE OF WASHINGTON
44335
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PROFESSIONAL LAND SURVEYOR
02/07/2012

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT I AM A LICENSED LAND SURVEYOR IN THE STATE OF WASHINGTON, THAT THIS MAP IS BASED ON AN ACTUAL FIELD SURVEY DONE BY ME OR UNDER MY DIRECT SUPERVISION AND THAT ALL DATA SHOWN HEREON ACTUALLY EXISTS IN THE LOCATIONS SHOWN AT THE TIME OF THIS SURVEY. THIS TOPOGRAPHIC MAP WAS DONE AT THE REQUEST OF <u>LANDAU ASSOCIATES, INC.</u> IN FEBRUARY OF 2012.

J. THOMAS BREWSTER, P.L.S. NO. 44335 DATE

02/07/2012

DATUM CONVERSION SCALE
(PER NOAA STATION DATA SHEET #9449679)

highest obs. tide = +12.33'
mhhw = +9.53'
mhw = +8.67'
mtl = +5.67'
msl = +5.48'
NGVD29 = +5.04'
mlw = + 2.66'
NAVD88 = +1.02'
mllw = 0.00'
lowest obs. tide = -3.58'
calc elw = -4.50'

10 8 6 4 2 0 -2 -4

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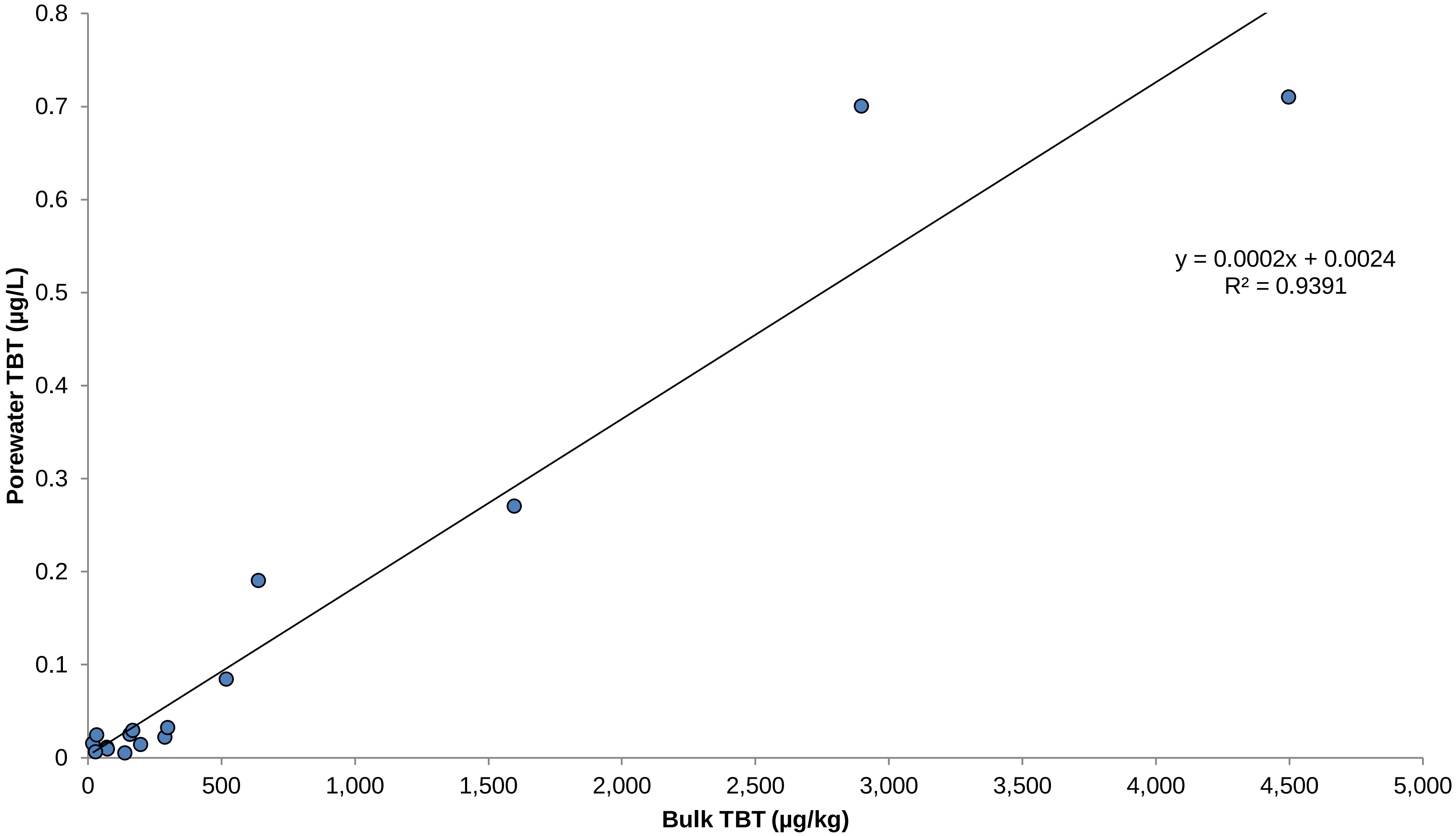
DESIGNED BY
DRAWN BY JGS/AKM
CHECKED BY JTB

LANDAU & ASSOC.
BLAINE WASHINGTON
BLAINE HARBOR
BATHYMETRIC SURVEY EXHIBIT MAP

DATE 02-07-2012
SCALE AS SHOWN
JOB NUMBER 2011-105
SHEET 1 OF 1

APPENDIX E

Correlating Bulk and Porewater Results for Tributyltin



Graph shows the correlation of tributyltin results in sediment samples analyzed using two methods: porewater and bulk analyses. Data used in developing the correlation are presented in Table E-1.

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Porewater and Bulk Tributyltin Concentration – Correlation

Figure
E-1

TABLE E-1
BULK AND POREWATER TRIBUTYLTIN CORRELATIONS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Sample Name	Date	Bulk Organotins (µg/kg-dry wt)	Porewater Organotins (µg/L)
WM-SG-01	10/08/2013	4,500	0.71
WM-SG-02	10/08/2013	520	0.084
WM-SG-03	10/08/2013	1,600	0.27
WM-SG-04	10/08/2013	72	0.011
WM-SG-05	10/08/2013	290 J	0.022
WM-SG-DUP*	10/08/2013	160 J	0.025
WM-SG-06	10/08/2013	74	0.009
WM-SG-07	10/08/2013	140	0.005 J
WM-SG-08	10/08/2013	300	0.032
WM-SG-09	10/08/2013	20	0.015
WM-SG-10	10/08/2013	640	0.19
WM-SG-11	10/08/2013	200	0.014
WM-SG-12	10/08/2013	34	0.024
WM-SG-13	10/08/2013	170	0.029
WM-SG-14	10/08/2013	2,900	0.70
WM-SG-15	10/08/2013	31	0.006

*Duplicate of WM-SG-05.
µg/kg = Micrograms per kilogram.
µg/L = Micrograms per liter.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

APPENDIX F

Report:
Development of Sediment Risk-Based Screening Levels

Report
Development of Sediment Risk-Based Screening Levels
Westman Marine Site
Blaine, Washington

April 13, 2015

Prepared for

Port of Bellingham
Bellingham, Washington

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

TABLE OF CONTENTS

TABLES

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LIST OF ABBREVIATIONS AND ACRONYMS

µg/kg	Micrograms per Kilogram
BAF	Bioaccumulation Factor
BSAF	Biota-Sediment Accumulation Factor
CL	Cleanup Level
CR	Cancer Risk
CSL	Cleanup Screening Level
COPC	Constituent of Potential Concern
cPAH	Carcinogenic Polycyclic Aromatic Hydrocarbon
CPF	Cancer Potency Factor
Ecology	Washington State Department of Ecology
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
FCR	Fish Consumption Rate
g/day	Grams per Day
HQ	Hazard Quotient
km^2	Square Kilometers
mg/kg	Milligrams per Kilogram
PCB	Polychlorinated Biphenyl
ppt	Parts per Trillion
PQL	Practical Quantitation Limit
RBC	Risk-Based Concentration
RfD	Reference Dose
RI	Remedial Investigation
SCO	Sediment Cleanup Objective
SCUM II	Draft Sediment Cleanup Users Manual II
Sfoc	Fraction of Organic Carbon in Sediment
Site	Westman Marine Site
SL	Screening Level
SLf	Shellfish Lipid Fraction
SMS	Sediment Management Standards
SQO	Sediment Quality Objective
SUF	Site Use Factor
TBT	Tributyltin
TEF	Toxicity Equivalency Factor
TEQ	Toxicity Equivalency Quotient

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1.0 INTRODUCTION

This appendix discusses the development of screening levels (SLs) protective of human health and higher trophic-level species in accordance with Sediment Management Standards (SMS) for the Westman Marine Site (Site) in Blaine, Washington. In the following sections, Sediment Cleanup Objectives (SCOs) and Cleanup Screening Level (CSLs) are developed for persistent bioaccumulative toxins (PBTs) in consideration of food chain effects resulting from their bioaccumulative properties. While the SMS provides numerical SQO and CSL criteria for protection of benthic organisms that are also intended to be protective of human health and the environment for most contaminants, they may not be adequately protective of human health for PBTs. As a result, the SMS requires that cleanup levels be developed for PBTs that specifically address the risk to human health and higher trophic-level species. The remedial investigation (RI) indicated that a number of PBTs are present in sediment at the Site that require development of SQO and CSL criteria protective of human health and higher trophic-level species.

The SMS has a two-tiered approach to setting sediment cleanup levels (CLs) for PBTs. Site PBT SLs, as described within this appendix, were developed consistent with this two-tiered approach and in accordance with guidance provided by the Washington State Department of Ecology (Ecology) in the Draft Sediment Cleanup Users Manual II (SCUM II; Ecology 2013). Using this approach, an SCO (the lower-bound criteria), and a CSL (the upper-bound criteria) were developed to be protective of the most sensitive receptor group among the benthic community, higher trophic-level species, and humans for each PBT.

The SCO is initially set at the highest value of 1) natural background concentrations, 2) the analytical practical quantitation limit (PQL), or 3) risk-based concentrations (RBCs) protective of the benthic community, upper trophic-level species, and human health. The CSL is initially set at the highest value of 1) regional background concentration, 2) PQL, or 3) RBCs (protective of the benthic community, upper trophic-level species, and human health). The SL may be adjusted upward from the initial SCO based on factors such as technical feasibility or net adverse impacts on the aquatic environment; however, it may not be adjusted above the CSL.

The SMS provides tabulated SCO and CSL values protective of the benthic community, which are presented in the RI report text for evaluating sediment contaminants that are not considered PBT. SCO or CSL criteria protective of humans and higher trophic-level species are not provided by Ecology; these criteria were calculated with a mix of standard and Site-specific input parameters, as described below.

For the purposes of this evaluation, the following constituents are considered Site PBTs for marine sediment based on their detection in marine sediment samples collected during the RI:

- Polychlorinated biphenyls (PCBs)
- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)

- Tributyltin (TBT)
- Metals (arsenic, cadmium, lead, and mercury).

2.0 BACKGROUND AND PRACTICAL QUANTITATION LIMIT CONCENTRATIONS

This section presents background and PQL concentrations that will be used in evaluating SLs. For PCBs, cPAHs, and TBT, RBCs were calculated to provide protection for upper trophic-level species and humans. The RBCs were compared to the PQL and natural background concentrations (for the SCO) and to the PQL and regional background concentrations (for the CSL). Regional background concentrations are not yet available for the Site vicinity, so CSLs were developed using natural background concentrations in lieu of regional background concentrations.

For the PBT metals (arsenic, cadmium, lead, and mercury), natural background concentrations were selected as the SCO and the CSL (since there are no regional background concentrations available). In accordance with SCUM II guidance (Ecology 2013), with this selection, further development of RBCs is not required for these compounds. Table F-1 presents the natural background and PQL concentrations for Site PBTs.

3.0 RISK-BASED CONCENTRATIONS

For PCBs, cPAHs, and TBT, the RBCs were developed to be protective of human health based on the following considerations:

- Site exposure pathways
- Site exposure scenarios
- Acceptable health risk.

Parameters that describe the exposure pathways and the acceptable health risk were used with Ecology-provided equations to calculate the RBCs of constituents of potential concern (COPCs) in sediment. These parameters are described below and parameter values used in the development of RBCs are provided in Table F-2.

3.1 EXPOSURE PATHWAYS

Exposure pathways may include absorption through the skin or ingestion of sediment during beach activities (direct contact/incidental ingestion) or exposure through bioaccumulation of contaminants through the food chain (seafood consumption). Based on the depth to marine sediment at the Site (below the maximum low water elevation) and the nature of current and future Site use (commercial/industrial), there is no direct access by humans to Site marine sediment, and the only complete exposure pathway from sediment to humans is seafood consumption. The Site does not provide access for clamming, and since clams are relatively immobile, it is not expected that clams caught outside of the harbor would have been exposed to contaminants at the Site. Although fishing within the Harbor is not likely a common occurrence, some seafood species may include the harbor as a part of their home range, but then are caught outside of the harbor. As a result, human consumption of seafood is considered a reasonable exposure pathway and is considered further below.

3.2 EXPOSURE SCENARIOS

Exposure scenarios include identifying the most highly exposed population and the appropriate parameters that describe their exposure. For the Site, the tribal subsistence fishing population (the local Lummi tribe) is used as the most conservative assumption, and exposure is considered to occur through seafood consumption. Based on the exposure pathways described above, seafood consumption includes finfish (excluding salmon, which are not expected to spend a significant part of their lifetime in the harbor) and crustaceans [80 grams per day (g/day) and 36 g/day, respectively, based on the 90th percentile; Lummi Nation 2012]. The average body weight of adults in the Lummi Tribe is 82.6 kg (Lummi Nation 2012).

Ecology default values were used for the remaining exposure pathway scenario parameters. All values are provided in Table F-2.

3.3 ACCEPTABLE HEALTH RISK

Acceptable health risk for individual PBTs is based on a number of Site- or chemical-specific factors, described below. These factors include the following:

3.3.1 CANCER RISK AND/OR HAZARD QUOTIENT

For carcinogens, the acceptable cancer risk (CR) is a unitless value that represents the risk that a contaminant concentration will result in cancer developing in a population for a specific exposure scenario. For both non-carcinogens and carcinogens (which may have a threshold toxicity in addition to their potential to cause cancer), the hazard quotient (HQ) is a unitless value that represents the threshold at which toxic effects will occur in a population.

Carcinogenic substance risks are calculated based on the likelihood of developing cancer, based on an exposure duration of 70 years, averaged over a 75-year lifetime. For individual carcinogenic substances, RBCs were developed for a CR within the range of 1 in 1 million ($1\text{x}10^{-6}$, the lower bound) to 1 in 100,000 ($1\text{x}10^{-5}$, the upper bound). For the RI, the SCOs for PBTs were developed for individual carcinogens using the lower-bound CR value ($1\text{x}10^{-6}$), and the upper-bound CR value ($1\text{x}10^{-5}$) was used to develop the CSL.

3.3.2 CANCER POTENCY FACTOR AND/OR REFERENCE DOSE

Cancer potency is quantified with the cancer potency factor (CPF), representing an upper-confidence limit on the increased CR over a lifetime of exposure. CPF values for each COPC were taken from Ecology's CLARC database (Ecology website 2015), as presented in Table F-3.

Non-carcinogenic substance risks were calculated based on the concept of an HQ. Non-carcinogenic contaminants must reach a threshold concentration, known as the reference dose (RfD) to have adverse health effects. The HQ is the ratio of a substance over a specified exposure period to the RfD for that substance over the same exposure period. An HQ of 1 would indicate that the threshold for adverse health effects has been reached; therefore, any ratio less than 1 would indicate that no deleterious effects would be expected. Carcinogenic substances may also have a threshold toxicity in addition to causing cancer, and non-carcinogenic risks were also calculated for carcinogenic substances. RfD values for each COPC were taken from Ecology's CLARC database (Ecology website 2015).

3.3.3 SITE USE FACTOR

An organism may spend only part of its life in the vicinity of contaminated sediment at a site. The site use factor (SUF) is meant to quantify the amount of time that an organism is potentially exposed to contaminated sediment. The marine portion of the Site, for the purposes of developing PBT SLs, is conservatively assumed to be the entirety of Blaine Harbor [about 0.2 square kilometers (km^2)] for calculation of the SUF. Based on an assumed home range of 10 km^2 for finfish (excluding salmon) and mobile crustaceans, the SUF was set to 0.02 or 2 percent.

3.3.4 BIOTA-SEDIMENT ACCUMULATION FACTOR

The PBTs considered in this evaluation bioaccumulate at variable rates. The bioaccumulation of contamination in organisms affected by marine sediment can be quantified as either a biota-sediment accumulation factor (BSAF) for non-polar organic contaminants or a bioaccumulation factor (BAF) for polar or metal contaminants. The BSAF is the lipid-normalized contaminant concentration in tissue divided by the organic carbon–normalized concentration in sediment. The BSAF is used for contaminants with generally high octanol/water partition coefficients (K_{ow}), which are hydrophobic and are preferentially distributed to lipids in organisms.

BSAF values were obtained from the U.S. Environmental Protection Agency Office of Research and Development BSAF database (EPA website 2015) and the U.S. Army Corps of Engineers Environmental Research Development Center BSAF database (USACE website). Mean BSAF values were calculated from listed BSAF values from whole body tissue samples, for the types of species represented in each calculation (finfish or crustaceans). Finfish species used were the brown bullhead catfish (*Ictalurus nebulosus*), channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), white catfish (*Ictalurus catus),* and white sucker (*Catostomus commersoni*). Crustacean species included any crabs, shrimp, and/or crayfish. When BSAF values were not available for finfish or crustaceans, the mean BSAF was calculated from a species more heavily affected than either finfish or crustaceans, which resulted in a much more conservative estimate of the BSAF. BSAF values were screened for potential outliers with the ProUCL (EPA website 2013) program and outliers were removed. BSAF values are shown in Table F-4.

3.3.5 BIOACCUMULATION FACTOR

The BAF is the concentration of contaminants in an organism divided by the concentration of contaminants in sediment. The BAF is used for polar contaminants and for metals where the BSAF is not appropriate. For the PBT metals of potential concern (arsenic, cadmium, lead, and mercury), natural background concentrations are expected to be higher than RBCs. Therefore, the Site SLs for PBT metals were set at the highest value between the PQL and natural background concentration. And in accordance with SCUM II guidance (Ecology 2013), it is not necessary to calculate RBC values if using this approach, so BAF values were not identified.

3.3.6 FISH/SHELLFISH LIPID FRACTION

Lipid content in organisms is quantified with the fish/shellfish lipid fraction (SLf). For calculations herein, the SLf was assumed to be 0.03 based on the Ecology default value of 0.03 for both finfish and crustaceans.

3.3.7 FRACTION OF ORGANIC CARBON IN SEDIMENT

The bioavailability of contaminants in sediment can also be affected by the fraction of organic carbon in sediment (Sfoc). For Site RBC calculations, the mean organic fraction (0.0156) for surface sediment at the Site was used.

3.4 CALCULATING RISK-BASED CONCENTRATIONS FOR TOXICITY EQUIVALENCY FACTOR-MODIFIED PERSISTENT BIOACCUMULATIVE TOXINS

Each individual cPAH and dioxin-like PCB congener present at the Site varies in extent, cancer potency, and rate of bioaccumulation in aquatic organisms. In order to derive a single carcinogenic-human health RBC for these groups of compounds based on the individual potencies, uptake rates, and toxicity equivalency factors (TEFs), Ecology's default equation (Ecology 2013) was rearranged following the method described below. From this arrangement, Site-specific total excess lifetime cancer risk (ELCR) through seafood consumption (both crustacean and finfish) for dioxin-like PCB congeners as a group ($\mathrm{ELCR}_{\mathrm{PCB\ TEQ}}$) and for cPAHs as a group ($\mathrm{ELCR}_{\mathrm{cPAH\ TEQ}}$) was calculated. These Site-specific ELCRs, along with the target ELCR ($1\mathrm{x}10^{-6}$), were used to generate a Site-specific dioxin-like PCB congener toxicity equivalency quotient (TEQ) RBC and a Site-specific cPAH TEQ RBC, protective of human health.

First, the expected tissue concentration ($C_{a,k}$) of a^{th} individual dioxin-like PCB congener or cPAH in k^{th} seafood type (finfish and crustaceans) was calculated using Equation 1, shown below.

Equation 1

$$C_{a,k} = SL_k \times BSAF_{a,k} \times CsedOC_a \times SUF$$

By multiplying the fish/shellfish lipid fraction (Ecology default 0.03) by the uptake factor (BSAF for a^{th} individual constituent in each k^{th} seafood type), by the average Site concentration of each constituent (carbon-normalized; $CsedOC_a$), and by the time each seafood type is expected to spend at the Site (SUF; 0.02), the expected tissue concentration for each constituent was calculated.

Using the expected finfish and crustacean tissue concentrations of dioxin-like PCB congeners or cPAHs ($C_{a,k}$), the total daily intake (CDI_a) of a^{th} individual congener or cPAH in the summed k^{th} seafood types was calculated using Equation 2, shown below.

Equation 2

$$CDI_a = \sum_{k=1}^{m} \left(\frac{\boldsymbol{C_{a,k}} \times FCR_k \times EF \times ED \times FDF_k}{AT_{cr} \times BW \times UCF} \right)$$

The chronic daily intake of each congener or cPAH included the daily intake of finfish and crustaceans taken together; therefore, the consumption rates (FCR_k) for crustaceans and finfish were expressed as fractions of the total daily seafood consumption rate (1). The fish consumption rate (FCR) for crustaceans was 0.3, while the FCR for finfish was 0.7. All other parameters were set to the Ecology default assumptions, as shown in Table F-2.

Using the potential total daily uptake of each cPAH through seafood consumption, the total excess lifetime cancer risk ($ELCR_a$) for each PCB congener or cPAH compound was calculated using Equation 3, shown below. Oral cancer potency factors ($CPFo_a$) for cPAHs were obtained from the CLARC database (Ecology website 2015) and are based on the toxicity equivalency factor (TEF_a) that is a relative measure of benzo(a)pyrene, the most potent cPAH [$CPFo_{benzo(a)pyrene}$ = 7.3 $(mg/kg\text{-}d)^{-1}$]. Oral cancer potency factors ($CPFo_a$) for dioxin-like PCB congeners were obtained from the SCUM II guidance (Ecology 2013) and are based on the toxicity equivalency factor (TEF_a) that is a relative measure of 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD), the most potent dioxin congener [$CPFo_{2,3,7,8\text{-}TCDD}$ = 130,000 $(mg/kg\text{-}d)^{-1}$]. CPFo data are shown in Table F-3.

Equation 3

$$ELCR_a = CPFo_a \times \boldsymbol{CDI_a}$$

The Site-specific total ELCR for dioxin-like PCB congeners and cPAHs ($ELCR_{PCB\ TEQ}$ and $ELCR_{cPAH\ TEQ}$) were calculated by summing together each a^{th} individual congener or cPAH $ELCR_a$, to the g^{th} number of cPAHs, using Equation 4, shown below.

Equation 4

$$ELCR_{cPAH\ TEQ} = \sum_{a=1}^{g} \boldsymbol{ELCR_a}$$

The RBCs for dioxin-like PCB congeners and cPAHs in sediment ($RBC_{PCB\ TEQ}$ and $RBC_{cPAH\ TEQ}$) were based on the ratio of the SQO target excess lifetime cancer risk ($ELCR_{target} = 1x10^{-6}$) to the Site-specific ELCR ($ELCR_{PCB\ TEQ}$ or $ELCR_{cPAH\ TEQ}$) to the sum of each constituent concentration multiplied by each individual TEF using Equation 5, shown below.

Equation 5

$$RBC_{cPAH\ TEQ} = \frac{ELCR_{Target}}{\boldsymbol{ELCR_{cPAH\ TEQ}}} \times \sum_{a=1}^{g} (Csed_a \times TEF_a)$$

3.5 CALCULATING RISK-BASED CONCENTRATIONS FOR TRIBUTYLTIN AND TOTAL POLYCHLORINATED BIPHENYLS

Because TBT and total PCBs have single BSAFs, single potency factors, and no TEF modifications, RBC calculations are more straightforward using Ecology's default equations. It should be noted that the toxicity data used in developing RBCs for PCB-TEQ are considered preferable to that available for total PCBs (sum of aroclors). The following paragraphs describe the development of RBCs for these constituents.

3.5.1 TRIBUTYLTIN

The RBC for bulk TBT as a non-carcinogen was developed with Ecology's default equation:

$$RBC_{Noncancer} = \left\{ \left(\frac{(HQ \times BW \times AT_{nc} \times RfDo)}{(FCR \times FDF \times EF \times ED\ )} \right) \times \left(\frac{S_{foc}}{SUF \times SL \times BSAF} \right) \right\}$$

Only one BSAF value for TBT was identified from a review of the databases for finfish and crustaceans. Therefore, BSAF values for mollusks were used to calculate a very conservative mean BSAF. Mollusks do not metabolize TBT well, and coupled with their high intake of sediment-based contaminants, they are the most sensitive organism to TBT concentrations in sediment. The mean BSAF value for TBT in mollusks [10.0 grams tissue (lipid-normalized)/grams sediment (organic carbon-normalized)] was calculated from 16 values. One outlier was identified with the ProUCL software and removed.

3.5.2 POLYCHLORINATED BIPHENYLS

The RBC for total PCBs (sum of aroclors) was estimated as a single carcinogen (with one BSAF and one CPFo, unlike PCB congeners) with Ecology's default equation:

$$RBC_{Cancer} = \left\{ \left(\frac{(CR \times BW \times AT_{cr} \times UCF)}{(CPF_{o} \times FCR \times FDF \times EF \times ED)} \right) \times \left(\frac{S_{foc}}{SUF \times SL \times BSAF} \right) \right\}$$

The RBC for total PCBs taken together as a single non-carcinogen was developed with Ecology's default equation:

$$RBC_{Noncancer} = \left\{ \left(\frac{(HQ \times BW \times AT_{nc} \times RfDo)}{(FCR \times FDF \times EF \times ED)} \right) \times \left(\frac{S_{foc}}{SUF \times SL \times BSAF} \right) \right\}$$

The mean BSAF value for PCBs in finfish (2.73) was calculated from 47 values for finfish. One outlier was identified with the ProUCL software and removed. The mean BSAF for PCBs in crustaceans (1.69) was calculated from 27 values for crabs and other crustaceans. One outlier was identified with the ProUCL software and removed. The remaining parameters were set to the Ecology default assumptions, except as described above and as shown in Table F-2.

4.0 PERSISTENT BIOACCUMULATIVE TOXIN SEDIMENT CLEANUP OBJECTIVE AND CLEANUP SCREENING LEVEL VALUES

SLs were developed for PBTs present in Site sediment based on the calculations and evaluations presented in the previous sections. Table F-5 presents the criteria used to select the SQO and CSLs for the Site, and the selected values. The following sections discuss the bases for selecting the PBT SLs presented in Table F-5.

4.1 METALS

As noted above, for the PBT metals of potential concern (arsenic, cadmium, lead, and mercury), the Site SL were set at the natural background concentrations. Thus, both the SQO and CSL for PBT metals were established at natural background concentrations, as follows:

- Arsenic = 11 milligram per kilogram (mg/kg)
- Cadmium = 1 mg/kg
- Lead = 21 mg/kg
- Mercury = 0.2 mg/kg.

4.2 TOTAL POLYCHLORINATED BIPHENYLS

The lowest RBC SCO value calculated for total PCB aroclors was 5.3 micrograms per kilogram (µg/kg), protective of human health through consumption of seafood based on an excess cancer risk of $1x10^{-6}$. This RBC is above the natural background concentration of 3.5 µg/kg, but lower than the analytical method PQL of 6 µg/kg, so the SCO for total PCBs was set at 6 µg/kg. The CSL was set at the highest value of 1) regional background, 2) PQL, or 3) RBCs (protective of the benthic community, upper trophic-level species, or human-health). Since no regional background concentrations are available for total PCBs, the CSL was set at the upper-bound RBC of 53 µg/kg based on a $1x10^{-5}$ excess cancer risk for protection of human health through consumption of seafood. Thus, the SLs for total PCBs are:

- SCO = 6 µg/kg
- CSL = 53 µg/kg.

4.3 DIOXIN-LIKE POLYCHLORINATED BIPHENYLS

The lowest RBC calculated for the PCB-TEQ for dioxin-like congeners was 0.18 parts per trillion (ppt), protective of human health through consumption of seafood. This RBC is just below the natural background concentration of 0.2 ppt and above the PQL of 0.052 ppt (using the sum of PQL goals for each of the dioxin-like PCB congeners from SCUM II multiplied by the associated TEFs). Therefore, the SCO for PCB-TEQ was set at 0.2 ppt. The CSL was set at the upper-bound RBC of 2 ppt based on an excess cancer risk of $1\text{x}10^{-5}$, protective of human health for consumption of seafood. The SLs for PCB-TEQ are:

- SCO = 0.2 ppt
- CSL = 2 ppt.

4.4 CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS

The lowest RBC calculated for cPAHs was 40 µg/kg, protective of human health through consumption of finfish. No table value for total cPAHs protective of the benthic community is available for comparison. This RBC is higher than the natural background concentration (16 µg/kg) and PQL (0.76 µg/kg), and was therefore set as the SCO. Since no regional background concentrations are available for total cPAHs, the CSL was set at the upper-bound RBC of 400 µg/kg based on an excess cancer risk of $1\text{x}10^{-5}$, protective of human health through consumption of seafood. The SLs for total cPAHs are:

- SCO = 40 µg/kg
- CSL = 400 µg/kg.

4.5 TRIBUTYLTIN

The lowest RBC calculated for bulk TBT was 822 µg/kg. This value is higher and less protective than the Site-specific SCO for protection of the benthic community of 238 µg/kg. As a result, the lower and more conservative value of 238 µg/kg was selected as the SCO and the Site-specific value of 738 µg/kg was selected as the CSL. The SLs for TBT are:

- SCO = 238 µg/kg
- CSL = 738 µg/kg.

5.0 USE OF THIS REPORT

This report has been prepared for the use of the Port of Bellingham and the Washington State Department of Ecology for specific application to the Westman Marine Site. The reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Jeremy M. Davis
Associate

SDS/CO/JMD/ccy
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6.0 REFERENCES

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TABLE F-1
BACKGROUND AND PRACTICAL QUANTITATION LIMIT CONCENTRATIONS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Natural Background (a)	PQL (b)	Units
Polychlorinated biphenyls (Total)	3.5	6	µg/kg
Polychlorinated biphenyls - TEQ	0.2	0.052	ppt
Carcinogenic polycyclic aromatic hydrocarbons - TEQ	16	0.76	µg/kg
Tributyltin	-	2.11	µg/kg
Arsenic	11	4.1	mg/kg
Cadmium	1	0.49	mg/kg
Lead	21	4.54	mg/kg
Mercury	0.2	0.067	mg/kg

(a) Adapted from SCUM II Table 11-1 (Ecology 2013).

(b) Adapted from SCUM II Table F-1; Average PQLs (Ecology 2013).

PQL = Practical Quantitation Limit

TEQ = Toxicity Equivalency Quotient

µg/kg = Micrograms per kilogram

ppt = Parts per trillion

mg/kg = Milligrams per kilogram

TABLE F-2
RISK-BASED CONCENTRATION – CALCULATION PARAMETERS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Symbol	Units	Value
Cancer Risk	CR	unitless	1.00E-06
Hazard Quotient	HQ	unitless	1
Body Weight	BW	kg	82.6 (a)
Averaging Time-Carcinogen	AT_{Cr}	days	27,375
Averaging Time-Non-Carcinogen	AT_{Nc}	days	27,375
Unit Conversion Factor	UCF	g/kg	1,000
Exposure Frequency	EF	days/yr	365
Exposure Duration	ED	years	70
Fish/Shelffish Consumption Rate (finfish) (b)	FCR	g/day	84 (a)
Fish/Shelffish Consumption Rate (crustaceans)	FCR	g/day	36 (a)
Fish/Shellfish Diet Fraction	FDF	proportion	1
Fraction of Organic Carbon in Sediment	Sfoc	gram/gram	0.0156
Site Use Factor	SUF	proportion	0.02
Fish/Shellfish Lipid Fraction	SL	gram/gram	0.03

(a) Lummi Tribe (Lummi Nation 2012)

(b) Excluding salmon, which are not expected to spend a significant portion of their life in Blaine Harbor in comparison to their large home

TABLE F-3
CANCER POTENCY FACTORS AND TOXICITY EQUIVALENCY FACTORS
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Carcinogenic Polycyclic Aromatic Hydrocarbons			
Chemical	**CAS**	**CPFo**	**TEF**
Benz(a)anthracene	56-55-3	7.30E-01	1.00E-01
Benzo(a)pyrene	50-32-8	7.30E+00	1.00E+00
Total Fluoranthene	205-99-2	7.30E-01	1.00E-01
Chrysene	218-01-9	7.30E-02	1.00E-02
Dibenz(a,h)anthracene	53-70-3	7.30E-01	1.00E-01
Indeno(1,2,3-cd)pyrene	193-39-5	7.30E-01	1.00E-01

Dioxin-Like Polychlorinated Biphenyls			
Chemical	**CAS**	**CPFo**	**TEF**
PCB 77	32598-13-3	1.30E+01	1.00E-04
PCB 81	70362-50-4	3.90E+01	3.00E-04
PCB 105	32598-14-4	3.90E+00	3.00E-05
PCB 114	74472-37-0	3.90E+00	3.00E-05
PCB 118	31508-00-6	3.90E+00	3.00E-05
PCB 123	65510-44-3	3.90E+01	3.00E-04
PCB 126	57465-28-8	1.30E+04	1.00E-01
PCB 156	38380-08-4	3.90E+00	3.00E-05
PCB 157	69782-90-7	3.90E+00	3.00E-05
PCB 167	52663-72-6	3.90E+00	3.00E-05
PCB 169	32774-16-6	3.90E+03	3.00E-02
PCB 189	39635-31-9	3.90E+00	3.00E-05

Tributytin and Total PCBs		
Chemical	**CAS**	**CPFo / RfDo**
Tributyltin	688-73-3	3.00E-04
Total PCBs	1336-36-3	2.00E+00

CPFo = Cancer Potency Factor

TEF = Toxicity Equivalency Factor

PCB = Polychlorinated biphenyl

RfDo = Reference dose

TABLE F-4
MEAN BIOTA SEDIMENT ACCUMULATION FACTOR VALUES
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Carcinogenic Polycyclic Aromatic Hydrocarbons

Chemical	CAS	Finfish	Crustaceans
Benz(a)anthracene	56-55-3	1.22E-03	1.29E+00
Benzo(a)pyrene	50-32-8	9.52E-04	3.47E-01
Total Fluoranthene	205-99-2	1.17E-03	7.67E-01
Chrysene	218-01-9	1.49E-03	1.26E+00
Dibenz(a,h)anthracene	53-70-3	1.29E-03	1.29E-02
Indeno(1,2,3-cd)pyrene	193-39-5	8.14E-05	5.47E+00

Dioxin-Like Polychlorinated Biphenyls

Chemical	CAS	Finfish	Crustaceans
PCB 77	32598-13-3	3.72E-01	2.43E+00
PCB 81	70362-50-4	4.58E+00	1.92E+00
PCB 105	32598-14-4	1.25E+01	1.67E+00
PCB 114	74472-37-0	2.78E+00	3.29E+00
PCB 118	31508-00-6	6.26E+00	2.27E+00
PCB 123	65510-44-3	1.16E-01	1.47E+00
PCB 126	57465-28-8	7.18E-01	1.99E+00
PCB 156	38380-08-4	5.42E+00	2.61E+00
PCB 157	69782-90-7	1.42E+00	2.61E+00
PCB 167	52663-72-6	7.22E+00	4.58E+00
PCB 169	32774-16-6	4.32E-01	5.04E-01
PCB 189	39635-31-9	6.06E+00	3.85E+00

Tributytin and Total PCBs

Chemical	CAS	Finfish	Crustaceans
Tributyltin	688-73-3	1.00E+01	1.00E+01
Total PCBs	1336-36-3	2.73E+00	1.69E+00

PCB = Polychlorinated biphenyl

BSAF = Biota-Sediment Accumulation Factor

TABLE F-5
SCREENING LEVELS FOR PERSISTENT BIOACCUMULATIVE TOXINS IN SEDIMENT
WESTMAN MARINE SITE – BLAINE, WASHINGTON

Parameter	Natural Background (a)	PQL (b)	Risk-Based SCO	Risk-Based CSL	Benthic SCO	Benthic CSL	Units
Polychlorinated biphenyls (Total)	3.5	6	**6**	**53**	130 (c)	1,000 (c)	µg/kg
Polychlorinated biphenyls - TEQ	0.2	0.052	**0.2**	**2**	-	-	ppt
Carcinogenic polycyclic aromatic hydrocarbons - TEQ	16	0.76	**40**	**400**	-	-	µg/kg
Tributyltin (non-carcinogen)	-	2.11	**822**	**1,920**	**238**	**738**	µg/kg
Arsenic	11	4.1	11	11	57	93	mg/kg
Cadmium	1	0.49	1	1	5.1	6.7	mg/kg
Lead	21	4.54	21	21	450	530	mg/kg
Mercury	0.2	0.067	0.2	0.2	0.41	0.59	mg/kg

(a) Adapted from SCUM II Table 11-1 (Ecology 2013).
(b) Adapted from SCUM II Table F-1; Average PQLs (Ecology 2013).
(c) Adapted Dry Weight Equivalents of SMS criteria - Chapter 173-204 WAC.

µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
ppt = Parts per trillion
CSL = Cleanup Screening Level
PQL = Practical Quantitation Limit
SCO = Sediment Cleanup Objective
SMS = Sediment Management Standards
TEQ = Toxicity Equivalency Quotient
Shaded values selected as Site Screening Levels

APPENDIX G

Data Validation Memoranda

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TECHNICAL MEMORANDUM

TO: Larry Beard, Project Manager

FROM: Anne Halvorsen and Kristi Schultz ASH KES

DATE: March 31, 2015

**RE: GROUNDWATER SAMPLING LABORATORY DATA VERIFICATION AND VALIDATION
WESTMAN MARINE
BELLINGHAM, WASHINGTON**

This technical memorandum provides the results of verification and validation checks of analytical data for 29 groundwater samples and 4 trip blanks collected during sampling events occurring on October 8-9, 2013, April 29-30, and July 7-8, 2014 at the Westman Marine site located in Bellingham, Washington. The samples were collected and analyzed as part of the Westman Marine remedial investigation. All sample analyses were conducted at Analytical Resources, Inc. (ARI) laboratory, located in Tukwila, Washington. This data quality evaluation covers ARI data packages XJ17, XJ62, XM52, YI69, YQ82, YU21, and YU22.

Groundwater samples were analyzed for some or all of the following: organic compounds (VOCs) using U.S. Environmental Protection Agency (EPA) Method SW8260C; semivolatile organic compounds (SVOCs) using EPA Method SW8270D; polycyclic aromatic hydrocarbons (PAHs) using EPA Method SW8270D-SIM; polychlorinated biphenyls (PCBs) using EPA Method SW8082A; petroleum hydrocarbon identification using Washington State Department of Ecology (Ecology)-approved Method NWTPH-HCID; gasoline-range petroleum hydrocarbons (TPH-G) using Method NWTPH-Gx; diesel- and motor oil-range petroleum hydrocarbons (TPH-D) using Method NWTPH-Dx; sulfate and nitrate using EPA Method 300.0; and total and dissolved metals using EPA Methods 200.8 and 7470A.

The verification and validation checks were conducted in accordance with the *Upland Sampling and Analysis Plan, Westman Marine Site, Blaine, Washington* (Landau Associates 2013), and with guidance from applicable portions of the *National Functional Guidelines for Organic Data Review* (EPA 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).

- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below.

LABORATORY DATA PACKAGE COMPLETENESS

Each laboratory data package contained a signed chain-of-custody, a cooler receipt form documenting the condition of the samples upon receipt at the laboratory, a cooler temperature compliance form, sample analytical results, and quality control results (method blanks, surrogate recoveries, laboratory control sample results, and replicate sample results). A case narrative identifying any complications was also provided with each laboratory data package. Definitions of laboratory qualifiers and quality control acceptance criteria were provided, as appropriate.

SAMPLE CONDITIONS AND ANALYSIS

The laboratory received the samples in good condition. Preservation of samples, as specified by the analytical method, was verified by the laboratory and adjusted as appropriate. All analyses were performed as requested, with the following exception:

- The original COC received by the laboratory for samples in data package XJ17 requested dissolved metals analyses for all samples; the client cancelled the request during the analytical process and results for dissolved metals were not reported in data package XJ17.

  Subsequently, the client later re-instated the request for dissolved metals analyses. The laboratory re-logged the samples for analysis for dissolved metals, and inadvertently logged a total metals sample bottle for sample WM-GP-DUP for dissolved metals analysis. Upon client receipt of the analytical results in data package XM52, the wide RPDs for copper and lead between the field duplicate pair samples was questioned and the log-in error was discovered. The laboratory also noted it had dissolved metals analytical results from the original analysis request that was subsequently cancelled.

  The associated results in data package XM52 were flagged as rejected (R), and the original analysis results were reported in a revised version of data package XJ17. No additional qualification of the data was necessary.

Upon receipt by ARI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. One cooler was received with a temperature of 0.1°C, which is below the EPA-recommended lower limit of 2°C. Because the samples were not frozen upon receipt at the laboratory and the samples were submitted to the laboratory within a few hours following sample collection, no qualification was determined necessary due to low cooler temperature.

One cooler was received with a temperature of 9.5°C, which is higher than the EPA-recommended limit of 6°C. Because the samples were placed on ice in the cooler and submitted to a laboratory within a few hours following sample collection, no qualification was determined necessary due to the high cooler temperature.

HOLDING TIMES

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA and project-specified holding times with the following exception:

- Recovery of surrogate d10-fluoranthene associated with the PAHs analyses for several samples and the associated matrix spike/matrix spike duplicate in data package YQ82 was below the laboratory-specified control limits. The laboratory re-extracted and re-analyzed several samples outside the method-recommended holding time with similar results. Both sets of data were included for review by the laboratory; the original set of results should be reported with no qualification necessary.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples. No contamination was detected in any of the method blanks, with the following exceptions:

- Bis(2-ethylhexyl)phthalate was detected in the method blanks associated with the SVOC analyses included in data packages XJ17 and XJ62. Associated samples did not contain concentrations of bis(2-ethylhexyl)phthalate above the reporting limit. No qualification of the data was necessary.

Field Trip Blanks

Trip blanks were submitted for VOC and TPH-G analysis with data packages XJ17, XJ62, YI69, and YQ82. No contamination was detected in any of the trip blanks. No qualification of the data was necessary.

SURROGATE RECOVERIES

Appropriate compounds were used as surrogate spikes for the VOC, SVOC, PAHs, PCBs, TPH-G, and TPH-D analyses. Recovery values for the surrogate spikes were within the current laboratory-specified control limits for all samples, with the following exceptions:

- Recovery of surrogate d10-fluoranthene associated with the SVOC analyses for several samples in data package YI69 was below the laboratory-specified control limits. EPA

National Functional Guidelines for SVOC sample surrogate qualification require two or more surrogates of the same fraction to be outside laboratory-specified control limits; therefore no qualification of the data was necessary.

- Recovery of surrogate d10-fluoranthene associated with the PAHs analyses for several samples and the associated matrix spike/matrix spike duplicate in data package YQ82 was below the laboratory-specified control limits. EPA National Functional Guidelines for SVOC sample surrogate qualification require two or more surrogates of the same fraction to be outside laboratory-specified control limits; therefore no qualification of the data was necessary.

MATRIX SPIKE (MS)/MATRIX SPIKE DUPLICATE (MSD) RESULTS AND LABORATORY DUPLICATE/MATRIX DUPLICATE RESULTS

A MS/MSD or laboratory duplicate and/or MS were analyzed with several of the VOCs, SVOCs, PAHs, TPH-D, conventionals, and total and dissolved metals analyses. The recovery values for each required spiking compound were within the laboratory-specified control limits for all project samples with the following exceptions:

- The MS/MSD recoveries for 2-chloroethylvinylether associated with the VOCs analysis for sample WM-GP-9-100813 in data package XJ17 was undetected; no qualification of the data was deemed necessary.
- The MS/MSD recoveries for 1,2,3-trichlorobenzene associated with the VOCs analysis for sample WM-GP-9-100813 in data package XJ17 exceeded the laboratory-specified control limit. The associated sample result was not detected; therefore, no qualification of the data was necessary.
- The MS recovery for pyrene associated with the SVOCs analysis for sample WM-GP-9-100813 in data package XJ17 exceeded the laboratory-specified control limit. The corresponding MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for 3,3'-dichlorobenzidiene associated with the SVOCs analysis for sample WM-GP-9-100813 in data package XJ17 and sample WM-MW-6 in data package YI69 were undetected; no qualification of the data was deemed necessary.
- The MS/MSD recoveries for diesel associated with the TPH-D analysis for sample WM-GP-9-100813 in data package XJ17 were below the laboratory-specified control limits; the associated sample result was qualified as estimated (UJ), as indicated in Table 1.
- The MS recovery for zinc associated with the total metals analysis for sample WM-GP-9-100813 in data package XJ17 was below the laboratory-specified control limits; the associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MS recovery for di-n-octyl phthalate associated with the SVOCs analysis for sample WM-MW-6 in data package YI69 was below the laboratory-specified control limit. The corresponding MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for 3-nitroaniline associated with the SVOCs analysis for sample WM-MW-6 in data package YI69 exceeded the laboratory-specified control limit. The associated sample result was not detected; therefore, no qualification of the data was necessary.

- The MS recoveries for several compounds associated with the PAHs analysis for sample WM-MW-6 in data package YI69 were not detected. The original sample concentrations were greater than four times the spike concentrations, therefore control limits did not apply and no qualification of the data was necessary.
- The MSD recovery for indeno(1,2,3-cd)pyrene associated with the PAHs analysis for sample WM-MW-6 in data package YI69 exceeded the laboratory-specified control limit. The corresponding MS recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.

A laboratory-specified control limit of 20 percent was used to evaluate the relative percent differences (RPDs) between the laboratory duplicate results; a laboratory-specified control limit of 40 percent was used to evaluate the RPDs between the MS/MSDs, except when the samples were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. The RPDs between the laboratory duplicate results or MS/MSD were within the current laboratory- or project-specified control limits for all project samples with the following exceptions:

- The MS/MSD RPD for 3,3'-dichlorobenzidiene associated with the SVOCs analysis for sample WM-GP-9-100813 in data package XJ17 was not available due to undetected percent recoveries of the MS/MSD. No qualification of the data was deemed necessary.
- The MS/MSD RPDs for several compounds associated with the PAHs analysis for sample WM-MW-6 in data package YI69 were not available due to undetected percent recoveries of the MS/MSD. No qualification of the data was deemed necessary.

LABORATORY CONTROL SAMPLE (LCS), LABORATORY CONTROL SAMPLE DUPLICATE (LCSD), AND STANDARD REFERENCE MATERIAL (SRM) RESULTS

At least one laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) or sample reference material (SRM) was analyzed with each batch of samples. Recoveries for each LCS and/or LCSD and the RPDs were within the current laboratory-specified control limits, with the following exceptions:

- The LCS/LCSD recoveries for 3-nitroaniline associated with the SVOCs analysis in data package YI69 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCSD RPD for 4-chloroaniline associated with the SVOCs analysis in data package YI69 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCSD recoveries for indeno(1,2,3-cd)pyrene associated with the PAHs analysis in data package YI69 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS recovery for 3-nitroaniline associated with the SVOCs analysis in data package YQ82 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS recoveries of 2,2'-oxybis(1-chloropropane) and 1-methylnaphthalene associated with the SVOCs analysis in data package YQ82 were below the laboratory-specified control

limit. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

BLIND FIELD DUPLICATES

Three pairs of blind field duplicate groundwater samples (WM-GP-9/WM-GP-DUP, WM-MW-1/WM-MW-DUP1, and WM-MW-8/WM-MW-DUP-1) were submitted for analysis with data packages XJ17, YI69, and YQ82 and were analyzed for some or all of the following: VOCs, SVOCs, PAHs, TPH-HCID, TPH-D, conventionals, and total and dissolved metals.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate water samples, except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. RPDs for the duplicate sample pairs submitted for analysis were within the project-specified control limits with the following exceptions:

- The RPDs for copper, lead, and zinc associated with the dissolved metals analysis for sample pair WM-GP-9/WM-GP-DUP exceeded the project-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The RPDs for multiple compounds associated with the PAHs analysis for sample pair WM-GP-9/WM-GP-DUP exceeded the project-specified control limit; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The RPDs for copper and lead associated with the dissolved metals analysis for sample pair WM-GP-9/WM-GP-DUP grossly exceeded the project-specified control limit and the validity of the results was questioned. The laboratory determined a log-in error had occurred prior to analysis (see Sample Conditions and Analysis section above for complete explanation). The associated sample results in data package XM52 were rejected (R), as indicated in Table 1. The dissolved metals analysis results for this sample pair that were associated with data package XJ17 (which were run previously but had not been reported due to a client request to cancel the original analysis) were reported in a re-issue of the data package.

INITIAL AND CONTINUING CALIBRATION

Laboratory-specified calibration limits for initial and continuing calibrations were met for all analyses, with the following exceptions:

- The VOC continuing calibration (CCAL) for analyses reported in data package XJ17 was low for 2-chloroethylvinylether; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The SVOC CCALs for analyses reported in data packages XJ17 and XJ62 were high for 4-chloroaniline, 3-nitroaniline, 2,6-dinitroaniline, and 2,4-dinitrotoluene. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The VOC CCAL for analyses reported in data package XJ62 was low for bromoform; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The SVOC CCAL for analyses reported in data package YI69 was low for 3-nitroaniline, 4-nitroaniline, and carbazole; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The PAH CCALs for analyses reported in data package YI69 were high for indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and the surrogate d14-dibenzo(a,h)anthracene. Associated sample results were not detected and the surrogate recoveries of the project samples were within control limits; therefore, no qualification of the data was necessary.
- The SVOC CCAL for analyses reported in data package YQ82 was low for benzoic acid, 3-nitroaniline, and carbazole; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

COMPLETENESS AND OVERALL DATA QUALITY

The completeness for this data set is 99 percent, which meets the project-specified goal of 95 percent minimum.

Data precision was evaluated through laboratory control sample duplicates, matrix spike duplicates, laboratory duplicates, and blind field duplicates. Data accuracy was evaluated through matrix spikes, laboratory control samples, and surrogate spikes. Based on this data quality verification and validation, the data were determined to be acceptable. No data were rejected, with the exception of those samples noted above; the rejected data were replaced in an amended report, thus completing the data set.

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Landau Associates. 2013. *Upland Sampling and Analysis Plan, Westman Marine Site, Blaine, Washington.* Prepared for the Port of Bellingham. August 21.

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Analytical Group	Analyte	Result	Qualifier	Sample Number	Reason
XJ17	VOCs	2-Chloroethylvinylether	1.0 U	UJ	WM-GP-17-100813	Low continuing calibration recovery
XJ17	VOCs	2-Chloroethylvinylether	1.0 U	UJ	WM-GP-12-100813	Low continuing calibration recovery
XJ17	VOCs	2-Chloroethylvinylether	1.0 U	UJ	WM-GP-16-100813	Low continuing calibration recovery
XJ17	VOCs	2-Chloroethylvinylether	1.0 U	UJ	WM-GP-9-100813	Low continuing calibration recovery
XJ17	VOCs	2-Chloroethylvinylether	1.0 U	UJ	WM-GP-DUP-100813	Low continuing calibration recovery
XJ17	PAHs	Naphthalene	0.022	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Naphthalene	0.053	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	2-Methylnaphthalene	0.010 U	UJ	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	2-Methylnaphthalene	0.020	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	1-Methylnaphthalene	0.010 U	UJ	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	1-Methylnaphthalene	0.019	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Acenaphthylene	0.018	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Acenaphthylene	0.043	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Fluorene	0.020	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Fluorene	0.039	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Phenanthrene	0.13	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Phenanthrene	0.29	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Anthracene	0.030	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Anthracene	0.071	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Fluoranthene	0.18	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Fluoranthene	0.41	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Pyrene	0.28	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Pyrene	0.71	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Benzo(a)anthracene	0.094	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Benzo(a)anthracene	0.24	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Chrysene	0.12	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Chrysene	0.28	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Benzo(a)pyrene	0.11	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Benzo(a)pyrene	0.28	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Indeno(1,2,3-cd)pyrene	0.062	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Indeno(1,2,3-cd)pyrene	0.16	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Dibenz(a,h)anthracene	0.015	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Dibenz(a,h)anthracene	0.036	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Benzo(g,h,i)perylene	0.077	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Benzo(g,h,i)perylene	0.19	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Dibenzofuran	0.010	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Dibenzofuran	0.024	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	PAHs	Total Benzofluoranthenes	0.17	J	WM-GP-9-100813	High field duplicate RPD
XJ17	PAHs	Total Benzofluoranthenes	0.43	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	TPH-Dx	Diesel	0.10 U	UJ	WM-GP-9-100813	Low MS/MSD recovery
XJ17	Total Metals	Zinc	20	J	WM-GP-9-100813	Low MS recovery
XJ17	Diss. Metals	Copper	0.7	J	WM-GP-9-100813	High field duplicate RPD
XJ17	Diss. Metals	Copper	4.9	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	Diss. Metals	Lead	0.6	J	WM-GP-9-100813	High field duplicate RPD
XJ17	Diss. Metals	Lead	1.2	J	WM-GP-DUP-100813	High field duplicate RPD
XJ17	Diss. Metals	Zinc	4 U	UJ	WM-GP-9-100813	High field duplicate RPD
XJ17	Diss. Metals	Zinc	6	J	WM-GP-DUP-100813	High field duplicate RPD
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-5-100913	Low continuing calibration recovery
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-2-100913	Low continuing calibration recovery
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-8-100913	Low continuing calibration recovery
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-13-100913	Low continuing calibration recovery
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-14-100913	Low continuing calibration recovery
XJ62	VOCs	Bromoform	0.20 U	UJ	WM-GP-7-100913	Low continuing calibration recovery
XM52	Diss. Metals	Copper	1.5	R	WM-GP-9-100813	High field duplicate RPD
XM52	Diss. Metals	Copper	35.5	J	WM-GP-DUP-100813	High field duplicate RPD
XM52	Diss. Metals	Lead	1.7	R	WM-GP-9-100813	High field duplicate RPD
XM52	Diss. Metals	Lead	44.6	J	WM-GP-DUP-100813	High field duplicate RPD
YI69	SVOCs	3-Nitrolaniline	3.0 U	UJ	WM-MW-6	Low continuing calibration recovery
YI69	SVOCs	4-Nitrolaniline	3.0 U	UJ	WM-MW-6	Low continuing calibration recovery
YI69	SVOCs	Carbazole	2.2	J	WM-MW-6	Low continuing calibration recovery
YQ82	PAHs	ALL	ALL	J, UJ DNR	WM-MW-2 RE	Analyzed outside hold time; do not report, use original analysis results
YQ82	PAHs	ALL	ALL	J, UJ DNR	WM-MW-8 RE	Analyzed outside hold time; do not report, use original analysis results

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
YQ82	PAHs	ALL	ALL	J, UJ DNR	WM-MW-DUP-1 RE	Analyzed outside hold time; do not report, use original analysis results
YQ82	SVOCs	Benzoic Acid	20 U	UJ	WM-MW-6	Low continuing calibration recover
YQ82	SVOCs	3-Nitroaniline	3.0 U	UJ	WM-MW-6	Low continuing calibration recover
YQ82	SVOCs	Carbazole	2.2	J	WM-MW-6	Low continuing calibration recover
YQ82	SVOCs	2,2'-Oxybis(1-Chloropropane)	1.0 U	UJ	WM-MW-6	Low LCS recovery
YQ82	SVOCs	1-Methylnaphthalene	1.5	J	WM-MW-6	Low LCS recovery

Notes

DNR = Do not report

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

R = The sample results are rejected due to serious deficiencies in the ability to analyze the samples and meet quality control criteria.
The presence or absence of the analyte cannot be verified.

U = Indicates the compound was not detected at the reported concentration.

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

LANDAU
ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TECHNICAL MEMORANDUM

TO: Larry Beard, Project Manager

ASH KES
FROM: Anne Halvorsen and Kristi Schultz

DATE: March 31, 2015

RE: SOIL SAMPLING LABORATORY DATA VERIFICATION AND VALIDATION
WESTMAN MARINE
BELLINGHAM, WASHINGTON

This technical memorandum provides the results of verification and validation checks of analytical data for 180 soil samples collected during multiple sampling events occurring on October 3-28, 2013, and April 14-16, 2014 at the Westman Marine site located in Bellingham, Washington. The samples were collected and analyzed as part of the Westman Marine remedial investigation. All sample analyses were conducted at Analytical Resources, Inc. (ARI) laboratory, located in Tukwila, Washington. This data quality evaluation covers ARI data packages XI41, XI74/XJ59, XJ14, XJ56, XK09, XL10, XL60, XM22, XM23, XO07, XO58, XR13, XT02, XV37, YH18, YH19, YH46, YH71, YI44, YI99, YK90, YM64, and YN60.

Soil samples were analyzed for some or all of the following: volatile organic compounds (VOCs) using U.S. Environmental Protection Agency (EPA) Method SW8260C; semivolatile organic compounds (SVOCs) using EPA Method SW8270D; polycyclic aromatic hydrocarbons (PAHs) using EPA Method SW8270D-SIM; tributyl tins (TBT) using methods EPA Method SW8270D-SIM and Krone 1988-SIM; polychlorinated biphenyls (PCBs) using EPA Method SW8082A; total petroleum hydrocarbon identification (TPH-HCID) using Washington State Department of Ecology (Ecology)-approved Method NWTPH-HCID; gasoline-range petroleum hydrocarbons (TPH-G) using Method NWTPH-Gx; diesel- and oil-range petroleum hydrocarbons (TPH-D) using Method NWTPH-Dx; total metals using EPA Methods 6010C, 200.8, and 7471A; total organic carbon (TOC) using method Plumb, 1981; and grain size distribution analysis by ASTM International (ASTM) D421/D422. The verification and validation checks were performed on the analytical data associated with these analyses with the exception of the grain size distribution.

The verification and validation checks were conducted in accordance with the *Upland Sediment Sampling and Analysis Plan, Westman Marine Site, Blaine, Washington* (Landau Associates 2013), and with guidance from applicable portions of the *National Functional Guidelines for Organic Data Review* (EPA 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory;

date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).

- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below.

LABORATORY DATA PACKAGE COMPLETENESS

Each laboratory data package contained a signed chain-of-custody, a cooler receipt form documenting the condition of the samples upon receipt at the laboratory, a cooler temperature compliance form, sample analytical results, and quality control results (method blanks, surrogate recoveries, laboratory control sample results, and replicate sample results). A case narrative identifying any complications was also provided with each laboratory data package. Definitions of laboratory qualifiers and quality control acceptance criteria were provided, as appropriate.

SAMPLE CONDITIONS AND ANALYSIS

The laboratory received the samples in good condition and all analyses were performed as requested. Preservation of samples, as specified by the analytical method, was verified by the laboratory and adjusted as appropriate.

Upon receipt by ARI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. Three coolers were received with temperatures ranging from 0.1°C-0.8°C, which is below the EPA-recommended lower limit of 2°C. Because the samples were not frozen upon receipt at the laboratory and the samples were submitted to the laboratory within a few hours following sample collection, no qualification was determined necessary due to low cooler temperatures.

Two coolers were received with temperatures ranging from 6.1°C-9.5°C, which is higher than the EPA-recommended limit of 6°C. Because the samples were placed on ice in the cooler and submitted to a laboratory relatively soon following sample collection, no qualification was determined necessary due to the high cooler temperature.

HOLDING TIMES

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA and project-specified holding times, with the following exception:

- The total metals (mercury) analyses associated with several samples in data packages XO07, XO58, XR13, XV37, YK90, YM64, and YN60 were completed outside the method-recommended hold time. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The VOCs and TPH-G analyses associated with samples WM-GP-18-10-12-101013 and WM-GP-19-11-12-101013 in data package XO58 were completed outside the method-recommended hold time. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples. No contamination was detected in any of the method blanks, with the following exceptions:

- Copper and zinc were detected in the method blank associated with the total metals analyses included in data package XI74/XJ59. The associated sample results contained concentrations of copper and/or zinc above the action level[1] and should be reported as detections and the "B" flag reported by the laboratory should be removed.
- Methylene chloride was detected in the method blanks associated with the VOCs analyses included in data package XJ56. Associated sample results with concentrations of methylene chloride below the action level were qualified as not detected (UJ), as indicated in Table 1. Please note that some of the associated methylene chloride results listed in the laboratory data package were due to dilution reanalysis by the laboratory, and not all methylene chloride results are reported.
- Methylene chloride was detected in the method blank associated with the VOCs analyses included in data package XK09. Associated sample results with concentrations of methylene chloride below the action level were qualified as not detected (U), as indicated in Table 1.

Field Trip Blanks

Trip blanks were submitted for VOC and TPH-G analysis with data packages XJ56 and YH19. No contamination was detected in any of the trip blanks with the following exceptions:

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[1] The action level is defined as 10 times the concentration in the blank for common volatile laboratory contaminants (methylene chloride, acetone, 2-butanone, cyclohexane, and phthalates), or 5 times the concentration for other target compounds (EPA 1999).

- Methylene chloride was detected in the trip blank associated with the VOCs analyses included in data package XJ56. Associated sample results with concentrations of methylene chloride below the action level were qualified as not detected (UJ), as indicated in Table 1.

SURROGATE RECOVERIES

Appropriate compounds were used as surrogate spikes for the VOC, SVOC, PAHs, TBT, PCB, TPH-HCID, TPH-G, and TPH-D analyses. Recovery values for the surrogate spikes were within the current laboratory-specified control limits for all samples with the following exceptions:

- Recovery of surrogate d10-fluoranthene associated with the PAHs analysis of the method blank in data package XI41 exceeded the laboratory-specified control limits. As all project sample recoveries were within control limits, no qualification of the data was determined necessary.
- Surrogate recoveries associated with the PAHs analyses of multiple samples in data packages XJ56, XK09, XL60, XM22, YH19, and YN60 were outside laboratory-specified control limits due to dilution or not recoverable; no qualification of the data was necessary.
- Surrogate o-terphenyl associated with the TPH-D analysis of sample WM-GP-11-5-6-101013 in data package XJ56 was not recoverable in the original analysis. The sample was reanalyzed at a dilution in order to properly quantify the target compounds within a reportable range; the surrogate recovery was diluted out of the second analytical run. No qualification of the data was necessary.
- Recovery of surrogate o-terphenyl associated with the TPH-D reanalysis of sample WM-BF-VAULT-S-2 in data package XK09 was outside laboratory-specified control limits due to dilution; no qualification of the data was necessary.
- Surrogate decachlorobiphenyl associated with the PCB analysis of the method blank in data package XM23 was not recovered. As all project sample recoveries were within control limits, no qualification of the data was determined necessary.
- Surrogate recoveries associated with the TBT reanalysis of sample WM-GP-13-0-1-100913 in data package YH46 were outside laboratory-specified control limits due to dilution; no qualification of the data was necessary.
- Recovery of surrogate d10-fluoranthene associated with the PAHs analyses of samples WM-GP-24-7-8 and WM-GP-24-6-7 in data package YN60 were not reported. As the remaining surrogate recoveries were within laboratory-specified control limits, no qualification of the data was determined necessary.

MATRIX SPIKE (MS)/MATRIX SPIKE DUPLICATE (MSD) RESULTS AND LABORATORY DUPLICATE RESULTS

A MS/MSD or laboratory duplicate or matrix duplicate and/or MS were analyzed with several of the SVOCs, PAHs, TBT, total metals, TPH-HCID, TPH-D, and conventionals analyses. The recovery values for each required spiking compound were within the laboratory-specified control limits for all project samples with the following exceptions:

- The MS recovery for lead associated with the total metals analysis for sample WM-SS-1(0-0.5) in data package XI41 was below the laboratory-specified control limits; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The MS recoveries for zinc associated with the total metals analyses for sample WM-SS-1(0-0.5) in data package XI41 and sample WM-HA-1-0-0.75-100813 in data package XJ14 were below the laboratory-specified control limit. The original sample concentrations were greater than four times the spike concentrations, therefore control limits did not apply and no qualification of the data was necessary.

- The MS recoveries for chromium, copper, and lead associated with the total metals analysis for sample WM-HA-1-0-0.75-100813 in data package XJ14 either exceeded or were below the laboratory-specified control limits. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The MS recovery for chromium associated with the total metals analysis for sample WM-BF-SS-24 in data package XL60 was below the laboratory-specified control limits. The associated sample result was qualified as estimated (J), as indicated in Table 1.

- The MS recoveries for copper, lead, mercury, and zinc associated with the total metals analyses for sample WM-BF-SS-24 in data package XL60 were below the laboratory-specified control limit. The original sample concentrations were greater than four times the spike concentrations, therefore control limits did not apply and no qualification of the data was necessary.

- The MS recoveries for several compounds associated with the SVOCs analysis for sample WM-GP-14-1-2-100913 in data package XM22 were outside the laboratory-specified control limits. The corresponding MSD recoveries were within the laboratory-specified control limits; therefore, no qualification of the data was necessary.

- The MS/MSD recoveries for several compounds associated with the PAHs analysis for sample WM-GP-19-11-12-101013 in data package XO58 were not available due to calculated negative recoveries. No qualification of the data was deemed necessary.

- The MS/MSD recoveries for several compounds associated with the PAHs analysis for sample WM-GP-19-11-12-101013 in data package XO58 were below the laboratory-specified control limits; the associated sample results were qualified as estimated (J), as indicated in Table 1.

- The MS recovery for indeno(1,2,3-cd)pyrene associated with the PAHs analysis for sample WM-GP-19-11-12-101013 in data package XO58 was outside the laboratory-specified control limits. The corresponding MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.

- The MS recoveries for arsenic and zinc associated with the total metals analysis for sample WM-GP-23-10-11 in data package YH19 were below the laboratory-specified control limits. The associated sample results were qualified as estimated (J), as indicated in Table 1.

- The MS recovery for copper associated with the total metals analyses for sample WM-GP-23-10-11 in data package YH19 was outside the laboratory-specified control limit. The original sample concentration was greater than four times the spike concentration, therefore control limits did not apply and no qualification of the data was necessary.

- The MS recovery for TOC associated with the conventionals analysis for sample WM-GP-25-6-7 in data package YI44 was below the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.

- The MS recoveries for copper and mercury associated with the total metals analysis for sample WM-GP-31-7-8 in data package YI99 either exceeded or were below the laboratory-specified control limits. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

A laboratory-specified control limit of 20 percent was used to evaluate the relative percent differences (RPDs) between the laboratory duplicate results; a laboratory-specified control limit of 40 percent was used to evaluate the RPDs between the MS/MSDs, except when the samples were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus two times the reporting limit was used. The RPDs between the laboratory duplicate results or MS/MSD were within the current laboratory- or project-specified control limits for all project samples with the following exceptions:

- The laboratory duplicate RPDs for copper and mercury associated with the total metals analyses for sample WM-SS-1(0-0.5) in data package XI41 exceeded the laboratory-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPD for lead associated with the total metals analysis for sample WM-HA-1-0-0.75-100813 in data package XJ14 exceeded the laboratory-specified control limit; the associated sample result was qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for arsenic and lead associated with the total metals analyses for sample WM-GP-6-0.5-1.5-101013 in data package XJ56 exceeded the laboratory-specified control limits; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for copper associated with the total metals analysis for sample WM-BF-VAULT-B-1 in data package XK09 and sample WM-MW-6-7-8 in data package YH18 exceeded the laboratory-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for cadmium and lead associated with the total metals analysis for sample WM-BF-SS-24 in data package XL60 exceeded the laboratory-specified control limits; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPD for benzoic acid associated with the SVOCs analysis for sample WM-GP-14-1-2-100913 in data package XM22 exceeded the project-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The laboratory duplicate RPDs for arsenic, copper, and zinc associated with the total metals analyses for sample WM-GP-23-10-11 in data package YH19 exceeded the laboratory-specified control limits; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for TOC associated with the conventionals analyses for sample WM-GP-25-6-7 in data package YI44 exceeded the laboratory-specified control limit; the associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPD for chrysene associated with the PAHs analysis for sample WM-MW-6-6-7 in data package YI99 exceeded the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for arsenic and copper with the total metals analysis for sample WM-GP-31-7-8 in data package YI99 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.

LABORATORY CONTROL SAMPLE (LCS), LABORATORY CONTROL SAMPLE DUPLICATE (LCSD), AND STANDARD REFERENCE MATERIAL (SRM) RESULTS

At least one laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) or sample reference material (SRM) was analyzed with each batch of samples as required by the method. Recoveries for each LCS and/or LCSD and the RPDs were within the current laboratory-specified control limits, with the following exceptions:

- The LCS/LCSD recovery of 4-nitroaniline associated with the SVOCs analysis in data package XJ14 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCSD recoveries for methylene chloride associated with the VOCs analysis in data packages XJ56 and XK09 exceeded the laboratory-specified control limit. The associated sample concentrations were determined to be not detected (U) due to method blank contamination; therefore, no qualification of the data was necessary.
- The LCSD recovery for fluorene associated with the SVOCs analysis in data package XM22 was below the laboratory-specified control limit. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The LCS and/or LCSD recoveries for 1,1-dichloroethane and cis-1,2-dichloroethene associated with the VOCs analysis in data package YH71 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCSD recoveries for bromodichloromethane associated with the VOCs analysis in data package YH71 were below the laboratory-specified control limits. The associated sample results were qualified as estimated (UJ), as indicated in Table 1.
- The LCS recovery for 1,2-dibromoethane associated with the VOCs analysis in data package YH71 was below the laboratory-specified control limit. The LCS recovery was only slightly out of limits and the LCSD recovery was within control limits; therefore, no qualification of the data was deemed necessary.

BLIND FIELD DUPLICATES

No blind field duplicate soil samples were collected during these sampling events.

INITIAL AND CONTINUING CALIBRATION

Laboratory-specified calibration limits for initial and continuing calibrations were met for all analyses, with the following exceptions;

- The 10/17/13 and 4/23/14 VOC continuing calibrations (CCALs) for analyses reported in data packages XJ56 and YH71 were low for 1,2-dibromo-3-chloropropane; the associated sample results were qualified as estimated (UJ), as indicated in Table 1.
- The 10/17/13 VOC CCALs for analyses reported in data package XJ56 were high for several compounds; the associated sample detections were qualified as estimated (J), as indicated in Table 1.
- The 10/23/13 VOC CCALs for analyses reported in data package XJ56 were high for methylene chloride. Associated sample WP-GP-7-8-9-100913 was determined to be not

detected (U) due to method blank contamination; associated sample WM-GP-14-10.5-11.5-100913 was a dilution reanalysis and methylene chloride was not reported from the reanalysis. No qualification of the data was necessary.

- The VOC CCALs for analysis reported in data package XK09 were high for several compounds. Associated sample results were not detected for all compounds except carbon disulfide. Associated sample detections of carbon disulfide were qualified as estimated (J), as indicated in Table 1.
- The VOCs CCALs for analyses reported in data packages XK09 and YH71 were low for 1,2-dibromo-3-chloropropane; the associated sample results were qualified as estimated (UJ), as indicated in Table 1.
- The 11/7/13 and 11/8/13 SVOCs CCALs for analysis reported in data package XM22 were high for multiple compounds. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The SVOCs CCALs for analysis reported in data package XM23 were high for several compounds. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The VOCs CCALs for analyses reported in data packages XO58 and YH71 were high for several compounds; the associated sample detections were qualified as estimated (J), as indicated in Table 1.
- The VOCs CCALs for analysis reported in data package YH18 were high for bromomethane and 1,1-dichloroethene. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The VOCs CCALs for analysis reported in data package YH19 were high for bromomethane and 1,1-dichloroethane. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The PAHs CCAL for analysis reported in data package YN60 was low for benzo(g,h,i)perylene. The associated sample results were qualified as estimated (UJ), as indicated in Table 1.

ADDITIONAL QUALITY CONTROL ACTION

Additional quality control measures taken by the laboratory included the following:

- The SVOC internal standards 1,4-dichlorobenzene , acenaphthene-d10, and phenanthrene-d10 were high in association with sample WM-GP-14-0-1-100913 in data package XJ56. The sample was reanalyzed at a dilution with the internal standards in control. The original analysis results were reported due to the lower reporting limits, and all associated results were qualified as estimated (J, UJ), as indicated in Table 1.
- The PAHs internal standards were low in association with all samples in data package XM22. The samples were reanalyzed at a dilution with some samples still having low internal standards. The original analytical results were reported due to the lower reporting limits, and all associated results were qualified as estimated (J, UJ), as indicated in Table 1.
- The PAHs internal standards were low in association with samples WM-HA-1-1-1.5-100813 and WM-HA-1-2-2.5-100813 in data package XM23. The samples were reanalyzed at a dilution with similar matrix effects. The original analytical results were reported due to the lower reporting limits, and all associated results were qualified as estimated (J, UJ), as indicated in Table 1.

- The PAHs internal standards were low in association with samples WM-GP-12-1-2-100813 and WM-GP-16-1-2-100813 in data package XM23. The samples were reanalyzed at a dilution with the internal standards in control. The original analytical results were reported due to the lower reporting limits, and all associated results were qualified as estimated (J, UJ), as indicated in Table 1.
- Sample WM-GP-35-5-6.5 in data package YH19 was submitted with limited sample volume; therefore, the associated VOC sample results have higher reporting limits.

COMPLETENESS AND OVERALL DATA QUALITY

The completeness for this data set is 100 percent, which meets the project-specified goal of 95 percent minimum.

Data precision was evaluated through laboratory control sample duplicates, matrix spike duplicates, and laboratory duplicates. Data accuracy was evaluated through matrix spikes, laboratory control samples, and surrogate spikes. Based on this data quality verification and validation, all of the data were determined to be acceptable. No data were rejected.

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TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Analytical Group	Analyte	Result	Qualifier	Sample Number	Reason
XI41	Total Metals	Copper	81.4	J	WM-SS-1(0-0.5)	High laboratory duplicate RPD
XI41	Total Metals	Mercury	0.10	J	WM-SS-1(0-0.5)	High laboratory duplicate RPD
XI41	Total Metals	Lead	31.1	J	WM-SS-1(0-0.5)	Low MS recovery
XJ14	Total Metals	Chromium	21.4	J	WM-HA-1-0-.75-100813	High MS recovery
XJ14	Total Metals	Copper	150	J	WM-HA-1-0-.75-100813	Low MS recovery
XJ14	Total Metals	Lead	42.2	J	WM-HA-1-0-.75-100813	Low MS recovery
XJ14	Total Metals	Lead	42.2	J	WM-HA-1-0-.75-100813	High laboratory duplicate RPD
XJ56	VOCs	Methylene Chloride	12 Q	UJ	WM-GP-14-10.5-11.5	Method blank/trip blank contamination
XJ56	VOCs	Methylene Chloride	5.6 Q	UJ	WM-GP-7-8-9	Method blank/trip blank contamination
XJ56	VOCs	Methylene Chloride	12 Q	UJ	WM-GP-11-5-6	Method blank/trip blank contamination
XJ56	VOCs	Methylene Chloride	17 Q	UJ	WM-WASTECHAR	Method blank/trip blank contamination
XJ56	VOCs	1,2-Dibromo-3-chloropropane	6.9 U	UJ	WM-GP-14-10.5-11.5	Low continuing calibration recovery
XJ56	VOCs	1,2-Dibromo-3-chloropropane	6.0 U	UJ	WM-GP-11-5-6	Low continuing calibration recovery
XJ56	VOCs	1,2-Dibromo-3-chloropropane	9.3 U	UJ	WM-WASTECHAR	Low continuing calibration recovery
XJ56	VOCs	Carbon Disulfide	10	J	WM-GP-14-10.5-11.5	High continuing calibration recovery
XJ56	VOCs	Carbon Disulfide	5.7	J	WM-GP-11-5-6	High continuing calibration recovery
XJ56	VOCs	Carbon Disulfide	31	J	WM-WASTECHAR	High continuing calibration recovery
XJ56	SVOCs	ALL	ALL	J, UJ	WM-GP-14-0-1	Report original analysis with J, UJ flags; internal standards <50% area
XJ56	SVOCs	ALL	ALL	DNR	WM-GP-14-0-1 (RE)	Do not report - use original analysis
XJ56	Total Metals	Arsenic	2.7	J	WM-GP-6-0.5-1.5	High laboratory duplicate RPD
XJ56	Total Metals	Lead	5.1	J	WM-GP-6-0.5-1.5	High laboratory duplicate RPD
XK09	VOCs	Methylene Chloride	9.6	U	WM-BF-VAULT-B-1	Method blank contamination
XK09	VOCs	Methylene Chloride	11	U	WM-BF-VAULT-S-1	Method blank contamination
XK09	VOCs	Methylene Chloride	9.7	U	WM-BF-VAULT-S-2	Method blank contamination
XK09	VOCs	Carbon Disulfide	4.0	J	WM-BF-VAULT-B-1	High continuing calibration recovery
XK09	VOCs	Carbon Disulfide	1.4	J	WM-BF-VAULT-S-1	High continuing calibration recovery
XK09	VOCs	1,2-Dibromo-3-chloropropane	6.4 U	UJ	WM-BF-VAULT-B-1	Low continuing calibration recovery
XK09	VOCs	1,2-Dibromo-3-chloropropane	6.3 U	UJ	WM-BF-VAULT-S-1	Low continuing calibration recovery
XK09	VOCs	1,2-Dibromo-3-chloropropane	5.9 U	UJ	WM-BF-VAULT-S-2	Low continuing calibration recovery
XK09	Total Metals	Copper	22.6	J	WM-BF-VAULT-B-1	High laboratory duplicate RPD
XL60	Total Metals	Cadmium	1.1	J	WM-BF-SS-24	High laboratory duplicate RPD
XL60	Total Metals	Lead	3870	J	WM-BF-SS-24	High laboratory duplicate RPD
XL60	Total Metals	Chromium	47.1	J	WM-BF-SS-24	Low MS recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-5-1-2-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-5-2-3-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-2-1-2-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-2-2-3-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-13-1-2-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-14-1-2-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-14-7-8-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-14-13.5-14.5-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-7-5-6-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-7-10-11-100913	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-11-1-2-101013	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-11-3-4-101013	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-11-7-8-101013	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-10-1-2-101013	Low internal standard recovery
XM22	PAHs	ALL	ALL	J, UJ	WM-GP-15-1-2-101013	Low internal standard recovery
XM22	PAHs	ALL	ALL	DNR	WM-GP-5-1-2-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-5-2-3-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-2-1-2-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-2-2-3-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-13-1-2-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-14-1-2-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-14-7-8-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-14-13.5-14.5-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-7-5-6-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-7-10-11-100913 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-11-1-2-101013 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-11-3-4-101013 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-11-7-8-101013 RE	Do not report - use original analysis
XM22	PAHs	ALL	ALL	DNR	WM-GP-10-1-2-101013 RE	Do not report - use original analysis

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
XM22	PAHs	ALL	ALL	DNR	WM-GP-15-1-2-101013 RE	Do not report - use original analysis
XM22	PAHs	Fluorene	4.8 U	UJ	WM-GP-5-1-2-100913	Low LCSD recovery
XM22	PAHs	Fluorene	5.0 U	UJ	WM-GP-5-2-3-100913	Low LCSD recovery
XM22	PAHs	Fluorene	14 U	UJ	WM-GP-2-1-2-100913	Low LCSD recovery
XM22	PAHs	Fluorene	4.8 U	UJ	WM-GP-2-2-3-100913	Low LCSD recovery
XM22	PAHs	Fluorene	4.6 U	UJ	WM-GP-13-1-2-100913	Low LCSD recovery
XM22	PAHs	Fluorene	4.8 U	UJ	WM-GP-14-1-2-100913	Low LCSD recovery
XM22	PAHs	Fluorene	4.7 U	UJ	WM-GP-14-7-8-100913	Low LCSD recovery
XM22	PAHs	Fluorene	4.8 U	UJ	WM-GP-14-13.5-14.5-100913	Low LCSD recovery
XM22	PAHs	Fluorene	8.8 J	J	WM-GP-7-5-6-100913	Low LCSD recovery
XM22	PAHs	Fluorene	8.0 J	J	WM-GP-7-10-11-100913	Low LCSD recovery
XM22	PAHs	Fluorene	18	J	WM-GP-11-1-2-101013	Low LCSD recovery
XM22	PAHs	Fluorene	11	J	WM-GP-11-3-4-101013	Low LCSD recovery
XM22	PAHs	Fluorene	46	J	WM-GP-11-7-8-101013	Low LCSD recovery
XM22	PAHs	Fluorene	4.6 U	UJ	WM-GP-10-1-2-101013	Low LCSD recovery
XM22	PAHs	Fluorene	26	J	WM-GP-15-1-2-101013	Low LCSD recovery
XM23	PAHs	ALL	ALL	J, UJ	WM-HA-1-1-1.5-100813	Low internal standard recovery
XM23	PAHs	ALL	ALL	J, UJ	WM-HA-1-2-2.5-100813	Low internal standard recovery
XM23	PAHs	ALL	ALL	J, UJ	WM-GP-12-1-2-100813	Low internal standard recovery
XM23	PAHs	ALL	ALL	J, UJ	WM-GP-16-1-2-100813	Low internal standard recovery
XM23	PAHs	ALL	ALL	DNR	WM-HA-1-1-1.5-100813 RE	Do not report - use original analysis
XM23	PAHs	ALL	ALL	DNR	WM-HA-1-2-2.5-100813 RE	Do not report - use original analysis
XM23	PAHs	ALL	ALL	DNR	WM-GP-12-1-2-100813 RE	Do not report - use original analysis
XM23	PAHs	ALL	ALL	DNR	WM-GP-16-1-2-100813 RE	Do not report - use original analysis
XO07	Total Metals	Mercury	0.02 U	UJ	WM-GP-12-2-3	Analyzed outside hold time
XO07	Total Metals	Mercury	0.04	J	WM-GP-16-2-3	Analyzed outside hold time
XO58	VOCs	ALL	ALL	J, UJ	WM-GP-18-10-12-101013	Analyzed outside hold time
XO58	VOCs	ALL	ALL	J, UJ	WM-GP-19-11-12-101013	Analyzed outside hold time
XO58	VOCs	Methylene Chloride	220	J	WM-GP-18-10-12-101013	High continuing calibration recovery
XO58	VOCs	Acetone	1100	J	WM-GP-18-10-12-101013	High continuing calibration recovery
XO58	VOCs	Methylene Chloride	18	J	WM-GP-19-11-12-101013	High continuing calibration recovery
XO58	VOCs	Acetone	460	J	WM-GP-19-11-12-101013	High continuing calibration recovery
XO58	TPH-Gx	Gasoline	50	J	WM-GP-18-10-12-101013	Analyzed outside hold time
XO58	TPH-Gx	Gasoline	9.6 U	UJ	WM-GP-19-11-12-101013	Analyzed outside hold time
XO58	PAHs	Benzo(a)anthracene	140	J	WM-GP-19-11-12-101013	Low MS/MSD recovery
XO58	PAHs	Chrysene	170	J	WM-GP-19-11-12-101013	Low MS/MSD recovery
XO58	PAHs	Benzo(a)pyrene	160	J	WM-GP-19-11-12-101013	Low MS/MSD recovery
XO58	Total Metals	Mercury	0.07	J	WM-HA-1-3-4-100813	Analyzed outside hold time
XO58	Total Metals	Mercury	0.16	J	WM-GP-2-5-6-100913	Analyzed outside hold time
XO58	Total Metals	Mercury	0.03 U	UJ	WM-GP-11-3-4-101013	Analyzed outside hold time
XO58	Total Metals	Mercury	0.03	J	WM-GP-10-2-3-101013	Analyzed outside hold time
XO58	Total Metals	Mercury	0.09	J	WM-GP-15-2-3-101013	Analyzed outside hold time
XR13	Total Metals	Mercury	0.04	J	WM-GP-11-2-3-101013	Analyzed outside hold time
XV37	Total Metals	Mercury	0.03	J	WM-GP-6-1.5-2.5-101013	Analyzed outside hold time
XV37	Total Metals	Mercury	0.11	J	WM-GP-4-1.4-2.4-100913	Analyzed outside hold time
XV37	Total Metals	Mercury	0.02 U	UJ	WM-GP-3-1.4-2.4-100913	Analyzed outside hold time
XV37	Total Metals	Mercury	0.02 U	UJ	WM-GP-17-1-2-100813	Analyzed outside hold time
XV37	Total Metals	Mercury	0.02 U	UJ	WM-GP-3-2.4-3.4-100913	Analyzed outside hold time
XV37	Total Metals	Mercury	0.06	J	WM-GP-4-2.4-3.4-100913	Analyzed outside hold time
XV37	Total Metals	Mercury	0.04	J	WM-GP-6-2.5-3.5-101013	Analyzed outside hold time
XV37	Total Metals	Mercury	0.03	J	WM-GP-17-2-3-100813	Analyzed outside hold time
YH18	Total Metals	Copper	12.9	J	WM-MW-6-7-8	High laboratory duplicate RPD
YH19	Total Metals	Arsenic	27.0	J	WM-GP-23-10-11	High laboratory duplicate RPD
YH19	Total Metals	Copper	378	J	WM-GP-23-10-11	High laboratory duplicate RPD
YH19	Total Metals	Zinc	190	J	WM-GP-23-10-11	High laboratory duplicate RPD
YH19	Total Metals	Arsenic	27.0	J	WM-GP-23-10-11	Low MS recovery
YH19	Total Metals	Zinc	190	J	WM-GP-23-10-11	Low MS recovery
YH71	VOCs	Bromomethane	0.6 Q	J	WM-MW-6-6-7	High continuing calibration recovery
YH71	VOCs	Iodomethane	1.1 Q	J	WM-MW-6-6-7	High continuing calibration recovery
YH71	VOCs	Acetone	1100 Q	J	WM-GP-23-8.5-10	High continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	2.9 U	UJ	WM-MW-6-6-7	Low continuing calibration recovery

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
YH71	VOCs	1,2-Dibromo-3-chloropropane	3.2 U	UJ	WM-GP-30-6.5-8	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	5.4 U	UJ	WM-MW-4-11-12	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	6.9 U	UJ	WM-GP-32-12-13	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	7.3 U	UJ	WM-GP-21-7-8	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	10 U	UJ	WM-GP-21-12-13	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	14 U	UJ	WM-GP-23-8.5-10	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	3.1 U	UJ	WM-GP-33-6-7	Low continuing calibration recovery
YH71	VOCs	1,2-Dibromo-3-chloropropane	3.0 U	UJ	WM-GP-34-6-7	Low continuing calibration recovery
YH71	VOCs	Bromodichloromethane	0.6 U	UJ	WM-MW-6-6-7	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	0.6 U	UJ	WM-GP-30-6.5-8	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	1.1 U	UJ	WM-MW-4-11-12	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	1.4 U	UJ	WM-GP-32-12-13	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	1.5 U	UJ	WM-GP-21-7-8	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	2.0 U	UJ	WM-GP-21-12-13	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	2.8 U	UJ	WM-GP-23-8.5-10	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	0.6 U	UJ	WM-GP-33-6-7	Low LCS/LCSD recovery
YH71	VOCs	Bromodichloromethane	0.6 U	UJ	WM-GP-34-6-7	Low LCS/LCSD recovery
YH71	VOCs	Acetone	83 QY	UJ	WM-MW-6-6-7	Not detected - elevated reporting limit
YH71	VOCs	Acetone	110 QY	UJ	WM-GP-30-6.5-8	Not detected - elevated reporting limit
YH71	VOCs	Acetone	250 QY	UJ	WM-MW-4-11-12	Not detected - elevated reporting limit
YH71	VOCs	Acetone	200 QY	UJ	WM-GP-32-12-13	Not detected - elevated reporting limit
YH71	VOCs	Acetone	390 QY	UJ	WM-GP-21-7-8	Not detected - elevated reporting limit
YH71	VOCs	Acetone	100 QY	UJ	WM-GP-33-6-7	Not detected - elevated reporting limit
YH71	VOCs	Acetone	50 QY	UJ	WM-GP-34-6-7	Not detected - elevated reporting limit
YI44	Conv.	Total Organic Carbon	1.51	J	WM-GP-25-6-7	High laboratory duplicate RPDs + Low MS recovery
YI99	PAHs	Chrysene	42	J	WM-MW-6-6-7	High MS/MSD RPD
YI99	Total Metals	Arsenic	6.9	J	WM-GP-31-7-8	High laboratory duplicate RPD
YI99	Total Metals	Copper	106	J	WM-GP-31-7-8	High laboratory duplicate RPD
YI99	Total Metals	Copper	106	J	WM-GP-31-7-8	High MS recovery
YI99	Total Metals	Mercury	0.83	J	WM-GP-31-7-8	Low MS recovery
YK90	Total Metals	Mercury	0.03	J	WM-GP-4-5-6-100913	Analyzed outside hold time
YK90	Total Metals	Mercury	0.02 U	UJ	WM-GP-3-5-6-100913	Analyzed outside hold time
YK90	Total Metals	Mercury	0.11	J	WM-GP-24-5-6	Analyzed outside hold time
YM64	Total Metals	Mercury	1.01	J	WM-GP-31-10-11	Analyzed outside hold time
YN60	PAHs	Benzo(g,h,i)perylene	48 U	UJ	WM-GP-12-5-6-100813	Low continuing calibration recovery
YN60	PAHs	Benzo(g,h,i)perylene	4.8 U	UJ	WM-GP-30-14-15	Low continuing calibration recovery
YN60	Total Metals	Mercury	0.02 U	UJ	WM-GP-17-5-6-100813	Analyzed outside hold time
YN60	Total Metals	Mercury	0.10	J	WM-GP-12-5-6-100813	Analyzed outside hold time
YN60	Total Metals	Mercury	0.02 U	UJ	WM-GP-9-5-6.5-100813	Analyzed outside hold time
YN60	Total Metals	Mercury	0.03 U	UJ	WM-GP-8-5-6-100913	Analyzed outside hold time
YN60	Total Metals	Mercury	0.03	J	WM-MW-5-7-8	Analyzed outside hold time
YN60	Total Metals	Mercury	0.31	J	WM-GP-29-5-6	Analyzed outside hold time
YN60	Total Metals	Mercury	0.03 U	UJ	WM-GP-29-6-7	Analyzed outside hold time
YN60	Total Metals	Mercury	0.03 U	UJ	WM-GP-31-11-12	Analyzed outside hold time
YN60	Total Metals	Mercury	0.02 U	UJ	WM-GP-30-14-15	Analyzed outside hold time
YN60	Total Metals	Mercury	0.04 U	UJ	WM-GP-26-6-7	Analyzed outside hold time

Notes

DNR = Do not report.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = Indicates the compound was not detected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

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TECHNICAL MEMORANDUM

TO: Larry Beard, Project Manager

ASH KES

FROM: Anne Halvorsen and Kristi Schultz

DATE: March 31, 2015

RE: **SEDIMENT SAMPLING LABORATORY DATA VERIFICATION AND VALIDATION**
WESTMAN MARINE
BELLINGHAM, WASHINGTON

This technical memorandum provides the results of verification and validation checks of analytical data for 42 sediment samples collected during sampling events occurring on October 8, 2013, and April 10 and 14, 2014 at the Westman Marine site located in Bellingham, Washington. The samples were collected and analyzed as part of the Westman Marine remedial investigation. All sample analyses were conducted at Analytical Resources, Inc. (ARI) laboratory, located in Tukwila, Washington, or SGS Environmental Services, located in Wilmington, North Carolina. This data quality evaluation covers ARI data packages XJ39/XJ74, YG22, YG58, YJ24, YJ78, YL41, YM09, YM32, ZP61, ZP77, ZR58, and ZV88.

Sediment samples were analyzed for some or all of the following: semivolatile organic compounds (SVOCs) using U.S. Environmental Protection Agency (EPA) Method SW8270D and SW8270D-SIM; tributyl tins (TBT; bulk and porewater) using method Krone 1988-SIM or SW8270D-SIM; polychlorinated biphenyls (PCBs) using EPA Method SW8082; PCB congeners using EPA Method 1668A; total metals using EPA Methods 6010C or 200.8 and 7471A; total volatile solids (TVS) using EPA Method SM2540E or SM2540G; preserved total solids and total solids using EPA Method SM2540G; ammonia using EPA Method 350.1M; sulfide using EPA Method 376.2 or SM4500-S2D; total organic carbon (TOC) using method Plumb, 1981; and grain size distribution analysis by Puget Sound Estuary Protocol (PSEP) methodology. The verification and validation checks were performed on the analytical data associated with these analyses with the exception of the grain size distribution.

The verification and validation checks were conducted in accordance with the *Marine Sediment Sampling and Analysis Plan, Westman Marine Site, Blaine, Washington* (Landau Associates 2013), and with guidance from applicable portions of the *National Functional Guidelines for Organic Data Review* (EPA 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).

- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below.

LABORATORY DATA PACKAGE COMPLETENESS

Each laboratory data package contained a signed chain-of-custody, a cooler receipt form documenting the condition of the samples upon receipt at the laboratory, a cooler temperature compliance form, sample analytical results, and quality control results (method blanks, surrogate recoveries, laboratory control sample results, and replicate sample results). A case narrative identifying any complications was also provided with each laboratory data package. Definitions of laboratory qualifiers and quality control acceptance criteria were provided, as appropriate.

SAMPLE CONDITIONS AND ANALYSIS

The laboratory received the samples in good condition and all analyses were performed as requested. Preservation of samples, as specified by the analytical method, was verified by the laboratory and adjusted as appropriate.

Upon receipt by ARI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. Four coolers were received with temperatures slightly below the EPA-recommended lower limit of 2°C. Because the samples were not frozen upon receipt at the laboratory and the samples were submitted to the laboratory within a few hours following sample collection, no qualification was determined necessary due to low cooler temperatures.

HOLDING TIMES

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA and project-specified holding times, with the following exception:

- The total metals (mercury) analysis associated with sample WM-SC-2(3.5-5) in data package YJ78 was completed 7 days outside the method-recommended hold time. The associated sample result was qualified as estimated (J, UJ), as indicated in Table 1.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples. No contamination was detected in any of the method blanks, with the following exceptions:

- Diethylphthalate was detected in the method blank associated with the SVOC analyses included in data package XJ39/XJ74. Associated sample results with concentrations of diethylphthalate below the action level[1] were qualified as not detected (U), as indicated in Table 1. Associated sample results with concentrations of diethylphthalate above the action level should be reported as detections and the “B” flag reported by the laboratory should be removed.
- Butyltin ion was detected in the method blank associated with the porewater TBT analysis included in data package XJ39/XJ74. Associated sample results with concentrations of butyltin ion below the action level were qualified as not detected (U), as indicated in Table 1. Associated sample results with concentrations of butyltin ion above the action level should be reported as detections and the “B” flag reported by the laboratory should be removed.
- Bis(2-ethylhexyl)phthalate was detected in the method blank associated with the SVOC analyses included in data package YG22. Associated sample results with concentrations of bis(2-ethylhexyl)phthalate below the action level were qualified as not detected (U), as indicated in Table 1. Associated sample results with concentrations of bis(2-ethylhexyl)phthalate above the action level should be reported as detections and the “B” flag reported by the laboratory should be removed.
- Numerous PCB congeners were detected in the method blank associated with the PCB congeners analysis in data package ZR58. Associated sample results with concentrations of the affected compounds below the action level were qualified as not detected (U), as indicated in Table 1. Associated sample results with concentrations of the affected compounds above the action level should be reported as detections and the “B” flag reported by the laboratory should be removed.

SURROGATE RECOVERIES

Appropriate compounds were used as surrogate spikes for the PCB, SVOC, SVOC SIM, and TBT analyses. Recovery values for the surrogate spikes were within the current laboratory-specified control limits for all samples. No qualification of the data was necessary.

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[1] The action level is defined as 10 times the concentration in the blank for common volatile laboratory contaminants (methylene chloride, acetone, 2-butanone, cyclohexane, and phthalates), or 5 times the concentration for other target compounds (EPA 1999).

MATRIX SPIKE (MS)/MATRIX SPIKE DUPLICATE (MSD) RESULTS AND LABORATORY DUPLICATE/MATRIX DUPLICATE RESULTS

A MS/MSD or laboratory duplicate or matrix duplicate and/or MS were analyzed with several of the SVOCs, SIM SVOCs, TBT, PCBs, total metals, and conventionals analyses. The recovery values for each required spiking compound were within the laboratory-specified control limits for all project samples with the following exceptions:

- The MS/MSD recoveries for hexachloroethane, n-nitrosodiphenylamine, and pyrene associated with the SVOCs analysis for sample WM-SG-15 in data package XJ39/XJ74 either exceeded or were below the laboratory-specified control limits; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The MS and/or MSD recoveries for several compounds associated with the SVOCs analysis for samples WM-SG-15 and WM-SG-DUP in data package XJ39/XJ74 were outside the laboratory-specified control limits. The corresponding MS or MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for fluoranthene associated with the SVOCs analysis for sample WM-SG-DUP in data package XJ39/XJ74 exceeded the laboratory-specified control limits; the associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MS and/or MSD recoveries for dibenz(a,h)anthracene and n-nitrosodiphenylamine associated with the SIM SVOCs analysis for sample WM-SG-15 in data package XJ39/XJ74 were outside the laboratory-specified control limits. The corresponding MS or MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for dibutyltin ion associated with the bulk TBT analysis for sample WM-SG-15 in data package XJ39/XJ74 were below the laboratory-specified control limits; the associated sample result was qualified as estimated (J, UJ), as indicated in Table 1.
- The MS/MSD recoveries for several compounds associated with the bulk TBT analysis for sample WM-SG-DUP in data package XJ39/XJ74 exceeded the laboratory-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS recoveries for chromium, copper, and zinc associated with the total metals analysis for sample WM-SG-15 in data package XJ39/XJ74 were below the laboratory-specified control limit. The original sample concentrations were greater than four times the spike concentrations, therefore control limits did not apply and no qualification of the data was necessary.
- The MS recoveries for lead and mercury associated with the total metals analysis for sample WM-SG-15 in data package XJ39/XJ74 either exceeded or were below the laboratory-specified control limits; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The MS recoveries for copper and zinc associated with the total metals analysis for sample WM-SG-DUP in data package XJ39/XJ74 were below the laboratory-specified control limits; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The MS recoveries for sulfide and TOC associated with the conventionals analysis for sample WM-SG-15 in data package XJ39/XJ74 either exceeded or were below the laboratory-specified control limit; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The MS/MSD recoveries for hexachloroethane associated with the SVOCs analysis for sample WM-SG-19 in data package YG22 was below the laboratory-specified control limit; the associated sample result was qualified as estimated (J, UJ), as indicated in Table 1.
- The MS recovery for benzo(g,h,i)perylene associated with the SVOCs analysis for sample WM-SG-19 in data package YG22 was below the laboratory-specified control limit. The corresponding MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS recovery for aroclor 1260 associated with the PCBs analysis for sample WM-SG-20 in data package YG22 was below the laboratory-specified control limit. The corresponding MSD recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for di-n-butylphthalate associated with the SVOCs analysis for sample WM-SC-10(1-2.5) in data package YG58 exceeded the laboratory-specified control limit. The associated sample result was not detected; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for dibutyltin ion associated with the bulk TBT analysis for sample WM-SC-10(1-2.5) in data package YG58 exceeded the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MSD recoveries for tributyltin ion and butyltin ion associated with the bulk TBT analysis for sample WM-SC-10(1-2.5) in data package YG58 exceeded the laboratory-specified control limits. The corresponding MS recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.
- The MS/MSD recoveries for aroclor 1260 associated with the PCBs analysis for sample WM-SC-10(1-2.5) in data package YG58 was not available due to a calculated negative recovery. No qualification of the data was deemed necessary.
- The MS recoveries for TOC associated with the conventionals analysis for samples WM-SC-10(1-2.5) in data package YG58, WM-SG-26 in data package YL41, and WM-SG-25 in data package YM09 were below the laboratory-specified control limit. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The MS recovery for tributyltin ion associated with the bulk TBT analysis for sample WM-SG-30 in data package ZP61 was below the laboratory-specified control limit; the MSD recovery was a calculated negative recovery. No qualification of the data was determined necessary.
- The MS/MSD recoveries for dibutyltin ion associated with the bulk TBT analysis for sample WM-SG-30 in data package ZP61 was not available due to a calculated negative recovery. No qualification of the data was deemed necessary.
- The MS recoveries for copper and zinc associated with the total metals analysis for sample WM-SG-29 in data package ZP61 were below the laboratory-specified control limits. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS recovery for sulfide associated with the conventionals analysis for sample WM-SC-31 (1.5-3) in data package ZP77 was below the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.

A laboratory-specified control limit of 20 percent was used to evaluate the relative percent differences (RPDs) between the laboratory replicate or matrix duplicate results or a project-specified control limit of 35 percent was used to evaluate the RPDs between the MS/MSDs, except when the samples were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus two times the reporting limit was used. The RPDs between the laboratory replicate results or matrix duplicate results or MS/MSD were within the current laboratory- or project-specified control limits for all project samples with the following exceptions:

- The MS/MSD RPDs for several compounds associated with the SVOCs analysis for samples WM-SG-15 and WM-SG-DUP in data package XJ39/XJ74 exceeded the laboratory-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPDs for diethylphthalate and n-nitrosodiphenylamine associated with the SVOCs analysis for sample WM-SG-15 in data package XJ39/XJ74 exceeded the project-specified control limit. The associated sample results were not detected (or were determined to be not detected due to method blank contamination); therefore, no qualification of the data was necessary.
- The MS/MSD RPD for hexachloroethane associated with the SVOCs analysis for sample WM-SG-15 in data package XJ39/XJ74 was not available due to the calculated negative percent recovery of the MSD. No qualification of the data was deemed necessary.
- The MS/MSD RPD for hexachloroethane associated with the SVOCs analysis for sample WM-SG-DUP in data package XJ39/XJ74 exceeded the project-specified control limit. The associated sample result was not detected; therefore, no qualification of the data was necessary.
- The MS/MSD RPD for dibenz(a,h)anthracene associated with the SIM SVOCs analysis of sample WM-SG-15 in data package XJ39/XJ74 exceeded the project-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPDs for n-nitrosodiphenylamine and benzyl alcohol associated with the SIM SVOCs analysis of sample WM-SG-15 in data package XJ39/XJ74 exceeded the project-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The MS/MSD RPDs for dibutyltin ion, butyltin ion, and/or tributyltin ion associated with the bulk TBT analysis of samples WM-SG-15 and WM-SG-DUP in data package XJ39/XJ74 exceeded the project-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for chromium, copper, lead, and zinc associated with the total metals analysis of sample WM-SG-15 in data package XJ39/XJ74 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for copper and zinc associated with the total metals analysis of sample WM-SG-DUP in data package XJ39/XJ74 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPDs for benzoic acid and pentachlorophenol associated with the SVOCs analysis for sample WM-SG-19 in data package YG22 exceeded the project-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The MS/MSD RPDs for several compounds associated with the SVOCs analysis for sample WM-SG-19 in data package YG22 exceeded the project-specified control limit. The

associated MS/MSD recoveries were within the laboratory-specified control limits; therefore, no qualification of the data was deemed necessary.

- The MS/MSD RPD for benzo(g,h,i)perylene associated with the SVOCs analysis for sample WM-SG-19 in data package YG22 exceeded the project-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPD for dibenz(a,h)anthracene associated with the SIM SVOCs analysis for sample WM-SG-19 in data package YG22 exceeded the project-specified control limit. The associated MS/MSD recoveries were within the laboratory-specified control limits; therefore, no qualification of the data was deemed necessary.
- The MS/MSD RPD for pentachlorophenol associated with the SIM SVOCs analysis for sample WM-SG-19 in data package YG22 exceeded the project-specified control limit. The associated sample result was not detected; therefore, no qualification of the data was necessary.
- The laboratory duplicate RPDs for multiple compounds associated with the SVOCs analysis for sample WM-SC-2(1-2) in data package YG58 exceeded either the laboratory-specified control limit or the project-specified control limit of plus or minus two times the reporting limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The MS/MSD RPDs for dibutyltin ion and butyltin ion associated with the bulk TBT analysis for sample WM-SC-10(1-2.5) in data package YG58 exceeded the project-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPDs for several compounds associated with the total metals analysis for sample WM-SC-2(1-2) in data package YG58 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPD for ammonia associated with the conventionals analysis for sample WM-SG-34 in data package ZP61 exceeded the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.
- The laboratory duplicate RPD for sulfide associated with the conventionals analysis for sample WM-SG-31 (1.5-3) in data package ZP77 exceeded the laboratory-specified control limit. The associated sample result was qualified as estimated (J), as indicated in Table 1.

LABORATORY CONTROL SAMPLE (LCS), LABORATORY CONTROL SAMPLE DUPLICATE (LCSD), AND STANDARD REFERENCE MATERIAL (SRM) RESULTS

At least one laboratory control sample (LCS) and/or laboratory control sample duplicate (LCSD) or sample reference material (SRM) was analyzed with each batch of samples. Recoveries for each LCS and/or LCSD and the RPDs were within the current laboratory-specified control limits, with the following exceptions:

- The LCS recovery of acenaphthylene associated with the SVOCs analysis in data package XJ39/XJ74 was below the laboratory-specified control limit. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The LCS/LCSD RPD for acenaphthylene associated with the SVOCs analysis in data package XJ39/XJ74 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.

- The LCS/LCSD recovery of butyltin ion associated with the porewater TBT analysis in data package XJ39/XJ74 was below the laboratory-specified control limit. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The LCS/LCSD RPDs for benzoic acid and pentachlorophenol associated with the SVOCs analysis in data package YG22 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCDS RPD for dibenz(a,h)anthracene associated with the SIM SVOCs analysis in data package YG22 exceeded the laboratory-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The LCS/LCSD RPD for pentachlorophenol associated with the SIM SVOCs analysis in data package YG22 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.
- The LCS/LCSD RPD for 2,4-dimethylphenol associated with the SVOCs and SIM SVOCs analysis in data package YG58 exceeded the laboratory-specified control limit. The associated sample results were not detected; therefore, no qualification of the data was necessary.

BLIND FIELD DUPLICATES

One pair of blind field duplicate sediment samples (WM-SG-05/WM-SG-DUP) was submitted for analysis with data package XJ39/XJ74 and analyzed for SVOCs, SIM SVOCs, bulk and porewater TBT, PCBs, conventionals, and total metals.

A project-specified control limit of 35 percent was used to evaluate the RPDs between the duplicate sediment samples, except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus two times the reporting limit was used. RPDs for the duplicate sample pair submitted for analysis were within the project-specified control limits with the following exceptions:

- The RPDs for several compounds associated with the SVOCs analysis for sample pair WM-SG-05/WM-SG-DUP exceeded the project-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The RPD for tributyltin ion associated with the sediment TBT analysis for sample pair WM-SG-05/WM-SG-DUP exceeded the project-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.
- The RPD for zinc associated with the total metals analysis for sample pair WM-SG-05/WM-SG-DUP exceeded the project-specified control limit; the associated sample results were qualified as estimated (J), as indicated in Table 1.

INITIAL AND CONTINUING CALIBRATION

Laboratory-specified calibration limits for initial and continuing calibrations were met for all analyses, with the following exceptions:

- The 10/22/13 SVOC continuing calibrations (CCALs) for analyses reported in data package XJ39/XJ74 were low for benzoic acid and pentachlorophenol; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The 10/23/13 SVOC CCALs for analysis reported in data package XJ39/XJ74 were high for benzoic acid and pentachlorophenol. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The 10/24/13 SVOC CCALs for analysis reported in data package XJ39/XJ74 were high for fluoranthene and pyrene. The associated sample results were qualified as estimated (J), as indicated in Table 1.
- The SIM SVOCs CCALs for analysis reported in data package XJ39/XJ74 were low for pentachlorophenol for all samples and low for dibenz(a,h)anthracene for select samples; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The SVOCs CCALs for analysis reported in data package YG22 were high for butylbenzylphthalate. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The SVOCs CCALs for analysis reported in data package YG22 were low for benzoic acid and pentachlorophenol; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The SIM SVOCs CCALs for analysis reported in data package YG22 were low for pentachlorophenol and high for butylbenzylphthalate; the associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The SVOCs CCALs percent difference for analysis reported in data package YG58 was high for benzyl alcohol, benzoic acid, and pentachlorophenol. Associated sample results were not detected; therefore, no qualification of the data was necessary.
- The SIM SVOCs CCALs percent difference for analysis reported in data package YG58 was high for pentachlorophenol. Associated sample results were qualified as estimated (J), as indicated in Table 1.
- The SIM SVOCs CCALs percent difference for analysis reported in data package YG58 was high for benzyl alcohol. Associated sample results were not detected; therefore, no qualification of the data was necessary.

ADDITIONAL QUALITY CONTROL ACTION

Additional quality control measures taken by the laboratory included the following:

- During the PCBs analysis for samples reported in data package YG58, the percent difference for the surrogate tetrachlorometaxylene exceeded the laboratory-specified control limit on one of the instrument columns. The percent difference for tetrachlorometaxylene on the secondary column was within laboratory-specified control limits. Affected results were reported from the secondary instrument column. No qualification of the data was determined necessary.
- The laboratory noted that the cleanup standard for CS PCB-28 was high during the PCB congener analysis reported in data package ZR58. Associated detected sample concentrations were qualified as estimated (J), as indicated in Table 1.

COMPLETENESS AND OVERALL DATA QUALITY

The completeness for this data set is 100 percent, which meets the project-specified goal of 95 percent minimum.

Data precision was evaluated through laboratory control sample duplicates, matrix spike duplicates, laboratory duplicates, and blind field duplicates. Data accuracy was evaluated through matrix spikes, laboratory control samples, and surrogate spikes. Based on this data quality verification and validation, all of the data were determined to be acceptable. No data were rejected.

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TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Analytical Group	Analyte	Result	Qualifier	Sample Number	Reason
XJ39/XJ74	SVOCs	Diethylphthalate	44 B	44 U	WM-SG-12	Method blank contamination
XJ39/XJ74	SVOCs	Diethylphthalate	21 B	21 U	WM-SG-10	Method blank contamination
XJ39/XJ74	SVOCs	Diethylphthalate	79 B	79 U	WM-SG-09	Method blank contamination
XJ39/XJ74	SVOCs	Diethylphthalate	230 B	230 U	WM-SG-08	Method blank contamination
XJ39/XJ74	SVOCs	Diethylphthalate	25 B	25 U	WM-SG-15	Method blank contamination
XJ39/XJ74	SVOCs	Hexachloroethane	19 U	UJ	WM-SG-15	Low MS/MSD recovery
XJ39/XJ74	SVOCs	N-Nitrosodiphenylamine	19 U	UJ	WM-SG-15	Low MS/MSD recovery
XJ39/XJ74	SVOCs	Pyrene	710	J	WM-SG-15	High MS/MSD recovery
XJ39/XJ74	SVOCs	2-Methylnaphthalene	66	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Dimethyphthalate	98	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	24	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Acenaphthene	27	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Dibenzofuran	36	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Fluorene	44	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Phenanthrene	430	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Anthracene	81	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Fluoranthene	790	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Pyrene	710	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Benzo(a)anthracene	300	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	bis(2-Ethylhexyl)phthalate	83	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Chrysene	500	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Benzo(a)pyrene	310	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Indeno(1,2,3-cd)pyrene	120	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Dibenz(a,h)anthracene	42	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Benzo(g,h,i)perylene	130	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	1-Methynaphthalene	36	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Total Benzofluoranthenes	850	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SVOCs	Fluoranthene	360	J	WM-SG-DUP	High MS/MSD recovery
XJ39/XJ74	SVOCs	Anthracene	56	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Fluoranthene	360	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Pyrene	440	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Benzo(a)anthracene	140	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	bis(2-Ethylhexyl)phthalate	110	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Chrysene	320	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Benzo(a)pyrene	160	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Total Benzofluoranthenes	480	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	16 J	J	WM-SG-07	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	9.2 J	J	WM-SG-04	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	110	J	WM-SG-14	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	55	J	WM-SG-01	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	29	J	WM-SG-05	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	13 J	J	WM-SG-06	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	44	J	WM-SG-12	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	18 J	J	WM-SG-13	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	59	J	WM-SG-11	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	48	J	WM-SG-10	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	42	J	WM-SG-02	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	25	J	WM-SG-03	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	16 J	J	WM-SG-09	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	41	J	WM-SG-08	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	24	J	WM-SG-15	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Acenaphthylene	23	J	WM-SG-DUP	Low LCS recovery; High LCS/LCSD RPD
XJ39/XJ74	SVOCs	Benzoic Acid	190 U	UJ	WM-SG-07	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	95 U	UJ	WM-SG-07	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	180 U	UJ	WM-SG-04	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	92 U	UJ	WM-SG-04	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	280 Q	J	WM-SG-14	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	350 Q	J	WM-SG-14	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	180 U	UJ	WM-SG-05	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	92 U	UJ	WM-SG-05	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	180 U	UJ	WM-SG-06	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	91 U	UJ	WM-SG-06	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	200 Q	J	WM-SG-12	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	94 U	UJ	WM-SG-12	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	190 U	UJ	WM-SG-13	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	97 U	UJ	WM-SG-13	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	200 U	UJ	WM-SG-11	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	99 U	UJ	WM-SG-11	Low continuing calibration recovery

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
XJ39/XJ74	SVOCs	Benzoic Acid	150 QJ	J	WM-SG-10	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	48 QJ	J	WM-SG-10	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	200 U	UJ	WM-SG-02	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	75 QJ	J	WM-SG-02	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	190 U	UJ	WM-SG-03	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	93 U	UJ	WM-SG-03	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	200 U	UJ	WM-SG-09	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	98 U	UJ	WM-SG-09	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Benzoic Acid	160 QJ	J	WM-SG-08	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Pentachlorophenol	94 U	UJ	WM-SG-08	Low continuing calibration recovery
XJ39/XJ74	SVOCs	Fluoranthene	6500 Q	J	WM-SG-14	High continuing calibration recovery
XJ39/XJ74	SVOCs	Pyrene	3500 Q	J	WM-SG-14	High continuing calibration recovery
XJ39/XJ74	SVOCs	Phenol	45	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Phenol	190	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Phenanthrene	710	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Phenanthrene	130	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Fluoranthene	1400	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Fluoranthene	360	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Pyrene	980	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Pyrene	440	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Chrysene	510	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Chrysene	320	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Indeno(1,2,3-cd)pyrene	140	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Indeno(1,2,3-cd)pyrene	67	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Benzo(g,h,i)perylene	150	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Benzo(g,h,i)perylene	96	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SVOCs	Total Benzofluoranthenes	740	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	SVOCs	Total Benzofluoranthenes	480	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	SIM SVOCs	Dibenz(a,h)anthracene	41	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	19 U	UJ	WM-SG-07	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	18 U	UJ	WM-SG-04	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	270	J	WM-SG-14	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	58	J	WM-SG-01	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	18 U	UJ	WM-SG-05	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	18 U	UJ	WM-SG-06	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	14 J	J	WM-SG-12	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	19 U	UJ	WM-SG-13	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	20 U	UJ	WM-SG-11	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	35	J	WM-SG-10	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	54	J	WM-SG-02	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	19 U	UJ	WM-SG-03	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	20 U	UJ	WM-SG-09	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	13 J	J	WM-SG-08	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Dibenz(a,h)anthracene	41	J	WM-SG-15	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	20	J	WM-SG-15	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Dibenz(a,h)anthracene	25	J	WM-SG-DUP	Low continuing calibration recovery
XJ39/XJ74	SIM SVOCs	Pentachlorophenol	12 J	J	WM-SG-DUP	Low continuing calibration recovery
XJ39/XJ74	TBT (sed)	Dibutyltin Ion	30	J	WM-SG-15	Low MS/MSD recovery
XJ39/XJ74	TBT (sed)	Tributyltin Ion	160	J	WM-SG-DUP	High MS/MSD recovery
XJ39/XJ74	TBT (sed)	Dibutyltin Ion	65	J	WM-SG-DUP	High MS/MSD recovery
XJ39/XJ74	TBT (sed)	Butyltin Ion	23	J	WM-SG-DUP	High MS/MSD recovery
XJ39/XJ74	TBT (sed)	Dibutyltin Ion	30	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	TBT (sed)	Butyltin Ion	8.7	J	WM-SG-15	High MS/MSD RPD
XJ39/XJ74	TBT (sed)	Tributyltin Ion	160	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	TBT (sed)	Dibutyltin Ion	65	J	WM-SG-DUP	High MS/MSD RPD
XJ39/XJ74	TBT (sed)	Tributyltin Ion	290	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	TBT (sed)	Tributyltin Ion	160	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.010 B	0.010 U	WM-SG-07	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.015 B	0.015 U	WM-SG-04	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025 B	none	WM-SG-14	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025 B	none	WM-SG-01	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.044 B	none	WM-SG-05	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.012 B	0.012 U	WM-SG-06	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025 B	none	WM-SG-12	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.022 B	none	WM-SG-13	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.014 B	0.014 U	WM-SG-11	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.020 B	0.020 U	WM-SG-10	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.023 B	none	WM-SG-02	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.056 B	none	WM-SG-03	No B Qual. - Conc. above MB action level

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.023 B	none	WM-SG-09	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.020 B	0.020 U	WM-SG-08	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.016 B	0.016 U	WM-SG-15	Method blank contamination
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.041 B	none	WM-SG-DUP	No B Qual. - Conc. above MB action level
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.010 U	UJ	WM-SG-07	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.015 U	UJ	WM-SG-04	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025	J	WM-SG-14	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025	J	WM-SG-01	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.044	J	WM-SG-05	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.012 U	UJ	WM-SG-06	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.025	J	WM-SG-12	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.022	J	WM-SG-13	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.014 U	UJ	WM-SG-11	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.020 U	UJ	WM-SG-10	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.023	J	WM-SG-02	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.056	J	WM-SG-03	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.023	J	WM-SG-09	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.020 U	UJ	WM-SG-08	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.016 U	UJ	WM-SG-15	Low LCS/LCSD recovery
XJ39/XJ74	TBT (pore)	Butyltin Ion	0.041	J	WM-SG-DUP	Low LCS/LCSD recovery
XJ39/XJ74	Metals	Lead	133	J	WM-SG-15	Low MS recovery
XJ39/XJ74	Metals	Mercury	0.14	J	WM-SG-15	High MS recovery
XJ39/XJ74	Metals	Copper	209	J	WM-SG-DUP	Low MS recovery
XJ39/XJ74	Metals	Zinc	249	J	WM-SG-DUP	Low MS recovery
XJ39/XJ74	Metals	Chromium	663	J	WM-SG-15	High laboratory duplicate RPD
XJ39/XJ74	Metals	Copper	13100	J	WM-SG-15	High laboratory duplicate RPD
XJ39/XJ74	Metals	Lead	133	J	WM-SG-15	High laboratory duplicate RPD
XJ39/XJ74	Metals	Zinc	1170	J	WM-SG-15	High laboratory duplicate RPD
XJ39/XJ74	Metals	Copper	209	J	WM-SG-DUP	High laboratory duplicate RPD
XJ39/XJ74	Metals	Zinc	249	J	WM-SG-DUP	High laboratory duplicate RPD
XJ39/XJ74	Metals	Zinc	90	J	WM-SG-05	High field duplicate RPD
XJ39/XJ74	Metals	Zinc	249	J	WM-SG-DUP	High field duplicate RPD
XJ39/XJ74	Conv.	Sulfide	2710	J	WM-SG-15	High MS recovery
XJ39/XJ74	Conv.	Total Organic Carbon	2.32	J	WM-SG-15	Low MS recovery
YG22	SVOCs	Hexachloroethane	20 U	UJ	WM-SG-19	Low MS/MSD recovery
YG22	SVOCs	Benzo(g,h,i)perylene	58	J	WM-SG-19	High MS/MSD RPD
YG22	SVOCs	bis(2-Ethylhexyl)phthalate	240	U	WM-SG-20	Method blank contamination
YG22	SVOCs	bis(2-Ethylhexyl)phthalate	51	U	WM-SG-18	Method blank contamination
YG22	SVOCs	bis(2-Ethylhexyl)phthalate	150	U	WM-SG-19	Method blank contamination
YG22	SVOCs	Benzoic Acid	200 U	UJ	WM-SG-18	Low continuing calibration recovery
YG22	SVOCs	Benzoic Acid	200 U	UJ	WM-SG-19	Low continuing calibration recovery
YG22	SVOCs	Benzoic Acid	580 U	UJ	WM-SG-20	Low continuing calibration recovery
YG22	SVOCs	Pentachlorophenol	98 U	UJ	WM-SG-18	Low continuing calibration recovery
YG22	SVOCs	Pentachlorophenol	100 U	UJ	WM-SG-19	Low continuing calibration recovery
YG22	SVOCs	Pentachlorophenol	290 U	UJ	WM-SG-20	Low continuing calibration recovery
YG22	SIM SVOCs	Dibenz(a,h)anthracene	18	J	WM-SG-19	High LCS/LCSD RPD
YG22	SIM SVOCs	Butylbenzylphthalate	12 J	J	WM-SG-20	High continuing calibration recovery
YG22	SIM SVOCs	Pentachlorophenol	58 U	UJ	WM-SG-20	Low continuing calibration recovery
YG22	SIM SVOCs	Pentachlorophenol	20 U	UJ	WM-SG-18	Low continuing calibration recovery
YG22	SIM SVOCs	Pentachlorophenol	20 U	UJ	WM-SG-19	Low continuing calibration recovery
YG22	SIM SVOCs	Butylbenzylphthalate	5.5	J	WM-SG-19	High continuing calibration recovery
YG58	SVOCs	Acenaphthylene	22	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	SVOCs	Fluoranthene	460	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	SVOCs	Pyrene	720	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	SVOCs	Chrysene	330	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	SIM SVOCs	Pentachlorophenol	23 Q	J	WM-SC-10(1-2.5)	High continuing calibration recovery %D
YG58	SIM SVOCs	Pentachlorophenol	36 Q	J	WM-SC-2(1-2)	High continuing calibration recovery %D
YG58	TBT	Dibutyltin Ion	29	J	WM-SC-10(1-2.5)	High MS/MSD recovery
YG58	TBT	Dibutyltin Ion	29	J	WM-SC-10(1-2.5)	High MS/MSD RPD
YG58	TBT	Butyltin Ion	5.2	J	WM-SC-10(1-2.5)	High MS/MSD RPD
YG58	Metals	Arsenic	3.7	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Metals	Chromium	12.1	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Metals	Copper	253	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Metals	Lead	19.2	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Metals	Mercury	0.36	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Metals	Zinc	174	J	WM-SC-2(1-2)	High laboratory duplicate RPD
YG58	Conv.	Total Organic Carbon	0.697	J	WM-SC-10(1-2.5)	Low MS recovery
YJ78	Metals	Mercury	0.13	J	WM-SC-2(3.5-5)	Analyzed outside hold time
YL41	Conv.	Total Organic Carbon	0.907	J	WM-SG-26	Low MS recovery

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
YM09	Conv.	Total Organic Carbon	0.356	J	WM-SG-25	Low MS recovery
ZP61	Conv.	Ammonia	31.2	J	WM-SG-34	High laboratory duplicate RPD
ZP61	Metals	Copper	155	J	WM-SG-29	Low MS recovery
ZP61	Metals	Zinc	141	J	WM-SG-29	Low MS recovery
ZP77	Conv.	Sulfide	90.5	J	WM-SC-31 (1.5-3)	Low MS recovery; High laboratory duplicate RPD
ZR58	PCBs	PCB-28	574 C	CJ	WM-SG-20	Cleanup standards exceeded recovery range
ZR58	PCBs	PCB-28	463 C	CJ	WM-SG-22	Cleanup standards exceeded recovery range
ZR58	PCBs	PCB-28	142 C	CJ	WM-SG-24	Cleanup standards exceeded recovery range
ZR58	PCBs	PCB-28	38.5 C	CJ	WM-SG-27	Cleanup standards exceeded recovery range
ZR58	PCBs	PCB-28	1130 C	CJ	WM-SG-31	Cleanup standards exceeded recovery range
ZR58	PCBs	PCB-11 33'-DiCB	23.7	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-23 235-TrCB	0.186	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-24 236-TrCB	0.137	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-41 22'34-TeCB	0.127	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-73 23'5'6-TeCB	0.0784	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-88 22'346-PeCB	0.193	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-104 22'466'-PeCB	0.107 J	UJ	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-106 233'45-PeCB	0.165	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-112 233'56-PeCB	0.152	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-115 2344'6-PeCB	0.184	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-121 23'45'6-PeCB	0.145	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-127 33'455'-PeCB	0.159	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-142 22'3456-HxCB	0.107	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-145 22'3466'-HxCB	0.0634	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-160 233'456-HxCB	0.0802	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-161 233'45'6-HxCB	0.0739	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-165 233'55'6-HxCB	0.0788	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-186 22'34566'-HpCB	0.0747	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-204 22'344'566'-OcCB	0.113	U	WM-SG-20	Method blank contamination
ZR58	PCBs	PCB-11 33'-DiCB	43.8	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-23 235-TrCB	0.368	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-36 33'5-TrCB	0.348	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-38 345-TrCB	0.374	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-73 23'5'6-TeCB	0.188	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-88 22'346-PeCB	0.264	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-104 22'466'-PeCB	0.146	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-106 233'45-PeCB	0.226	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-112 233'56-PeCB	0.208	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-115 2344'6-PeCB	0.252	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-127 33'455'-PeCB	0.218	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-142 22'3456-HxCB	0.217	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-145 22'3466'-HxCB	0.107	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-160 233'456-HxCB	0.162	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-161 233'45'6-HxCB	0.15	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-165 233'55'6-HxCB	0.16	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-186 22'34566'-HpCB	0.197	U	WM-SG-22	Method blank contamination
ZR58	PCBs	PCB-10 26-DiCB	0.146	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-11 33'-DiCB	38.2	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-23 235-TrCB	0.24	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-26/29 23'5/245-TrCB	0.238	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-38 345-TrCB	0.245	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-41 22'34-TeCB	0.238	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-43 22'35-TeCB	0.257	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-56 233'4'-TeCB	0.39	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-57 233'5-TeCB	0.371	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-58 233'5'-TeCB	0.356	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-73 23'5'6-TeCB	0.146	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-78 33'45-TeCB	0.39	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-80 33'55'-TeCB	0.322	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-81 344'5-TeCB	0.413	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-88 22'346-PeCB	0.237	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-94 22'356'-PeCB	0.261	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-98 22'34'6'-PeCB	0.282	U	WM-SG-24	Method blank contamination

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
ZR58	PCBs	PCB-104 22'466'-PeCB	0.123	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-106 233'45-PeCB	0.203	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-111 233'55'-PeCB	0.176	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-112 233'56-PeCB	0.186	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-115 2344'6-PeCB	0.226	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-120 23'455'-PeCB	0.175	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-121 23'45'6-PeCB	0.178	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-127 33'455'-PeCB	0.204	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-145 22'3466'-HxCB	0.122	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-152 22'3566'-HxCB	0.114	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-155 22'44'66'-HxCB	0.125	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-184 22'344'66'-HpCB	0.198	U	WM-SG-24	Method blank contamination
ZR58	PCBs	PCB-186 22'34566'-HpCB	0.188	U	WM-SG-24	Method blank contamination
ZR58	PCBs	Di-CB	35.2	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-1 2-MoCB	2.31	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-3 4-MoCB	2.21	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-4 22'-DiCB	3.07 J	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-5 23-DiCB	0.0725	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-6 23'-DiCB	2.25	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-9 25-DiCB	0.541 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-10 26-DiCB	0.148 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-11 33'-DiCB	7.16	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-14 35-DiCB	0.0613	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-19 22'6-TrCB	1.24	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-23 235-TrCB	0.0908	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-24 236-TrCB	0.0775	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-34 23'5'-TrCB	0.177 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-39 34'5-TrCB	0.084	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-43 22'35-TeCB	0.0821	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-55 233'4-TeCB	0.328 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-58 233'5'-TeCB	0.0976 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-68 23'45'-TeCB	0.23 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-73 23'5'6-TeCB	0.0468	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-78 33'45-TeCB	0.0863	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-79 33'45'-TeCB	0.166 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-80 33'55'-TeCB	0.0714	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-81 344'5-TeCB	0.0915	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-88 22'346-PeCB	0.0693	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-89 22'346'-PeCB	0.0782	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-94 22'356'-PeCB	0.15 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-98 22'34'6'-PeCB	0.0825	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-100/93 22'44'6/22'356-PeCB	0.214 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-104 22'466'-PeCB	0.0463	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-106 233'45-PeCB	0.0593	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-111 233'55'-PeCB	0.0514	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-112 233'56-PeCB	0.0545	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-115 2344'6-PeCB	0.0662	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-116/85 23456/22'344'-PeCB	0.0686	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-120 23'455'-PeCB	0.165 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-121 23'45'6-PeCB	0.0522	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-122 233'4'5'-PeCB	0.0616	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-127 33'455'-PeCB	0.0569	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-131 22'33'46-HxCB	0.063	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-139/140 ...-HxCB	0.0552	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-142 22'3456-HxCB	0.0646	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-143 22'3456'-HxCB	0.0665	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-145 22'3466'-HxCB	0.0401	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-150 22'34'66'-HxCB	0.152 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-152 22'3566'-HxCB	0.0374	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-155 22'44'66'-HxCB	0.0409	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-160 233'456-HxCB	0.0483	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-161 233'45'6-HxCB	0.0445	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-162 233'4'55'-HxCB	0.0718	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-165 233'55'6-HxCB	0.0475	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-169 33'44'55'-HxCB	0.123	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-175 22'33'45'6-HpCB	0.262 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-181 22'344'56-HpCB	0.0963	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-182 22'344'56'-HpCB	0.0922	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-184 22'344'66'-HpCB	0.038	U	WM-SG-27	Method blank contamination

TABLE 1
SUMMARY OF DATA QUALIFIERS
WESTMAN MARINE
BELLINGHAM, WASHINGTON

Data Package	Group	Analyte	Result	Qualifier	Sample Number	Reason
ZR58	PCBs	PCB-186 22'34566'-HpCB	0.0361	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-189 233'44'55'-HpCB	0.253 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-191 233'44'5'6-HpCB	0.26 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-192 233'455'6-HpCB	0.0833	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-204 22'344'566'-OcCB	0.0672	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-205 233'44'55'6-OcCB	0.119	U	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-207 22'33'44'566'-NoCB	0.198 J	UJ	WM-SG-27	Method blank contamination
ZR58	PCBs	PCB-5 23-DiCB	0.145	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-11 33'-DiCB	37.4	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-73 23'5'6-TeCB	0.116	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-88 22'346-PeCB	0.255	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-98 22'34'6'-PeCB	0.304	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-106 233'45-PeCB	0.218	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-112 233'56-PeCB	0.201	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-115 2344'6-PeCB	0.244	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-127 33'455'-PeCB	0.2	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-142 22'3456-HxCB	0.209	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-143 22'3456'-HxCB	0.215	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-145 22'3466'-HxCB	0.113	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-160 233'456-HxCB	0.156	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-161 233'45'6-HxCB	0.144	U	WM-SG-31	Method blank contamination
ZR58	PCBs	PCB-165 233'55'6-HxCB	0.154	U	WM-SG-31	Method blank contamination

Notes

C = Two or more congeners co-elute.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = Indicates the compound was not detected at the reported concentration.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

APPENDIX H

Report:
Development of Marine Sediment Cleanup Levels and Sediment Management Areas

Report
Development of Marine Sediment Cleanup Levels and Sediment Management Areas
Westman Marine Inc. Site
Blaine, Washington

October 22, 2015

Prepared for

Port of Bellingham
Bellingham, Washington

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TABLE OF CONTENTS

FIGURES

TABLES

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1.0 INTRODUCTION AND BACKGROUND

This report presents proposed cleanup levels (PCLs) for marine sediment for the Westman Marine Site (Site) in Blaine, Washington (Figure 1). As recommended by the Washington State Department of Ecology (Ecology) Sediment Cleanup Users Manual II (SCUM II; Ecology 2015[1]), the development of sediment cleanup levels is closely tied to the identification of sediment management areas (SMAs) and remedial technologies that may be applied within the different SMAs. Based on this guidance, this report identifies proposed SMAs at the Site and the remedial technologies planned for evaluation for each SMA in conjunction with development of the PCLs.

The following sections present a background discussion on the development of sediment cleanup levels, the development of sediment cleanup objective (SCO) and cleanup screening level (CSL) values for Site marine sediment, the identification of Site SMAs and the remedial technologies to be applied within each SMA, and the PCLs to be applied to Site sediment to develop remedial alternatives in the feasibility study (FS).

Sediment screening levels (SLs) were developed in the remedial investigation (RI) report to provide a basis for evaluating chemical data collected in the marine portion of the Site. The SLs are further developed into PCLs for use in the feasibility study (FS) as a basis for developing and evaluating sediment cleanup alternatives. After the FS, Site cleanup levels will be established by Ecology in the cleanup action plan (CAP) for the Site.

The Sediment Management Standards [SMS; Washington Administrative Code (WAC) Chapter 173-204] provide an approach for developing sediment cleanup levels within an acceptable range of values. The lower limit of this range, the SCO, is the contaminant concentration that represents the goal for protection of human health and the environment. The upper limit of the acceptable range is the CSL, which is the maximum allowable concentration to be achieved in any cleanup action under the SMS.

The final sediment cleanup level is often established as the SCO, but can be adjusted higher (between the SCO and the CSL) if achieving and maintaining the SCO would have net adverse ecological effects. Net adverse ecological effects can result from applying active remedial technologies such as dredging or capping over large areas and potentially damaging the existing marine ecosystem. As a result, it is necessary to develop a general understanding of the cleanup approaches to consider for the Site in order to establish appropriate PCLs for use in the FS.

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[1] Ecology. 2015. Sediment Cleanup Users Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards (Chapter 173-204 WAC). Publication No. 12-09-057. Washington State Department of Ecology. March. Available at https://fortress.wa.gov/ecy/publications/SummaryPages/1209057.html.

The following sections summarize the indicator hazardous substances (IHSs) identified for Site sediment, the SCO and CSL values developed in the RI, the SMAs defined for the Site, remedial technologies applicable to each SMA, and present PCLs based on these considerations.

2.0 DEVELOPMENT OF SEDIMENT CLEANUP OBJECTIVE AND CLEANUP SCREENING LEVEL SEDIMENT QUALITY CRITERIA

Development of SCO and CSL criteria for marine sediment requires the consideration of criteria that are protective of benthic organisms, human health, and other higher trophic-level species. For most hazardous substances, benthic criteria are also considered adequately protective of human health and higher trophic-level species. However, some hazardous substances are considered to be persistent bioaccumulative toxins (PBTs) that pose a risk to human health and higher trophic-level species that is not adequately addressed by criteria based on protection of benthic organisms. As a result, criteria that account for bioaccumulative effects must be considered during the development of SCO and CSL values for PBTs.

The following sections identify Site IHSs and develop SCO and CSL values of Site IHSs, including PBTs.

2.1 Indicator Hazardous Substances

The IHSs for Site sediment were developed in the RI and consist of the following hazardous substances (bold indicates the PBTs):

- Metals (**arsenic**, **cadmium**, chromium, copper, **lead**, **mercury**, silver, and zinc)
- Semivolatile organic compounds [SVOCs, including naphthalenes and carcinogenic polycyclic aromatic hydrocarbons (**cPAHs**)]
- Polychlorinated biphenyls (**PCBs**)
- Organotins [specifically tributyltin (**TBT**)].

2.2 Protection of Benthic Species

The SMS regulations provide a table of SCO and CSL values for protection of the benthic species for most IHSs. There is also the option under the regulations to demonstrate that sediment quality is adequately protective of benthic organisms by conducting bioassay testing; a passing result provides an alternate compliance demonstration rejecting chemical criteria exceedances (i.e., bioassay testing provides more reliable and accurate toxicity information than chemical testing). However, bioassay testing does not resolve the risk to human health and higher trophic-level species for PBTs and, as a result, bioassay testing was not pursued for evaluation of Site sediment quality. Therefore, the tabulated SCO and CSL values were adopted in the RI for the evaluation of sediment quality for the protection of benthic organisms. TBT, however, does not have a numerical criterion established for protection of benthic organisms in the SMS, so Site-specific TBT criteria protective of benthic organisms were developed in the RI. The SCO criteria developed in the RI are carried forward into the FS as the PCLs for protection of benthic organisms, and are provided in Table 1.

2.3 Protection of Human Health and Higher Trophic-Level Species

For the seven Site IHSs that are considered PBTs, additional evaluation is required to develop SCO and CSL criteria protective of human health and higher trophic-level species because the SMS rule does not provide tabulated values. For these constituents, the SCO and CSL values were developed to be protective of human health and higher trophic-level organisms in accordance with SMS and guidance provided by Ecology in SCUM II, as presented in the RI/FS report.

The SCO for each PBT is the highest value of:

1) Natural background concentration
2) Analytical practical quantitation limit (PQL), or
3) A risk-based concentration (RBC) that is the lowest calculated value based on protection of the benthic community, higher trophic-level species, and human health using an allowable excess human health cancer risk of 10^{-6}.

The CSL for each PBT is the highest value of:

1) Regional background concentration (natural background if regional is not available)
2) Analytical PQL, or
3) An RBC, using an allowable excess human health cancer risk of 10^{-5}.

For the PBT metals (arsenic, cadmium, lead, and mercury), the natural background concentration was selected as the appropriate SCO. Regional background metals concentrations are not available for the Site vicinity, so CSLs are equal to natural background concentrations, resulting in CSL values that provide equivalent protection as the SCOs. The PCLs for PBT metals are listed in Table 1.

The SLs for PCBs, cPAHs, and TBT were developed by first calculating the concentrations that would be protective of higher trophic-level species and humans (described in the following section), then comparing these concentrations to the laboratory PQL and natural background concentrations. Regional background concentrations for these constituents are not available for the Site vicinity, so natural background concentrations were used.

2.4 Risk-Based Concentrations for Protection of Human Health and Higher Trophic-Level Species

The RBCs presented below were calculated in accordance with Ecology-provided parameters and equations based on the maximum reasonable Site exposure scenarios. Calculations and input parameters are provided in the RI/FS report. Since there is no practical access for clamming within Blaine Harbor, the maximum reasonable exposure scenario for Site sediment is human consumption of both finfish and crabs that may be exposed to Blaine Harbor sediment.

PCBs: In the RI/FS, RBCs were calculated for both total PCB aroclors and PCB-toxicity equivalency (TEQ) for dioxin-like congeners. However, much more PCB aroclor data were available for the Site than congener data, and the distribution of concentrations of total PCB aroclors and total PCB congeners were similar. The SCO developed for total PCB aroclors is 6 micrograms per kilogram (µg/kg) and the CSL is 53 µg/kg. The SCO and CSL for PCB TEQ for dioxin-like congeners are 0.2 picograms per gram (pg/g) and 2 pg/g, respectively.

cPAHs: For cPAHs, the SCO is 40 µg/kg and the CSL is 400 µg/kg.

TBT: The RBCs developed in the RI for TBT were higher and less protective than the benthic criteria. As a result, the TBT SCO and CSL developed for protection of benthic organisms are carried forward into the FS. SCO and CSL values for PBTs are provided in Table 1.

3.0 ESTABLISHING PROPOSED CLEANUP LEVELS FOR PERSISTENT BIOACCUMULATIVE TOXINS

This section establishes PCLs based on consideration of the SMAs identified for the marine portion of the Site, and the sediment cleanup technologies applicable to those areas.

3.1 Sediment Management Units

As described in the RI/FS report, sediment contamination is present in the area around the marine railway at higher concentrations than elsewhere in the harbor. Figure 2 presents a Site plan, showing the boundary of SMA-1 is the area generally surrounding the marine railway and extending south from the uplands about 200 feet (ft), where concentrations of IHSs exceed the SCOs based on protection of benthic species. There were no concentrations of IHSs that exceed the benthic criteria outside of this area except in one localized area adjacent to the eastern side of the Site uplands, which is incorporated into SMA-1 as delineated on Figure 2. IHS concentrations in SMA-1 exceeding the SCO are mostly limited to the upper 1 ft of sediment, although in some areas extend to a depth of approximately 2.5 ft. All exceedances of the CSLs for PBTs are also contained within SMA-1.

Outside of SMA-1, the remainder of the harbor is defined as SMA-2. The PBT cPAHs and PCBs are the only IHSs that exceed the SCO in SMA-2. PCB aroclor concentrations generally decrease with distance from the marine railway until they are undetectable near the eastern and western harbor boundaries. The concentrations of cPAHs are highest near the marine railway indicating that cPAHs in SMA-1 may be related to Site releases. However, outside of SMA-1, cPAHs were detected at variable concentrations exceeding the SCO throughout the harbor. As discussed in the RI, this distribution is interpreted to indicate that the harbor-wide cPAH concentrations in SMA-2 are related to creosote-treated marine infrastructure and not Site releases. Bulkheads and dock pilings throughout much of the industrial area in the harbor are constructed of creosote-treated timber.

Figures 3 and 4 show the cumulative SCO exceedance factors for each sample location. The cumulative SCO exceedance factors were calculated by adding together the value of each IHS concentration normalized to its SCO; an exceedance factor greater than 1 indicates an exceedance of the SCO for at least one IHS. For example, a sample location with two IHSs that exceed their corresponding SCO, each exceeding the SCO by a factor of 3, would have a cumulative SCO exceedance factor of 6. Note that IHSs with concentrations below the SCO are not included in the calculation. Figure 3 shows these factors for IHSs based only on benthic criteria.

Figure 4 presents these exceedance factors for PBT SCOs. For Figure 4, only PCBs were used to develop the exceedance factors because cPAHs in SMA-2 are not considered related to Site releases. Note that PCB aroclor data and SCO criteria were used to develop Figure 4 because insufficient PCB congener data were available. The distribution of exceedance factors in the figures indicates that the greatest levels of exposure risk are in the vicinity of the Site marine railway and that SCO exceedances do not extend beyond Blaine Harbor. The distribution of PCB aroclor exceedance factors also suggests that sediment transport is largely from west to east through the harbor based on higher exceedance factors present to the east of the marine railway area than to the west.

3.2 Applicable Sediment Cleanup Technologies

Because the concentrations of contaminants in SMA-1 are significantly elevated in comparison to SMA-2, sediment cleanup alternatives will include the use of active cleanup technologies in this area. SCUM II defines active cleanup actions as those requiring physical dredging, capping, treatment, or enhanced monitored natural recovery (EMNR) cleanup technologies. As noted previously, active cleanup actions can have potentially negative environmental effects on the existing marine ecosystem, so they are best used when targeting limited areas where contaminant concentrations are highest. The area of SMA-1 is approximately 21,000 square feet (ft^2), which is small in comparison to the harbor-wide area of nearly 2,000,000 ft^2. Limiting active cleanup to the smaller target area of SMA-1 would limit the negative impacts to the existing marine ecosystem, which would be significant if employing active cleanup actions harbor-wide.

Active cleanup in SMA-1 would achieve most cleanup standards immediately since this area encompasses the area with exceedances of benthic criteria (both CSL and SCO). This would also address PBT CSL exceedances based on impacts to human health, which are limited to SMA-1. The only remaining impacts to address at the Site would be PBT SCO exceedances based on impacts to human health in SMA-2. Active cleanup action within SMA-1 also reduces area-wide concentrations of PBTs since it targets the area where these concentrations are the highest. The average concentration of total PCB aroclors within SMA-1 is about 112 μg/kg, which is significantly higher than the SCO (6 μg/kg) and also elevated in comparison to the concentrations detected in SMA-2.

Because of its much greater area, the more limited exceedances, and the need to maintain navigation depths throughout Blaine Harbor, most active cleanup technologies are not appropriate for SMA-2. As a result, cleanup technologies that are potentially applicable to SMA-2 are limited to EMNR and monitored natural recovery (MNR). As presented in the RI/FS report, sedimentation has been occurring within the harbor at a rate of about 1 inch (2.5 centimeters) per year based on a comparison of 1997 and 2012 bathymetric surveys. Sediment accretion is expected to provide suitable benthic habitat and further reduce PBT concentrations in surface sediment within the biologically active zone. Although this natural process is slower than active cleanup actions, the restoration timeframe is expected to be within acceptable guidelines presented in the SCUM II guidance (10 years). The restoration timeframe for MNR would be estimated in the FS, and evaluated in comparison to the ongoing risk of exposure. In SMA-2, a longer restoration timeframe would be acceptable based on the significant reduction in overall risk at the Site if active cleanup action is taken within SMA-1.

The FS will evaluate applicable cleanup technologies and develop cleanup alternatives that may include a combination of technologies. The cleanup technologies that will be considered for inclusion in cleanup alternatives in the FS are as follows:

- SMA-1
    - Capping
    - Dredging
    - EMNR
- SMA-2
    - EMNR
    - MNR.

These cleanup technologies may be used exclusively or in conjunction with other cleanup technologies. Additionally, some treatment technologies may be screened out during the development of the remedial alternatives if determined not be effective or applicable upon further evaluation.

3.3 Sediment Cleanup Goals

The primary remedial action goal will be to meet cleanup standards across the Site. Cleanup standards will include numerical criteria and points of compliance (both lateral and vertical). Compliance with the cleanup standards to protect benthic organisms will be based on a point-by-point comparison of detected contaminant concentrations in sediment to numerical cleanup criteria. This point-by-point comparison will determine compliance for SMA-1. In SMA-2, compliance with the cleanup standards will be based on area-wide mean concentrations for PBTs, in accordance with SCUM II guidance (Ecology 2015), since human health and higher trophic-level species have area-wide exposures. SCUM II recommends that area-wide mean concentrations be calculated using Thiessen polygons, which are shown on Figure 4 for reference.

3.4 Proposed Cleanup Levels for Persistent Bioaccumulative Toxins

Based on the SMAs identified for the marine portion of the Site and the cleanup technologies planned for development into remedial alternatives, it is expected that the SCO for protection of benthic species would be achieved immediately upon implementation of the cleanup action. Using active remedial technologies outside of SMA-1 to reduce PBT concentrations to below their respective SCO values throughout the harbor would cause adverse environmental impact due to the invasive and disruptive nature of active cleanup actions. In accordance with WAC 173-204-560(2)(a)(ii)(B), cleanup levels can be adjusted based on this consideration to above the SCO (but below the CSL).

Active remediation in SMA-1 (where the average PCB aroclor concentration is 112 μg/kg) would result in a post-construction area-weighted average concentration for PCBs throughout Blaine Harbor of approximately 18 μg/kg for total PCB aroclors. This concentration is approximately 38 percent above the SCO relative to the CSL. A corresponding PCB dioxin-like congener concentration 38 percent above the SCO relative to the CSL would be 0.9 pg/g. Based on these considerations, concentrations of 18 µg/kg for total PCB aroclors and 0.9 pg/g for PCB-TEQ are the proposed PCB PCLs for Site marine sediment. As will be discussed in the FS, compliance would be determined based on PCB-TEQ values in accordance with Ecology's preference for this testing approach.

Based on the distribution of cPAHs in Blaine Harbor, and the concentrations of cPAHs relative to other Site IHSs, active remediation within SMA-1 would appear to effectively address elevated cPAH concentrations in marine sediment attributable to Site releases. However, as described in Section 3.1, elevated concentrations of cPAHs in marine sediment elsewhere in Blaine Harbor appear to result from the presence of marine infrastructure constructed using creosote-treated wood. These multiple sources of cPAHs result in highly variable concentrations throughout the harbor that do not exhibit a clear trend, other than a general decrease in concentration away from the greater Blaine Harbor Industrial Area.

This variable distribution in cPAH concentrations is evident through application of the statistical approach used to establish regional background concentrations for sediment, as presented in SCUM II (Ecology 2015), to sediment quality data from Blaine Harbor. The upper tolerance limit of the mean with 90 percent coverage and 90 percent confidence (90/90 UTL) was calculated for cPAHs in surface sediment using all cPAH data collected outside of SMA-1. The high variance in concentration throughout the harbor is reflected in a large standard deviation from the mean and results in a calculated 90/90 UTL with a value greater than 800 µg/kg, assuming a normal data distribution. This value is well above the CSL for cPAHs of 400 µg/kg. The calculation was repeated assuming lognormal and non-parametric data distribution, and with removal of apparent outliers. In each case, the 90/90 UTL is greater than the CSL. As a result, it appears that the variance of cPAH concentrations throughout the harbor is too high to identify a cPAH PCL for protection of human health that is lower than the CSL, and as a result, the CSL (400 µg/kg) is identified as the PCL for cPAHs in marine sediment. It should be noted that following active remediation within SMA-1 and achieving cleanup standards for PCBs, the harbor-wide concentration of cPAHs should be reduced to a value well below the PCL, provided that significant concentration outliers do not occur during compliance monitoring.

It is anticipated that the area-wide PBT concentrations will decrease significantly following active remediation in SMA-1 and will continue to decrease through natural recovery, given the active deposition of marine sediment occurring in Blaine Harbor. Although the timeframe to achieve cleanup standards and reduce exposure risks to acceptable levels is expected to be within 10 years though implementing cleanup actions, the timeframe for reduction in concentration to the SCO is uncertain given that the SCOs were established near the natural background levels.

4.0 USE OF THIS REPORT

This report has been prepared for the use of the Port of Bellingham and the Washington State Department of Ecology for specific application to the Westman Marine Inc. Site. None of the information, conclusions, and recommendations included in this document can be used for any other project without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the Pacific Northwest under similar conditions as this project. We make no other warranty, either express or implied.

This document was prepared under the supervision and direction of the following key staff.

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JMD/LDB/ccy
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Data Source: Esri 2012

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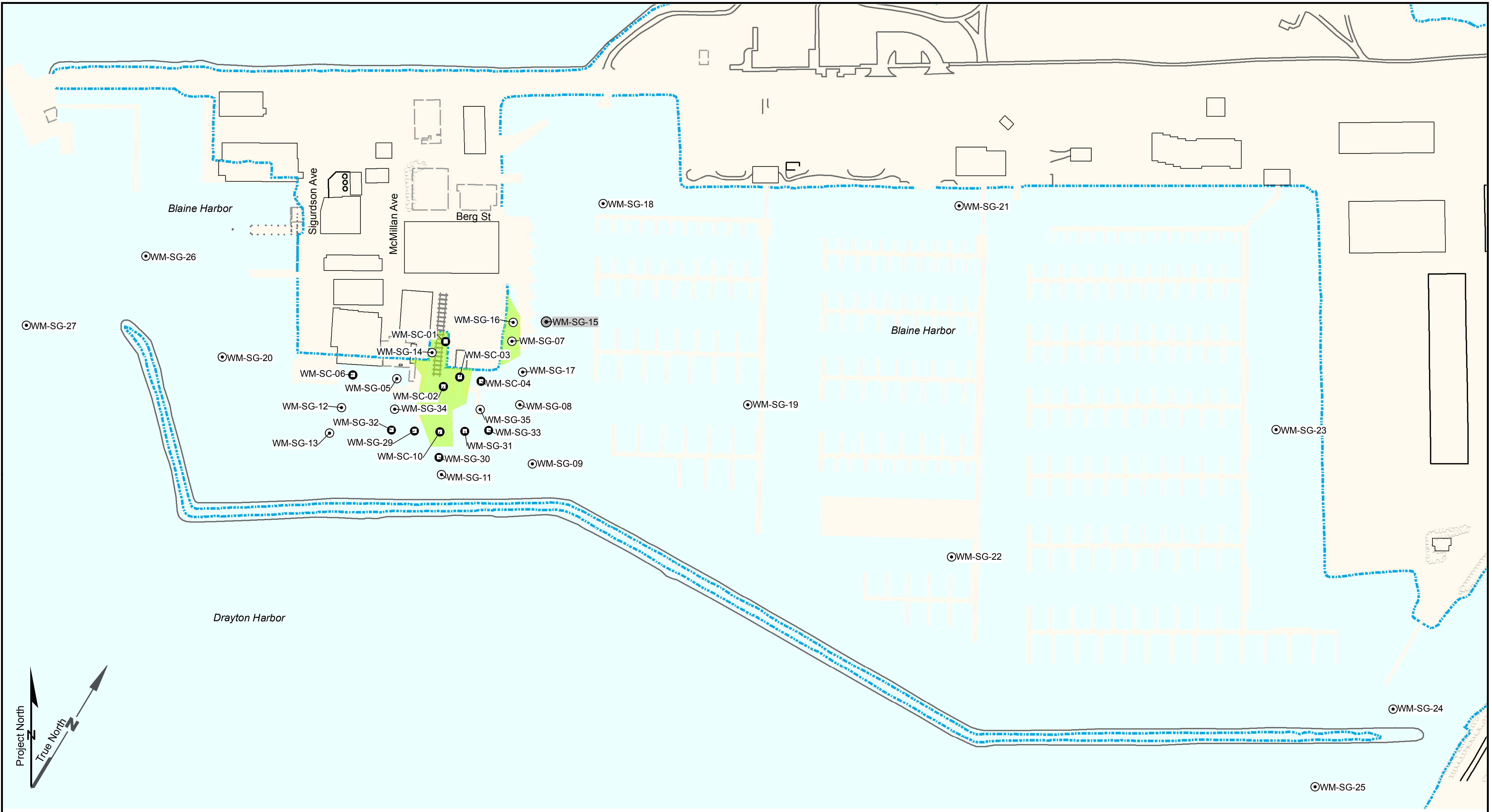
LANDAU ASSOCIATES

Westman Marine Blaine Harbor Blaine, Washington	**Vicinity Map**	Figure 1



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Legend

◉ WM-SG-15 - Location is not Considered as Part of the Site
🟩 SMA-1
▣ Sediment Core Sample Location
(Surface Sample Also Collected at this Location)
⊙ Surface Sediment Sample Location

Notes
1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400

Scale in Feet

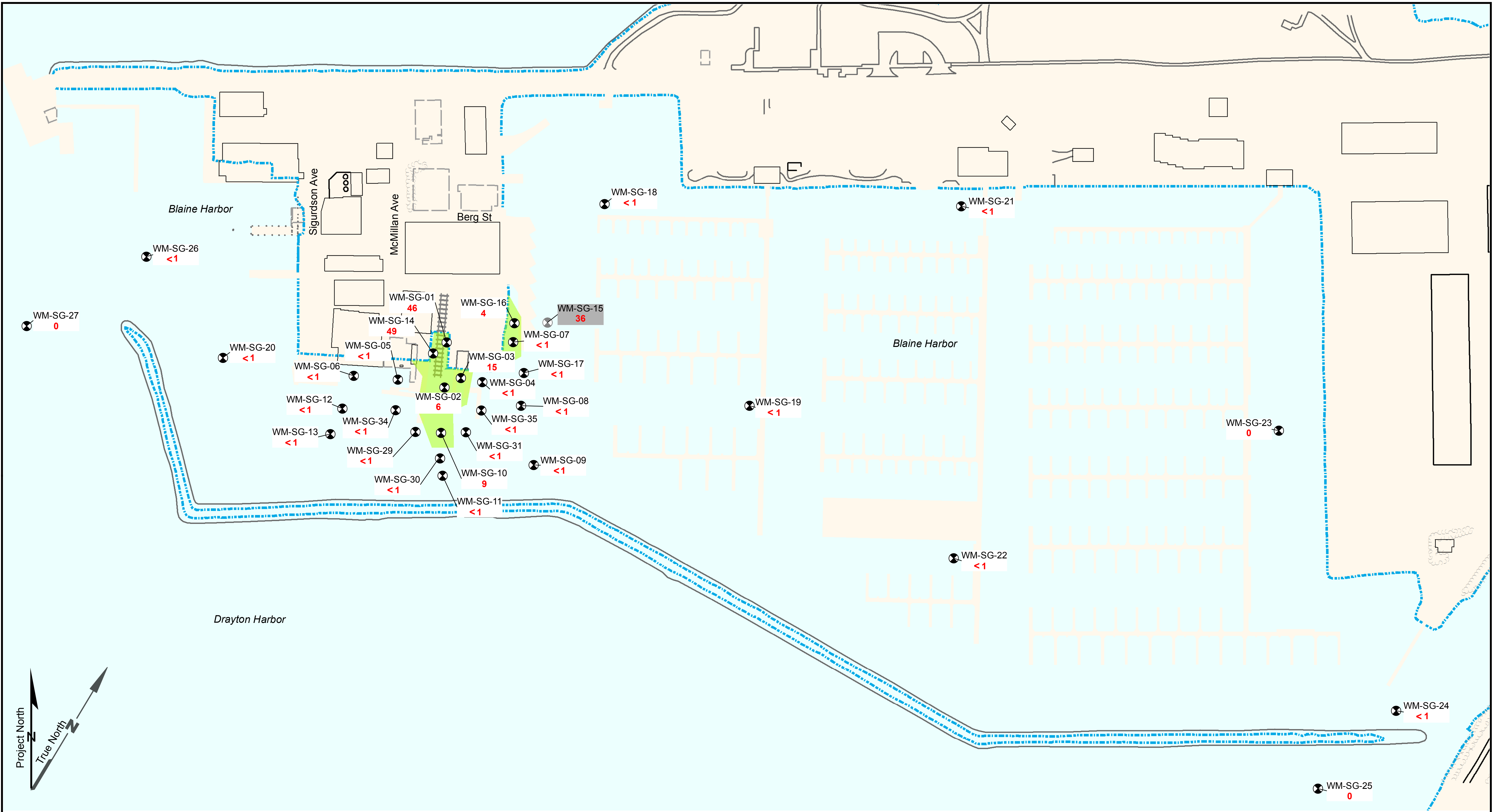
Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

Landau Associates

Westman Marine
Blaine Harbor
Blaine, Washington

Site Plan

Figure
2



Legend

⊗ WM-SG-15 - Location is not Considered as Part of the Site

🟩 SMA-1

⊗ Surface Sediment Sample Location

1 Sum of Exceedance Factors >1 for Each SCO Criteria Exceedance

Notes
1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Exceedance factor equals concentration divided by the sediment cleanup objective.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

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Westman Marine
Blaine Harbor
Blaine, Washington

Benthic SCO Exceedance Factors

Figure
3

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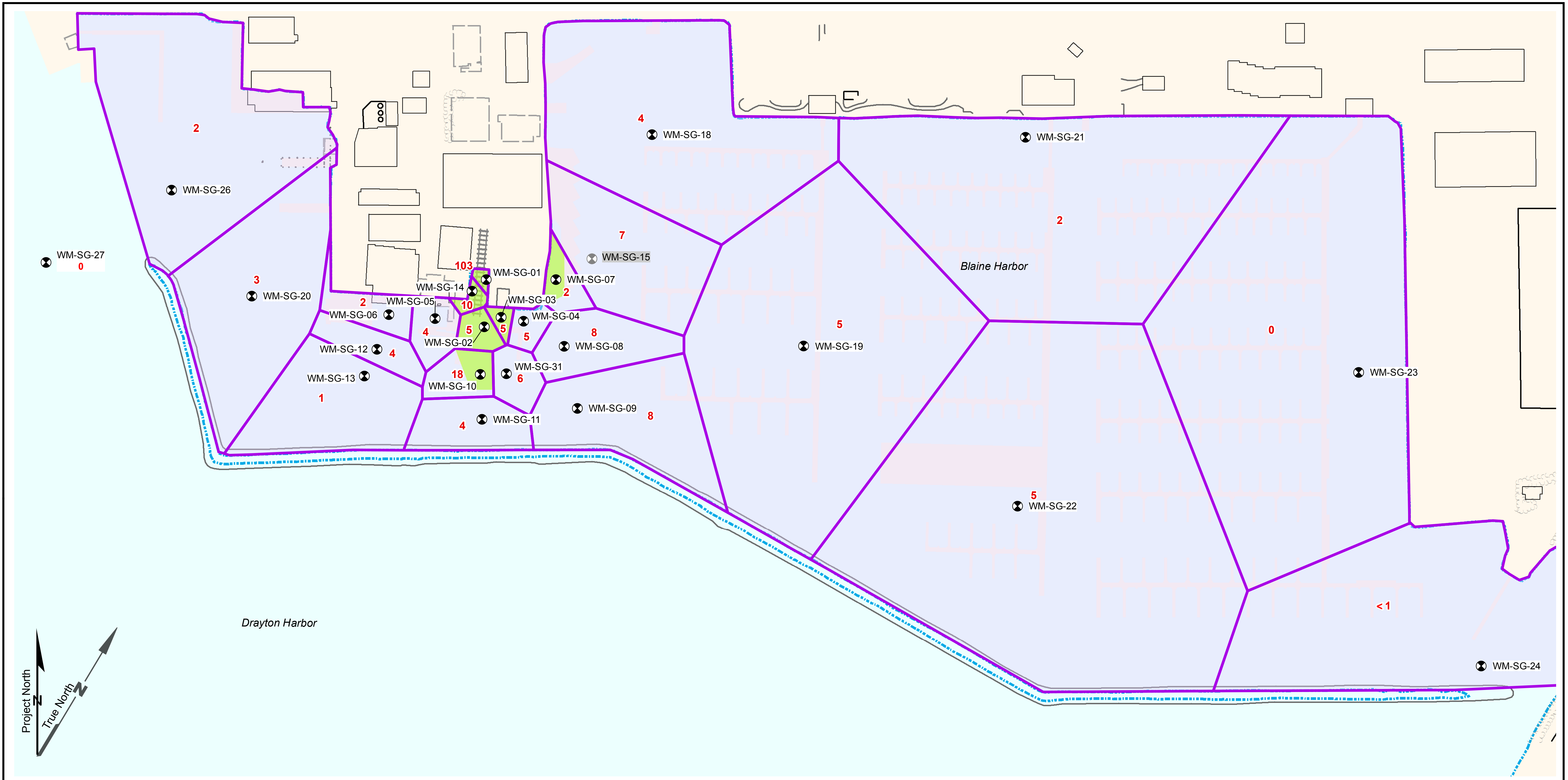

Legend

⊗ WM-SG-15 - Location is not Considered as Part of the Site

⊗ Surface Sediment Sample Location

▭ Thiessen Polygons

🟩 SMA-1

1 PCB SCO Exceedance Factor

Notes
1. SMA-2 = All of Blaine Harbor outside of SMA-1.
2. Exceedance factor equals concentration divided by the sediment cleanup objective.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400

Scale in Feet

Source: Wilson Engineering 2011, Port of Blaine 2011, Walker and Associates, Inc.

LANDAU ASSOCIATES

Westman Marine
Blaine Harbor
Blaine, Washington

PBT SCO Exceedance Factors

Figure
4

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TABLE 1
PROPOSED SEDIMENT CLEANUP LEVELS
WESTMAN MARINE INC. SITE
BLAINE, WASHINGTON

	RI Screening Levels		Proposed Cleanup Levels
Benthic Criteria	SCO	CSL	
TOTAL METALS (mg/kg-dry wt)			
Methods SW6010C/SW7471A			
Arsenic	57	93	(see below)
Copper	390	390	390
Mercury	0.41	0.59	(see below)
Zinc	410	960	410
BULK ORGANOTINS (µg/kg-dry wt)			
KRONE88			
Tributyltin Ion	238	738	238
POREWATER ORGANOTINS (µg/L)			
KRONE88			
Tributyltin Ion	0.05	0.15	0.05
PERSISTENT BIOACCUMULATIVE TOXINS			
	SCO	CSL	
cPAHs (TEQ) (µg/kg)			
Method SW8270DSIM			
cPAHs (TEQ)	40	400	400
PCBs (pg/g)			
Method SW8082A			
Total PCBs	6	53	18
Dioxin-Like PCBs (TEQ)	0.2	2	0.9
TOTAL METALS (mg/kg-dry wt)	**Natural Background**		
Methods SW6010C/SW7471A			
Arsenic	11		11
Mercury	0.2		0.2
Cadmium	1		1
Lead	21		21

RI = remedial investigation
SCO = sediment cleanup objective
CSL = cleanup screening level
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
TEQ = toxicity equivalency
PCBs = polychlorinated biphenyls
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
pg/g = picograms per gram

APPENDIX I

Remedial Alternative Cost Summaries

Table I-1
Feasibility Study Cost Estimate
Upland Site Unit – Alternative U-1
Westman Marine – Blaine, Washington

Alternative U-1: **Shallow Soil Excavation and Offsite Disposal of Contaminated Soil, Containment by Soil Capping and Institutional Controls**

Scope of Work:
Remove marine side rails east and west of Marine Railway.
Excavation and offsite disposal of top 2 ft of soil east of Marine Railway.
Site restoration, including returning Site to existing grades using imported clean fill.
Institutional controls (restrictive covenants); and long-term operation and maintenance (assume 30 years).

Capital Cost Item - Upland Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Near-Surface Soil and Marine Railway Sidetrack Removal					
Mobilize / Demobilize	LS	1	$20,000	$20,000	1,2
Marine Railway Sidetrack Removal					
Environmental Controls	LS	1	$10,000	$10,000	3
Expose and Demolish Side Rail Systems (Foundations and Rails)	LS	1	$18,000	$18,000	4
Disposal of Concrete and Rails	TON	144	$120	$17,000	4
Near-Surface Excavation and Offsite Treatment/Disposal					
Excavation and Loading of Contaminated Soil (Upper 2 ft)	CY	2,057	$29	$59,000	5
Transport and Disposal of Soil	TON	3,498	$65	$227,000	6
Containment System (Asphalt Pavement)					
Install Geotextile Separation / Marker Layer	SY	3,086	$2	$6,000	7
Backfill: Supply and Install Clean Imported Material	TON	3,498	$20	$70,000	1
Site Grading to Match Existing Conditions	SF	27,775	$0.60	$17,000	1
Subtotal for Capital Direct Costs				***$ 440,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$55,000	8
Engineering Design Report (EDR)	LS	1		$60,000	1
Remedial Design	%	15		$66,000	9
Project Management	%	6		$26,000	9
Construction Management (Including Construction QA)	%	8		$35,000	9
Construction Completion Report	LS	1		$50,000	1
Permitting and Regulatory Compliance	%	8		$35,000	1
Ecology Oversight	%	5		$22,000	1
Estimate of Taxes	%	9		$40,000	10
Subtotal for Capital Indirect Costs				***$389,000***	
Subtotal for Capital Direct and Indirect Costs				***$829,000***	
Contingency for Capital Direct and Indirect Costs	%	30		***$249,000***	9
Total for Direct and Indirect Capital Costs				**$1,080,000**	

Operation and Maintenance - Upland Site Unit	Unit	Qty. (Yearly)	Unit Cost	Annual Cost	Present Worth	Notes
Discount Rate	%	3.9				11
Containment System Monitoring and Maintenance	YR	30	$1,000	$1,000	$18,000	12
Post-Construction Management of Contaminated Soil	LS	1	$ 25,000		$ 25,000	13
Subtotal for Operation and Maintenance Costs				***$43,000***		
Contingency on Operation and Maintenance Costs	%	30		***$13,000***		9
Total for Operation and Maintenance Costs				***$56,000***		
PRESENT WORTH OF ALTERNATIVE 2 - Upland Site Unit				**$1,100,000**		14

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Assumes 6 100-ft-long segments and 6 80-ft-long segments with 3-ft-wide and 8-inch-thick foundations.
5 Assumes area of 27,775 SF and 2-ft depth
6 Based on costs incurred during the Interim Action. Assumes truck transfer to Ferndale intermodal facility followed by rail transport for Subtitle D disposal.
7 Installation of geotextile cushion/marker layer over bottom of excavation prior to placement of overlying fill materials.
8 Assumes limited pre-design investigation activities to confirm vertical and lateral extent of railway sidetracks and foundations and a limited allowance for additional delineation with 1 day of direct-push borings for additional contaminant delineation to support remedial design.
9 Based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Remedial design includes preparation of construction plans and specifications, preparation of engineer's estimate of probable cost, and bidding support. Project management includes bid/contract administration, cost and performance reporting, planning and coordination. Construction management includes submittal review, change order review, design modifications, construction schedule tracking. Contingency includes Scope and Bid contingency totaling 30%.
10 Combined sales tax, Blaine, Washington.
11 Based on an average return on investment of 6% with an assumed inflation rate of 2.1%.
12 Annual inspection of Site cap. Assumes little to no repair will be required.
13 Assumes preparation of soil management plan and an allowance for construction and support for future Site activities that would encounter contaminated soil, such as trenching for utilities, etc.
14 Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup

Abbreviations

CY = cubic yard
EPA = US Environmental Protection Agency
FS = feasibility study
FT = foot
LS = lump sum
MTCA = Model Toxics Control Act
QA = quality assurance
SF = square foot
SY = square yard
YR = year

Table I-2
Feasibility STudy Cost Estimate
Upland Site Unit – Alternative U-2
Westman Marine – Blaine, Washington

Alternative U-2 **Near-Surface Excavation and Offsite Disposal of Contaminated Soil, Containment by Asphalt Capping and Institutional Controls**

Scope of Work:
Remove marine side rails and adjacent soil east and west of Marine Railway.
Excavation and offsite disposal of top 1 ft of soil east of Marine Railway.
Install pavement section including 4 inches of asphalt and associated stormwater controls in areas not currently paved.
Institutional controls (restrictive covenants); and long-term operation and maintenance (assume 30 years).

Capital Cost Item - Upland Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Near-Surface Soil and Marine Railway Sidetrack Removal					
Mobilize / Demobilize	LS	1	$24,000	$24,000	1,2
Marine Railway Sidetrack Removal					
Environmental Controls	LS	1	$10,000	$10,000	3
Expose and Demolish Side Rail Systems (Foundations and Rails)	LS	1	$18,000	$18,000	4
Disposal of Concrete and Rails	TON	144	$120	$17,000	4
Near-Surface Excavation and Offsite Treatment/Disposal					
Excavation and Loading of Contaminated Soil (Upper 1 ft)	CY	1,029	$29	$30,000	5
Transport and Disposal of Soil	TON	1,749	$65	$114,000	6
Backfill: Supply and Install Clean Imported Material	TON	1,166	$20	$23,000	1
Containment System (Asphalt Pavement)					
Site Grading and Preparation (Backfill Above as Base Course)	SF	27,775	$0.60	$17,000	1
Asphalt Paving	SF	27,775	$4	$117,000	7
Allowance for Stormwater Control and Discharge Management	LS	1	$100,000	$100,000	1
Subtotal for Capital Direct Costs				***$470,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$55,000	8
Engineering Design Report (EDR)	LS	1		$60,000	1
Remedial Design	%	15		$71,000	9
Project Management	%	8		$38,000	9
Construction Management (Including Construction QA)	%	10		$47,000	9
Construction Completion Report	LS	1		$50,000	1
Permitting and Regulatory Compliance	%	8		$38,000	1
Ecology Oversight	%	5		$24,000	1
Estimate of Taxes	%	9		$42,000	10
Subtotal for Capital Indirect Costs				***$ 425,000***	
Subtotal for Capital Direct and Indirect Costs				***$ 895,000***	
Contingency for Capital Direct and Indirect Costs	*%*	*30*		***$ 269,000***	9
Total for Direct and Indirect Capital Costs				**$ 1,160,000**	

Operation and Maintenance - Upland Site Unit	Unit	Qty. (Yearly)	Unit Cost	Annual Cost	Present Worth	Notes
Discount Rate	%	3.9				11
Containment System Monitoring and Maintenance	YR	30	$1,500	$1,500	$26,000	12
Institutional Controls and Future Management of Contaminated Soil	LS	1	$ 40,000		$40,000	13
Subtotal for Operation and Maintenance Costs				$66,000		
Contingency on Operation and Maintenance Costs	%	30		$19,800		9
Total for Operation and Maintenance Costs				**$85,800**		
PRESENT WORTH OF ALTERNATIVE 3 - Upland Site Unit				**$ 1,200,000**		14

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Assumes 6 100-ft-long segments and 6 80-ft-long segments with 3-ft-wide and 8-inch-thick foundations.
5 Assumes area of 27,775 SF and 1-ft depth
6 Based on costs incurred during the Interim Action. Assumes truck transfer to Ferndale intermodal facility followed by rail transport for Subtitle D disposal.
7 Assumes 6 inches of base course beneath 4 inches of asphalt cap.
8 Assumes limited pre-design investigation activities to confirm vertical and lateral extent of railway sidetracks and foundations and a limited allowance for additional delineation with 1 day of direct-push borings for additional contaminant delineation to support remedial design.
9 Based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Remedial design includes preparation of construction plans and specifications, preparation of engineer's estimate of probable cost, and bidding support. Project management includes bid/contract administration, cost and performance reporting, planning and coordination. Construction management includes submittal review, change order review, design modifications, construction schedule tracking. Contingency includes Scope and Bid contingency totalling 30%.
10 Combined sales tax, Blaine, Washington.
11 Based on an average return on investment of 6% with an assumed inflation rate of 2.1%.
12 Annual inspection of Site cap and stormwater controls. Assumes little to no repair will be required.
13 Assumes preparation of soil management plan and an allowance for construction and support for future Site activities that would encounter contaminated soil, such as trenching for utilities, etc.
14 Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup.

Abbreviations

EPA = US Environmental Protection Agency
FS = feasibility study
LS = lump sum
MTCA = Model Toxics Control Act

QA = quality assurance
SY = square yard
YR = year
SF = square foot

Table I-3
Feasibility Study Cost Estimate
Upland Site Unit – Alternative U-3
Westman Marine – Blaine, Washington

Alternative U-3: **Site-Wide Excavation and Removal of Contaminated Soil**

Scope of Work: Remove and dispose of contaminated soils (entire Upland Site Unit) and the marine side rails (both sides of the marine railway).
Site restoration, including returning Site to existing grades using imported clean fill.

Capital Cost Item - Upland Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Soil Excavation and Marine Railway Sidetrack Removal					
Mobilize / Demobilize	LS	1	$30,000	$30,000	1,2
Environmental Controls	LS	1	$16,000	$16,000	3
Demolish Side Rail Systems (Foundations and Rails)	LS	1	$18,000	$18,000	4
Disposal of Concrete Foundations	TON	144	$120	$17,000	4
Excavation and Loading of Contaminated Soil	CY	3,872	$34	$132,000	5
Dewatering Allowance	LS	1	$75,000	$75,000	1
Transport and Disposal of Soil	TON	6,583	$65	$428,000	6
Backfill: Supply and Install Clean Imported Material	TON	6,583	$20	$132,000	1
Site Grading to Match Existing Conditions	SF	29,275	$0.60	$18,000	1
Compliance Monitoring (Soil Confirmation Samples)	LS	1	$52,000	$52,000	1
Subtotal for Capital Direct Costs				***$918,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$75,000	7
Engineering Design Report (EDR)	LS	1		$80,000	1
Remedial Design	%	12		$110,000	8
Project Management	%	6		$55,000	8
Construction Management (Including Construction QA)	%	8		$73,000	8
Construction Completion Report	LS	1		$75,000	1
Permitting and Regulatory Compliance	%	8		$73,000	1
Ecology Oversight	%	5		$46,000	1
Estimate of Taxes	%	9		$83,000	9
Subtotal for Capital Indirect Costs				***$670,000***	
Subtotal for Capital Direct and Indirect Costs				***$1,588,000***	
Contingency for Capital Direct and Indirect Costs	%	30		***$476,400***	8
Total for Direct and Indirect Capital Costs				**$2,060,000**	
PRESENT WORTH OF ALTERNATIVE 4 - Upland Site Unit				**$2,100,000**	10

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Assumes 6 100-ft-long segments and 6 80-ft-long segments with 3-ft-wide and 8-inch-thick foundations.
5 Soil removal quantity based on excavation depths ranging from 2 to 12 ft in five areas of the Site as follows:
23,900 SF - 2-ft depth; 315 SF - 3-ft depth; 180 SF - 9-ft depth; 1,600 SF - 6-ft depth; 5,300 SF - 12-ft depth.
Unit costs for excavation are higher than for other alternatives due to shoring and safety considerations required for deeper excavations, and close proximity to the shoreline.
6 Based on costs incurred during the Interim Action. Assumes truck transfer to Ferndale intermodal facility followed by rail transport for Subtitle D disposal.
7 Assumes limited pre-design investigation activities to conifrm vertical and lateral extent of railway sidetracks and foundations, limited geotechnical investigation to support deep excavation and dewatering design and a limited allowance for additional delineation with 2 days of direct-push borings for additional contaminant delineation to support remedial design.
8 Based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Remedial design includes preparation of construction plans and specifications, preparation of engineer's estimate of probable cost, and bidding support. Project management includes bid/contract administration, cost and performance reporting, planning and coordination. Construction management includes submittal review, change order review, design modifications, construction schedule tracking. Contingency includes Scope and Bid contingency totalling 30%.
9 Combined sales tax, Blaine, Washington.
10 Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup.

Abbreviations

CY = cubic yard
EPA = US Environmental Protection Agency
FS = feasibility study
FT = foot
LS = lump sum
MTCA = Model Toxics Control Act
QA = quality assurance
SF = square foot

Table I-4
Remedial Alternative Cost Estimate – Sediment Cleanup Alternative M-2
Westman Marine Site – Blaine, Washington

Alternative M-2: **Sediment Dredging in SMA-1 and MNR in SMA-2**

Scope of Work:
Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment.
Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
Remove contaminated sediment from throughout SMA-1 (including SMA-1a and SMA-1b) and dispose of the removed materials at an upland offsite disposal facility.
Implement MNR in SMA-2 until cleanup standards are achieved.

Capital Cost Item - Marine Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Contractor Mobilization					
Contractor Mobilization / Demobilization	LS	1	$65,000	$65,000	1,2
Replace Bulkheads in Dredging Area					
Mobilization for Bulkhead Repairs	LS	1	$140,000	$140,000	1,2
Environmental Controls	LS	1	$60,000	$60,000	3
Install Cantilevered Sheetpiles in Front of Existing Bulkhead	LF	475	$2,500	$1,187,500	4
Earthwork - Excavation/Import Inc. Haul and Placement/Disposal	LS	1	$82,398	$82,000	5
Temporarily Remove and Replace Marine Railway					
Remove Marine Railway	LS	1	$20,000	$20,000	6
Disposal of Concrete, Rails, Rail Ties, Piles	TON	90	$120	$11,000	7
New Steel Piling for Railway	EA	30	$8,000	$240,000	1
New Steel I Beam Caps	LF	300	$80	$24,000	1
New Steel Beam Rail Support	LF	300	$80	$24,000	1
New Steel Rail System	LF	300	$120	$36,000	1
Dredging in SMA-1					
Pre-Construction Bathymetric Survey	LS	1	$12,000	$12,000	8
Transloading Facility	LS	1	$60,000	$60,000	1
Temporary Removal/Replacement of Floating Docks (Pilings Not Removed)	LS	1	$35,000	$35,000	1
Sediment Dredging and Handling (SMA-1-A)	CY	1,600	$37	$59,000	1,9
Dewatering, Water Treatment, and Disposal	LS	1	$40,000	$40,000	1
Sediment Transportation and Disposal	TON	2,400	$65	$156,000	1,7
Sediment Vacuum-Removal (SMA-1-B; Vac Truck)	EA	4	$1,000	$4,000	10
Vac-Truck Waste Disposal	GAL	16,000	$0.45	$7,000	10
Placement of Residual Cover Layer (6-inches Sand)	CY	400	$42	$17,000	11
Water Quality Monitoring During Construction	LS	1	$20,000	$20,000	1
Post-Construction Bathymetric Survey and Compliance Monitoring	LS	1	$31,000	$31,000	8,12
Subtotal for Capital Direct Costs				***$2,331,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$80,000	13
Engineering Design Report (EDR)	LS	1		$80,000	1
Remedial Design	%	17		$396,000	14,15
Project Management	%	6		$140,000	14,16
Construction Management	%	8		$186,000	14,17
Construction Completion Report	LS	1		$60,000	1
Permitting and Regulatory Compliance	%	8		$186,000	18
Ecology Oversight	%	2		$47,000	1
Estimate of Taxes	%	9		$210,000	19
Subtotal for Capital Indirect Costs				***$1,385,000***	
Subtotal for Capital Direct and Indirect Costs				***$3,716,000***	
Contingency for Capital Direct and Indirect Costs	%	30		***$1,115,000***	14
Total for Direct and Indirect Capital Costs				**$4,831,000**	

Operation and Maintenance - Marine Site Unit	Unit	Qty. (Yearly)	Unit Cost	Annual Cost	Present Worth	Notes
Natural Recovery Compliance Monitoring and Reporting (SMA-2)						
Sediment Sampling (Yr 1, 3, 5 after Construction)	EA	1	$34,000	$34,000	$93,000	20
Bathymetric Survey of Subtidal MNR (same schedule as monitoring)						
Survey and Letter Report	EA	1	$12,000	$12,000	$32,000	21
Subtotal for Operation and Maintenance Costs				***$125,000***		
Contingency on Operation and Maintenance Costs		30%		***$38,000***		14
Total for Operation and Maintenance Costs				***$163,000***		
PRESENT WORTH OF ALTERNATIVE M-2 - Marine Site Unit				**$5,000,000**		22

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Cantilevered sheetpile wall; estimate by Reid Middleton for bulkhead section zones 8, 9, 10, and a portion of 7.
5 Includes limited earthwork associated with removal of existing tie-backs or backfilling existing areas of depression adjacent to the bulkheads; estimate by Reid Middleton.
6 Includes silt curtain installation; demolition, and removal of 270 LF of steel rails and 8-inch-thick foundations. Sediment and soil removal considered in SMA-1.
7 Assumes material hauled by truck to Intermodal Transfer Station, and disposed of at Subtitle D facility.
8 Based on previous hydrographic studies in Blaine Harbor.
9 Assumes a total dredging depth of 2.5 ft over 17,200 SF of area (includes sediment/soil from marine railway well). Includes silt curtains and water quality monitoring.
10 5,000-gallon vac truck at $100/hour x 10 hrs ($1,000/day rate); disposal costs provided by contractor.
11 Area of residuals cover is approximately 21,600 SF; thickness is 6 inches.
12 Assumes 11 surface sediment samples collected within SMA-1 and analyzed for Site IHS; long-term compliance monitoring included in O&M.
13 Assumes pre-design investigation activities include geotechnical investigations to support bulkhead and marine railway removal and installation design, and limited additional contaminant delineation to support dredge prism design.
14 Estimated cost based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Capital indirect costs based on percentages of direct capital costs have been increased by 3% to account for applying the increased regulatory and engineering complexity for in-water design and construction.
15 Remedial design includes preparation of construction plans and specifications for dredging and marine railway system removal, preparation of engineer's estimate of probable cost, and bidding support. Remedial design cost increased by 5% from standard rate to address structural design for bulkhead and travel lift.
16 Project management includes bid/contract administration, cost and performance reporting, planning and coordination.
17 Construction management includes submittal review, change order review, design modifications, and construction schedule tracking.
18 In-water permitting is estimated at a higher percentage of capital costs than upland work based on required coordination with US Army Corps of Engineers and Federal Services.
19 Combined sales tax, Blaine, Washington.
20 11 surface sediment samples collected for PCB congener analysis throughout the harbor. Assumes years 1, 3, and 5 post-construction.
21 Assume bathymetry survey on same frequency as sediment monitoring.
22 Present worth value calculated assuming a 3% discount rate. Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup.

Abbreviations

CY = cubic yard
EA = each
EPA = US Environmental Protection Agency
FS = feasibility study
FT = foot
GAL = gallon
IHS = indicator hazardous substance
LF = linear feet
LS = lump sum
MNR = monitored natural recovery
O&M = operations and maintenance
PCB = polychlorinated biphenyl
SF = square foot / square feet
YR = year

Table I-5
Remedial Alternative Cost Estimate – Sediment Cleanup Alternative M-3
Westman Marine Site – Blaine, Washington

Alternative M-3: **Sediment Dredging in SMA-1 and EMNR in SMA-2**

Scope of Work:
Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment.
Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
Remove contaminated sediment from throughout SMA-1 (including SMA-1a and SMA-1b) and dispose of the removed materials at an upland offsite disposal facility.
EMNR in SMA-2 (6 inches of sand) to reduce area-weighted average PCB concentration to below the SCO.
Conduct compliance monitoring to confirm cleanup standards are achieved and maintained.

Capital Cost Item - Marine Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Contractor Mobilization					
Contractor Mobilization / Demobilization	LS	1	$80,000	$80,000	1,2
Replace Bulkheads in Dredging Area					
Mobilization for Bulkhead Repairs	LS	1	$140,000	$140,000	1,2
Environmental Controls	LS	1	$60,000	$60,000	3
Install Cantilevered Sheetpiles in Front of Existing Bulkhead	LF	475	$2,500	$1,187,500	4
Earthwork - Excavation/Import Inc. Haul and Placement/Disposal	LS	1	$82,398	$82,000	5
Temporarily Remove and Replace Marine Railway					
Remove Marine Railway	LS	1	$20,000	$20,000	6
Disposal of Concrete, Rails, Rail Ties, Piles	TON	90	$120	$11,000	7
New Steel Piling for Railway	EA	30	$8,000	$240,000	1
New Steel I Beam Caps	LF	300	$80	$24,000	1
New Steel Beam Rail Support	LF	300	$80	$24,000	1
New Steel Rail System	LF	300	$120	$36,000	1
Dredging in SMA-1					
Pre-Construction Bathymetric Survey	LS	1	$12,000	$12,000	8
Transloading Facility	LS	1	$60,000	$60,000	1
Temporary Removal of Floating Docks (Pilings Not Removed)	LS	1	$35,000	$35,000	1
Sediment Dredging and Handling (SMA-1a)	CY	1,600	$37	$59,000	1,9
Dewatering, Water Treatment, and Disposal	LS	1	$40,000	$40,000	1
Sediment Transportation and Disposal	TON	2,400	$65	$156,000	1,7
Sediment Vacuum-Removal (SMA-1b; Vac Truck)	EA	4	$1,000	$4,000	10
Vac-Truck Waste Disposal	GAL	16,000	$0.45	$7,000	10
Placement of Residual Cover Layer (6-inches Sand)	CY	400	$42	$17,000	11
Water Quality Monitoring During Construction	LS	1	$20,000	$20,000	1
Post-Construction Bathymetric Survey and Compliance Monitoring	LS	1	$50,000	$50,000	8,12
Construction of Thin-Layer Cap in a Portion of SMA-2 (Contingent Action)					
Contractor Mobilization / Work Plans	LS	1	$25,000	$25,000	1,2
Placement of Thin-Layer Sand Cap	CY	2,800	$42	$117,600	11
Post-Construction Bathymetric Survey	LS	1	$18,000	$18,000	8
Subtotal for Capital Direct Costs				***$2,525,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$85,000	13
Engineering Design Report (EDR)	LS	1		$85,000	1
Remedial Design	%	17		$429,000	14,15
Project Management	%	6		$152,000	14,16
Construction Management	%	8		$202,000	14,17
Construction Completion Report	LS	1		$75,000	1
Permitting and Regulatory Compliance	%	8		$202,000	18
Ecology Oversight	%	2		$51,000	1
Estimate of Taxes	%	9		$227,000	19
Subtotal for Capital Indirect Costs				***$1,508,000***	
Subtotal for Capital Direct and Indirect Costs				***$4,033,000***	
Contingency for Capital Direct and Indirect Costs	%	30		***$1,210,000***	14
Total for Direct and Indirect Capital Costs				**$5,243,000**	

Operation and Maintenance - Marine Site Unit	Unit	Qty. (Yearly)	Unit Cost	Annual Cost	Present Worth	Notes
Natural Recovery Compliance Monitoring and Reporting (SMA-2)						
Sediment Sampling (Yrs 1, 3 after construction)	EA	1	$34,000	$34,000	$63,037	20
Bathymetric Survey of Subtidal MNR (same schedule as monitoring)						
Survey and letter report	EA	1	$12,000	$12,000	$21,413	21
Subtotal for Operation and Maintenance Costs				***$84,000***		
Contingency on Operation and Maintenance Costs		30%		***$25,000***		14
Total for Operation and Maintenance Costs				***$109,000***		
PRESENT WORTH OF ALTERNATIVE M-3 - Marine Site Unit				**$5,400,000**		22

Table I-5
Remedial Alternative Cost Estimate – Sediment Cleanup Alternative M-3
Westman Marine Site – Blaine, Washington

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Cantilevered sheetpile wall; estimate by Reid Middleton for bulkhead section zones 8, 9, 10, and a portion of 7.
5 Includes limited earthwork associated with removal of existing tie-backs or backfilling existing areas of depression adjacent to the bulkheads; estimate by Reid Middleton.
6 Includes silt curtain installation; demolition and removal of 270 LF of steel rails and 8-inch-thick foundations.
7 Assumes material hauled by truck to Intermodal Transfer Station, and disposed of at Subtitle D facility.
8 Based on previous hydrographic studies in Blaine Harbor.
9 Assumes a total dredging depth of 2.5 ft over 17,200 SF of area (includes sediment/soil from marine railway well). Includes silt curtains and water quality monitoring.
10 5,000-gallon vac truck at $100/hour x 10 hrs ($1,000/day rate); disposal costs provided by contractor.
11 Area of thin-layer cap is approximately 152,000 SF; thickness is 6 inches; extends approximately 200 ft outside SMA-1.
12 Assumes 11 surface sediment samples collected in SMA-1 for IHS and 8 samples collected within 200 ft of SMA-1 analyzed for PCB congeners; long-term compliance monitoring. included in O&M.
13 Assumes pre-design investigation activities include geotechnical investigations to support bulkhead extension design, inspection of marine railway system, and additional contaminant delineation to support dredge prism design and EMNR boundary.
14 Estimated cost based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Capital indirect costs based on percentages of direct capital costs has been increased by 3% to account for applying the increased regulatory and engineering complexity for in-water design and construction.
15 Remedial Design includes preparation of construction plans and specifications for dredging, marine railway system removal, and thin-layer cap; preparation of engineer's estimate of probable cost; and bidding support. Remedial design cost increased by 5% from standard rate to address structural design for bulkhead and travel lift.
16 Project management includes bid/contract administration, cost and performance reporting, planning and coordination.

17 Construction management includes submittal review, change order review, design modifications, construction schedule tracking.
18 In-water permitting is estimated at a higher percentage of capital costs than upland work based on required coordination with US Army Corps of Engineers and Federal Services.
19 Combined sales tax, Blaine, Washington.
20 11 surface sediment samples collected for PCB congener analysis throughout the harbor. Assumes years 1, 3, post-construction, though the second event may not be required.
21 Assume bathymetry survey on same frequency as sediment monitoring.
22 Present worth values calculated assuming a 3.9% discount rate. Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup.

Abbreviations

CY = cubic yard
EA = each
EMNR = enhanced monitored natural recovery
EPA = US Environmental Protection Agency
FS = feasibility study
FT = foot
GAL = gallon
IHS = indicator hazardous substance
LF = linear feet
LS = lump sum
MNR = monitored natural recovery
O&M = operations and maintenance
PCB = polychlorinated biphenyl
SCO = sediment cleanup objective
SF = square foot / square feet
YR = year

Table I-6
Remedial Alternative Cost Estimate – Sediment Cleanup Alternative M-4
Westman Marine Site – Blaine, Washington

Alternative M-4: **Harbor-Wide Contaminated Sediment Removal**

Scope of Work:
Replace perimeter bulkhead to support dredging of contaminated sediment and prevent release of upland contaminated soil to marine sediment.
Temporarily remove and replace the marine railway system to provide access for sediment dredging in SMA-1.
Removal of sediment throughout the harbor with concentrations of IHSs greater than PCLs; disposal at an upland offsite disposal facility.

Capital Cost Item - Marine Site Unit	Unit	Qty.	Unit Cost	Cost	Notes
Capital Direct Costs -					
Contractor Mobilization					
Contractor Mobilization / Demobilization	LS	1	$125,000	$125,000	1,2
Replace Bulkheads in Dredging Area					
Mobilization for Bulkhead Repairs	LS	1	$140,000	$140,000	1,2
Environmental Controls	LS	1	$60,000	$60,000	3
Install Cantilevered Sheetpiles in Front of Existing Bulkhead	LF	475	$2,500	$1,187,500	4
Earthwork - Excavation/Import Inc. Haul and Placement/Disposal	LS	1	$82,398	$82,000	5
Temporarily Remove and Replace Marine Railway					
Remove Marine Railway	LS	1	$20,000	$20,000	6
Disposal of Concrete, Rails, Rail Ties, Piles	TON	90	$120	$11,000	7
New Steel Piling for Railway	EA	30	$8,000	$240,000	1
New Steel I Beam Caps	LF	300	$80	$24,000	1
New Steel Beam Rail Support	LF	300	$80	$24,000	1
New Steel Rail System	LF	300	$120	$36,000	1
Excavation of Marine Sediment					
Pre-Construction Bathymetric Survey	LS	1	$12,000	$12,000	8
Transloading Facility	LS	1	$100,000	$100,000	1
Temporarily Remove Docks, Floats, and Other Marine Infrastructure	LS	1	$80,000	$80,000	1
Mass Removal of Contaminated Sediment	CY	23,000	$37	$851,000	1,9
Dewatering, Water Treatment, and Disposal	LS	1	$80,000	$80,000	1
Sediment Transportation and Disposal	TON	34,500	$65	$2,240,000	1,7
Post-Construction Bathymetric Survey and Compliance Monitoring	LS	1	$50,000	$50,000	11
Placement of Residual Cover Layer (6-inches Sand)	CY	3,200	$42	$134,000	12
Water Quality Monitoring During Construction	LS	1	$60,000	$60,000	1
Habitat Mitigation	LS	1	$400,000	$400,000	13
Subtotal for Capital Direct Costs				***$5,960,000***	
Capital Indirect Costs -					
Pre-Design Investigation/Evaluation	LS	1		$100,000	14
Engineering Design Report (EDR)	LS	1		$100,000	1
Remedial Design	%	13		$775,000	15,16
Project Management	%	5		$298,000	15,17
Construction Management	%	6		$358,000	15,18
Construction Completion Report	LS	1		$75,000	1
Permitting and Regulatory Compliance	%	6		$358,000	1,19
Ecology Oversight	%	2		$119,000	1
Estimate of Taxes	%	9		$536,000	20
Subtotal for Capital Indirect Costs				***$2,719,000***	
Subtotal for Capital Direct and Indirect Costs				***$8,679,000***	
Contingency for Capital Direct and Indirect Costs	%	30		***$2,604,000***	
Total for Direct and Indirect Capital Costs				**$11,283,000**	
PRESENT WORTH OF ALTERNATIVE M-4 - Marine Site Unit				**$11,300,000**	21

Notes

1 Cost estimates based on costs incurred from similar projects, estimates from experienced contractors, and/or professional judgment.
2 Includes moving equipment and personnel on and off Site, establishing work zones, temporary fencing/facilities, and preparing contractor work plans.
3 Includes surface water barrier, silt fence, catch basin covers, and stockpile cover, as needed, depending on timing with Marine Site Unit remedial action work.
4 Cantilevered sheetpile wall; estimate by Reid Middleton for bulkhead section zones 8, 9, 10, and a portion of 7.
5 Includes limited earthwork associated with removal of existing tie-backs or backfilling existing areas of depression adjacent to the bulkheads; estimate by Reid Middleton.
6 Includes silt curtain installation; demolition and removal of 270 LF of steel rails and 8-inch-thick foundations.
7 Assumes material hauled by truck to Intermodal Transfer Station, and disposed of at Subtitle D facility.
8 Based on previous hydrographic studies in Blaine Harbor.
9 In SMA-1, assumes a total dredging depth of 2.5 ft over 17,200 SF of area (includes sediment/soil from marine railway well). Includes silt curtains and water quality monitoring.
10 In SMA-2, assumes a total dredging depth of 0.5 ft over approximately 26 acres of the Harbor. Includes silt curtains and water quality monitoring.
11 Assumes 11 surface sediment samples collected in SMA-1 and IHS and a a total of 11 samples collected throughout the harbor and analyzed for PCB congeners; long-term compliance monitoring included in O&M.
12 Assumes area of thin-layer cap required will be 4 acres (out of 26 acres dredged); thickness of 6 inches.
13 Assuming limited mitigation will be required for mitigating harbor-wide impacts to habitat.
14 Assumes pre-design investigation activities include geotechnical investigations to support bulkhead extension design, inspection of marine railway system, and limited additional contaminant delineation to support harbor-wide dredge prism design.
15 Estimated cost based on: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Capital indirect costs based on percentages of direct capital costs have been increased by 3% to account for applying the increased regulatory and engineering complexity for in-water design and construction.
16 Remedial design includes preparation of construction plans and specifications for dredging, marine railway system removal and replacement, and thin-layer cap; preparation of engineer's estimate of probable cost; and bidding support. Remedial design cost increased by 5% from standard rate to address structural design for bulkhead and travel lift.
17 Project management includes bid/contract administration, cost and performance reporting, planning and coordination.
18 Construction management includes submittal review, change order review, design modifications, and construction schedule tracking.
19 For this alternative, long-term monitoring is not anticipated and collection of compliance monitoring samples is assumed to be included in this line item.
20 Combined sales tax, Blaine, Washington.
21 Present worth value rounded to two significant digits.

Costs presented in this FS are considered to have a relative accuracy within the range of -30 to +50 percent, as shown above, and should be used primarily as a basis for comparison of costs between alternatives. More exact costs will be developed during the design and implementation phases of the cleanup.

Abbreviations

CY = cubic yard
EPA = US Environmental Protection Agency
FS = feasibility study
FT = foot
IHS = indicator hazardous substance
LF = linear foot
LS = lump sum
O&M = operations and maintenance
PCL = preliminary cleanup level
SF = square foot