# Remedial Investigation Work Plan
# Westman Marine Site
# Blaine, Washington

August 21, 2013

Prepared for

**Port of Bellingham**
**Bellingham, Washington**

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA  98020
(425) 778-0907

# TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1

2.0 BACKGROUND 2-1
  2.1 HISTORICAL SITE DEVELOPMENT AND OPERATIONS 2-1
  2.2 SITE USAGE AND FEATURES 2-2
    2.2.1 Environmental Setting 2-3
    2.2.2 Terrestrial Ecological Setting and Water Uses 2-4
  2.3 NEARBY ENVIRONMENTAL CONDITIONS OF INTEREST 2-5
    2.3.1 Former Boundary Fish Underground Storage Tanks 2-5
    2.3.2 Blaine Marina Inc. Site 2-6
  2.4 FUTURE SITE USE 2-6

3.0 PREVIOUS SITE OBSERVATIONS AND RELATED INVESTIGATIONS 3-1
  3.1 SITE VISITS BY WASHINGTON STATE DEPARTMENT OF ECOLOGY AND PORT OF BELLINGHAM 3-1
    3.1.1 Ecology Technical Assistance Visit –1993 3-1
    3.1.2 Port Environmental Compliance Audits –1993 and 2001 3-1
    3.1.3 Washington State Department of Ecology Site Visit – 2010 3-2
  3.2 LANDAU ASSOCIATES INVESTIGATION –2001 3-2

4.0 PRELIMINARY CONCEPTUAL SITE MODEL 4-1
  4.1 POTENTIAL CONTAMINANT SOURCES, MIGRATION PATHWAYS, AND MEDIA OF POTENTIAL CONCERN 4-1
  4.2 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS 4-2
    4.2.1 Potential Exposure Pathways 4-3

5.0 PRELIMINARY SCREENING LEVELS 5-1
  5.1 CONSTITUENTS OF POTENTIAL CONCERN 5-2
  5.2 PRELIMINARY SOIL SCREENING LEVELS 5-3
  5.3 PRELIMINARY GROUNDWATER SCREENING LEVELS 5-3
  5.4 PRELIMINARY SEDIMENT SCREENING LEVELS 5-4

6.0 CURRENT ENVIRONMENTAL SITE CONDITIONS 6-1

7.0 REMEDIAL INVESTIGATION SCOPE OF WORK 7-1
  7.1 UPLAND SOIL INVESTIGATION 7-1
  7.2 UPLAND GROUNDWATER INVESTIGATION 7-4
    7.2.1 Direct-Push Groundwater Samples 7-4
    7.2.2 Monitoring Well Installation Procedures 7-5
    7.2.3 Hydrogeologic Characterization 7-6
    7.2.4 Groundwater Analyses 7-6
  7.3 SURFACE WATER INVESTIGATION 7-7
  7.4 SEDIMENT INVESTIGATION 7-7
  7.5 SAMPLING AND ANALYSIS PLANS 7-9

8.0 REPORTING 8-1
  8.1 REMEDIAL INVESTIGATION REPORT 8-1

8.2 FEASIBILITY STUDY REPORT 8-2

9.0 SCHEDULE 9-1

10.0 USE OF THIS REPORT 10-1

11.0 REFERENCES 11-1

## FIGURES

| Figure | Title |
|---|---|
| 1 | Vicinity Map |
| 2 | Site Plan |
| 3 | Historical Site Layout |
| 4 | Previous Site Observations and Investigations |
| 5 | Conceptual Site Model |
| 6 | Groundwater Screening Level Flowchart |
| 7 | Proposed Investigation Sample Locations |

## TABLES

| Table | Title |
|---|---|
| 1 | Previous Related Investigations – Marine Sediment Analytical Results |
| 2 | Soil and Groundwater Constituents of Potential Concern |
| 3 | Preliminary Soil Screening Levels |
| 4 | Preliminary Groundwater Screening Levels |
| 5 | Preliminary Sediment Screening Levels |
| 6 | Summary of Remedial Investigation Upland Sample Locations |
| 7 | Summary of Remedial Investigation Marine Sediment Sample Locations |

## APPENDICES

| Appendix | Title |
|---|---|
| A | Historical Aerial Photographs |
| B | Health and Safety Plan |
| C | Upland Sampling and Analysis Plan |
| D | Marine Sediment Sampling and Analysis Plan |

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| µg/kg | Micrograms per Kilogram |
| BGS | Below Ground Surface |
| CFR | Code of Federal Regulations |
| COPC | Constituent of Potential Concern |
| CSL | Cleanup Screening Level |
| DIY | Do It Yourself |
| Development Plan | Port of Bellingham 2007 Blaine Wharf District Master Plan |
| DNR | Washington State Department of Natural Resources |
| DO | Dissolved Oxygen |
| Ecology | Washington State Department of Ecology |
| EPA | U.S. Environmental Protection Agency |
| FS | Feasibility Study |
| ft | Feet |
| mg/kg | Milligrams per Kilogram |
| MTCA | Model Toxics Control Act |
| OC | Organic Carbon |
| ORP | Oxidation Reduction Potential |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| PID | Photoionization Detector |
| Port | Port of Bellingham |
| PQL | Practical Quantitation Limit |
| PSL | Preliminary Screening Level |
| RI | Remedial Investigation |
| SAP | Sampling and Analysis Plan |
| Site | Westman Marine Site |
| SMS | Sediment Management Standards |
| SQS | Sediment Quality Standards |
| SVOC | Semivolatile Organic Compound |
| TBT | Tributyltin |
| TPH | Total Petroleum Hydrocarbon |
| TPH-D | Diesel-Range Total Petroleum Hydrocarbon |
| TPH-G | Gasoline-Range Total Petroleum Hydrocarbon |
| TPH-O | Oil-Range Total Petroleum Hydrocarbon |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |
| WAC | Washington Administrative Code |

This page intentionally left blank.

# 1.0 INTRODUCTION

This document presents a work plan to conduct a Remedial Investigation (RI) for the Westman Marine Site (Site) in Blaine, Washington (Figure 1). The purpose of this RI work plan is to provide a detailed approach to evaluating the nature and extent of the contamination at the Site for the purpose of developing and evaluating various cleanup alternatives, and to enable the selection of the final cleanup action.

The Site, as described in Agreed Order DE-9001, is defined by the extent of contamination caused by the release of hazardous substances at the Site, and is not limited to lease area or property area boundaries. The Site includes areas where hazardous substances have been deposited, stored, disposed of, placed, or otherwise have come to be located. The preliminary boundaries of the Site are shown on Figure 2. For the purposes of this work plan, the term Site will refer to the area within these preliminary boundaries. The actual boundaries of the Site will be determined during the RI.

The Site encompasses property that is owned by the Port of Bellingham (Port) and the Washington Department of Natural Resources (DNR), and is a part of a larger area referred to as the Blaine Harbor Industrial Area that supports the local marine industry. The Port-owned portion of the property is upland of the inner harbor line, and the DNR-owned portion of the property is on the shoreward side of the inner harbor line. A surface sediment investigation conducted by the Port in 2001 indicated contamination is present that may be associated with the maintenance and repair of marine vessels at the Site. These activities are referred to generally in this work plan as “boatyard activities,” which indicate that the maintenance and repair of marine vessels was the primary Site use.

Upland soil and groundwater quality have not been characterized. However, Westman Marine was a listed small-quantity generator of hazardous waste during its operations, and Site visits in the 1990s by the Washington State Department of Ecology (Ecology) and the Port revealed that housekeeping was an ongoing issue for this facility. Reportedly, there was evidence of potential surface contamination including numerous minor spills on the ground surface, and paint chips and sandblast grit noticed in surface soil. Therefore, while there are no existing analytical data for the Site uplands, it is anticipated that at least localized areas of affected soil are present.

The Site has been listed on the Ecology Hazardous Sites List (FSID 66519819) and ranked 1 out of 5 on its priority list for cleanup, with a ranking of 1 being the highest priority for cleanup. The RI will be conducted under Agreed Order No. DE 9001 between the Port and Ecology. This work plan was prepared to meet the requirements of an RI as defined by the Washington Model Toxics Control Act (MTCA) Cleanup Regulation (WAC 173-340-350), and describes the RI activities to be conducted.

# 2.0 BACKGROUND

The Site is located in Blaine, Washington within Blaine Harbor. Blaine Harbor is at the north end of Drayton Harbor, in the Willamette Meridian northwest quarter of Section 1, Township 40 North, Range 1 West. Westman Marine leased approximately 1.5 acres of upland property at 218 McMillan Avenue from the Port from 1989 until January 2011. Following Westman Marine's departure in 2011, the Port has continued to lease the boatyard to other entity(s) for boatyard activities. Westman Marine and other tenants have conducted boatyard activities at this location that may have resulted in the release of hazardous substances to soil, groundwater and/or marine sediment. The extent of these releases and the media that have been affected will be determined in the RI and will define the Site boundary. For the purposes of the RI Work Plan, the Site upland is defined by the current and former boatyard operational area and the aquatic portion of the Site is defined by the extent of surface sediment exhibiting concentrations above the sediment screening levels identified in this document. These boundaries will be revised in the RI report based on the RI data.

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.

## 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, which are provided in Appendix A.

Blaine Harbor was originally created in the late 1930s by dredging 2 acres of tideflats to create a small boat harbor. An access road was constructed and adjacent tidelands were filled to create uplands and provide shore support for the area. In the late 1940s, 4 additional acres were dredged, additional tidelands were filled, and a breakwater, bulkheads, floats, and ramps were constructed, as shown in the 1949 aerial photograph (Appendix A). The upland area created at the Site generally consists of hydraulic fill with timber bulkheads along the shoreline. In some areas, riprap was used instead of, or in conjunction with, the bulkheads to establish the shoreline. An additional 15-acre area of tideflats was dredged and an extension of the breakwater was completed in the mid-1950s (TEC 2001). The 1956 aerial photograph (Appendix A) shows the breakwater extending farther east and improvements to upland facilities. The harbor and industrial area 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 and the footprint of the upland industrial area has remained largely unchanged from that shown in the 1949 aerial photograph. In 2001, the Port completed an expansion project at Blaine Harbor that included dredging approximately 15 acres of tide flat, enlarging the moorage basin, and adding more than 300 slips. The 2011 aerial photograph of the Site (Appendix A) generally depicts the current layout of the Site and surrounding facilities.

Business activity has historically been focused in the area along the western end of Blaine Harbor referred to herein as 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).

## 2.2 SITE USAGE AND FEATURES

The Site has been used for commercial marine operations since approximately 1949. The following summarizes historical operations at the Site, based on the leasing history and some observations made during Site visits that are discussed in Section 3:

- 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, which are visible in the 1966 aerial photograph (Appendix A), and shown on Figure 3. A portion of the marine railway and sidetracks are still in use today, although the sidetracks occupy a smaller footprint than they once did, as shown on Figure 4.
- 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, and the fueling office associated with the fuels sales operation are shown on Figure 3, outside the approximate Site boundary. The USTs were reportedly closed in place in 2001 (EDR 2011) and the dock was removed some time prior to when the Port conducted a sediment quality investigation in the area in 2001 as it does not appear present in the figures presented by TEC (2001).
- In 2012, Boundary Fish reportedly removed the three USTs 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. The UST removal and post-removal environmental sampling is discussed in Section 2.3.
- Carl Berg subleased portions of the Site in 1955 to Pacific Coast Seafoods and Kaylor & Dahl for seafood processing.
- 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)
  - Wrang Shipyard (boatyard)
  - Berg Shipyard (boatyard)
  - Jack Davis Marine (boatyard)
  - Westman Industrial (boatyard).
- In 1989, Westman Marine began leasing approximately 1.5 acres of property from the Port for boatyard operations.

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 are shown on Figure 4 and included a shop (removed in 2010), a travel lift, a stormwater treatment system, and a solvent recycling shack. Westman Marine operated a boat haul-out (travel lift), which allowed customers to perform repairs in the gravel area east of the marine railway (TEC 2001).

Westman Marine was listed with the U.S. 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).

Westman Marine operated under a National Pollutant Discharge Elimination System (NPDES) general boatyard permit (WAG030053 – currently registered to Walsh Marine at 218 McMillan Avenue). 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. An audit was reportedly conducted in 1995 with no significant findings (Landau Associates 2002). Since that time, Ecology has worked with the leaseholders to resolve various issues associated with this permit including sampling, reporting, and the housekeeping issues discussed in Section 3.1.3.

### 2.2.1 ENVIRONMENTAL SETTING

The upland portion of the Site was created in the 1940s by dredging and filling over what previously existed as tideflat. 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. Geotechnical borings were advanced near the Site in 1998 as part of breakwater improvements. Logs of these borings indicate that glaciomarine drift is present to a considerable depth in the area.

Additional information regarding subsurface conditions was collected in 2012 during a geotechnical exploration conducted for the repair of a section of failing bulkhead approximately 300 feet (ft) northwest of the Site (Landau Associates 2012). Subsurface geologic conditions observed during the investigation consisted of up to 15 ft of dredge fill material consisting of sandy, silty clay, and lenses of silty sand. Below the fill, silty fine sand and fine sandy silt were present to a depth of about 25 ft below ground surface (BGS). Below a depth of about 25 ft BGS, the glaciomarine drift 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).

Hydrogeology at the Site has not been characterized to date, and will be evaluated during the RI process. Groundwater at or potentially affected by the Site is not currently used for drinking water. It is not considered to be a reasonable future source of drinking water due to its proximity to marine surface water, its limited productivity, and the high probability that it would have a high salinity content following extended periods of groundwater extraction that would make it unsuitable as a domestic water supply.

There are reportedly no storm drains on the Site and none were observed during an April 2013 reconnaissance of the Site shoreline. The reconnaissance was conducted during low tide, and as discussed in Section 3.0, no stormwater outfalls were observed along the shoreline. A stormwater treatment system was installed between 1993 and 1996 to treat water that collects in a sump associated with the travel lift pad lift sump and water from the rail lift (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 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). 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 uplands portion of the Site in 2001 (TEC 2001) and during the April 2013 reconnaissance are indicated on Figure 4.

### 2.2.2 TERRESTRIAL ECOLOGICAL SETTING AND WATER USES

The upland portion of the Site is currently estimated to be slightly more than 1 acre in area and has been used since the 1950s 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 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 530 ft northeast of the Site. The terrestrial ecological setting of the Site is not expected to change in the future during Site redevelopment. Based on the terrestrial ecological setting, the Site is exempt from the requirement of conducting a terrestrial ecological evaluation in accordance with WAC 173-340-7491.

## 2.3 NEARBY ENVIRONMENTAL CONDITIONS OF INTEREST

Two conditions of environmental interest are present in the Site vicinity, the former Boundary Fish petroleum hydrocarbon USTs located immediately west of the estimated Site boundary and the Blaine Marina Inc. site (FSID_2888), located to the north of the Site. These two conditions of environmental interest are summarized below.

### 2.3.1 FORMER BOUNDARY FISH UNDERGROUND STORAGE TANKS

As discussed in Section 2.2, three USTs were formerly located near the Boundary Fish seafood processing building. Boundary Fish reportedly removed the three USTs from its leased property late in 2012. The USTs and associated fueling operations are located to the west of the apparent limits of historical boatyard activities and are thus outside of the preliminary Site boundary. However, if there had been a release associated with the USTs, it could be relevant during RI activities at the Site.

The approximate location of the former USTs is shown on Figure 3. Stratum Group conducted the 2012 UST Site Assessment to evaluate subsurface conditions associated with the former USTs at the time of removal (Stratum Group 2013). The assessment included collecting five soil samples and one groundwater sample from the open excavation after the USTs were removed. The open excavation was approximately 25 ft long, 10 ft wide, and 10 ft deep. There was reportedly about 1 ft of water in the base of the excavation, assumed to be exposed groundwater.

Soil samples from the excavation sidewalls and floor were screened in the field for indications of contamination. No hydrocarbon sheen, odor, or discoloration was observed in the soil samples. One floor soil sample and four sidewall soil samples were analyzed for diesel-range and oil-range total petroleum hydrocarbons (TPH-D and TPH-O) by Method NWTPH-Dx. There were no detections of TPH in any of the soil samples.

Groundwater in the open excavation was also screened for indications of petroleum contamination. The water reportedly had no hydrocarbon odor, but a slight sheen was observed at the western end of the excavation. A groundwater sample was collected and analyzed for TPH-D and TPH-O by Method NWTPH-Dx. There were no detections of TPH in the groundwater sample. Because there was no hydrocarbon odor associated with the sheen observed in the groundwater, and because the analytical results of the groundwater sample did not indicate that detectable concentrations of TPH were present, it appears that the sheen observed was biogenic and the result of naturally occurring organic material in the soil. Based on the results presented in the Stratum Group report, it does not appear that a release has occurred from the former USTs at the Boundary Fish Company lease area that would impact the Westman Marine Site.

### 2.3.2 BLAINE MARINA INC. SITE

The Blaine Marina Inc. (BMI) site is located north of the Site, at 214 Sigurdson Avenue. The BMI site is being addressed under an agreed order between the Port and Ecology. RI activities are currently under way for that site to investigate potential impacts from a retail fuel operation that has operated at that site since approximately 1950. Contaminants of concern for the site include gasoline-range total petroleum hydrocarbons (TPH-G) and TPH-D, and other fuel-related compounds. Based on preliminary RI results, soil and groundwater contamination from the BMI site does not extend as far south as the estimated Site boundary presented on Figure 2. Based on these findings, there appears to be a clear separation between the BMI site and the Westman Marine Site.

## 2.4 FUTURE SITE USE

The Port is in the planning phase of redevelopment of the Blaine Harbor Industrial Area, including updating the infrastructure. Development efforts will be guided by the Port’s 2007 Blaine Wharf District Master Plan (Development Plan; Port of Bellingham 2007), development regulations in the City of Blaine’s Land Use Code (BMC 17.23), and Design Standards, BMC 17.121 for the Wharf District. The Development Plan is intended to provide for a variety of recreational, commercial, marine, industrial and residential activities. The upland portion of the Site is located in the Wharf District Planning Area 6, referred to in the Development Plan as the Shipyard Industrial Park. This area will be preserved for marine-related commercial and industrial use, serving primarily the commercial fishing, boat building, and boat services and repair industry. Redevelopment of this area was scheduled in 2007 to begin between 2010 and 2015.

# 3.0 PREVIOUS SITE OBSERVATIONS AND RELATED INVESTIGATIONS

Environmental assessments to characterize the Site have been limited to visual observations during Site visits conducted by Ecology and the Port, a Site reconnaissance to observe whether any stormwater outfalls are present along the Site shoreline, and a sediment investigation conducted by Landau Associates. The observations and results of the sediment investigation are described in this Section. The Site reconnaissance to observe whether stormwater outfalls are present was brief in nature and is not included as a separate section below. That reconnaissance was conducted in April 2013, and was limited to a visual inspection of the shoreline during a significant rain event and during low tide, in order to observe whether a stormwater outfall is present. As mentioned in Section 2.2.1, no outfalls were observed.

## 3.1 SITE VISITS BY WASHINGTON STATE DEPARTMENT OF ECOLOGY AND PORT OF BELLINGHAM

Ecology and Port personnel have visited the Site to provide technical assistance regarding pollution prevention and to observe environmental conditions and practices. Pertinent observations from three of these visits are listed below, and features relevant to the RI scope of work are shown on Figure 4.

### 3.1.1 ECOLOGY TECHNICAL ASSISTANCE VISIT –1993

On June 17, 1993, a Technical Assistance Officer from Ecology visited the Site to assist Westman Marine in implementing a proactive approach to environmental affairs. In a letter to Westman Marine following the visit (Ecology 1993), Ecology relayed the following observations made on June 17:

- Abandoned waste was accumulating at the Site, likely attributed to do-it-yourself (DIY) boat maintenance users who were working in the eastern portion of the Site
- Cutting fluids were noted accumulating on the floor in the shop
- A parts washer was in use at the Site that used mineral spirits and naptha/d-limonene as solvent
- Sandblast grit was being used at the site
- Soil contaminated with paint and mineral spirits was present in drums at the Site.

### 3.1.2 PORT ENVIRONMENTAL COMPLIANCE AUDITS –1993 AND 2001

On August 24, 1993 and January 10, 2001, the Port conducted environmental compliance audits to visually observe environmental conditions at the Site. The following observations were recorded on the audit checklists from these visits (Port of Bellingham 1993, 2001):

- Heavily stained soil was observed at the northeast corner of the Site and north of the upland end of the marine railway. For the purposes of this RI work plan, Landau Associates interprets the observation of stained soil to indicate potential petroleum hydrocarbon contamination.

- 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 potentially migrating into the waterway.
- Stormwater that flows across the impervious surfaces may have been picking up contaminants from the boatyard and carrying them to other areas of the Site that have a 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.

### 3.1.3 WASHINGTON STATE DEPARTMENT OF ECOLOGY SITE VISIT – 2010

Ecology conducted a Site visit in 2010 (Ecology 2010) to evaluate compliance with the NPDES general boatyard permit. During the visit, Ecology noted that spent sandblast grit was exposed to stormwater throughout the yard, and on the deck and cradle of the marine railway. Paint chips were observed spread throughout the gravel area surrounding the travel lift pad. The railway was noted to have large openings in the deck edges that allow washwater and paint chips to leak through to the marine waters below, and the washwater recycle system was determined to not be functioning properly.

## 3.2 LANDAU ASSOCIATES INVESTIGATION –2001

Landau Associates conducted a sediment quality investigation in Blaine Harbor on behalf of the Port in 2001 (Landau Associates 2002). The purpose of the investigation was to evaluate compliance with the Washington State Sediment Management Standards (SMS) for surface sediment within Blaine Harbor that may have been affected by harbor activities. The investigation evaluated sediment quality throughout much of Blaine Harbor, including the vicinity of the Westman Marine leasehold. The following discussion is focused on the samples collected in the vicinity of the Westman Marine uplands that are considered relevant to Site sediment quality.

Surface sediment samples BH-02, BH-03, and BH-11 through BH-14, were collected in close proximity to the upland portion of the Site during the 2001 sediment quality investigation. The locations of these samples are shown on Figure 4. Samples were analyzed for metals, PCBs, PAHs, SVOCs, organotins, and conventional sediment parameters. The analytical results are summarized in Table 1. The analytical results were compared to the SMS Sediment Quality Standards (SQS) for those constituents for which SQS criteria area available. SQS criteria are not available for organotins, so the Puget Sound Dredge Disposal Analysis program (PSDDA) screening level of 73 micrograms per kilogram (µg/kg) for bulk tributyltin (TBT) as the TBT ion was used for screening purposes. PSDDA, now administered by the Dredged Material Management Office (DMMO), also promulgated TBT criteria comparable to the SQS based on analysis of sediment pore water, but pore water samples were not collected for the 2001 investigation. As indicated in the table, samples collected from locations BH-02, BH-03, BH-12, BH-13, and BH-14 exceeded the sediment screening level for bulk TBT.

The detected concentration of copper [estimated at 521 milligrams per kilogram (mg/kg)] in the surface sediment sample collected from BH-02, the sample location closest to the marine railway and travel lift piers, exceeded the Sediment Quality Standard (SQS) and the Cleanup Screening Level (CSL; 390 mg/kg) established in the Sediment Management Standards (WAC 173-204). These surface sediment samples were collected 12 years ago, so current surface sediment quality is unknown.

To support this investigation, The Environmental Company prepared an uplands source assessment report (TEC 2001). Based on this report and the results of the investigation, SMS and TBT screening level exceedances were attributed to marine vessel repair activities that have been performed at the Site since the 1950s. TBT and copper are common constituents of marine bottom paints and were thought to have been released to sediments from sand blasting and hull painting activities. TBT and copper concentrations were highest in sediment near the marine railway well.

# 4.0 PRELIMINARY CONCEPTUAL SITE MODEL

This section presents a preliminary conceptual Site model of contaminant distribution and migration related to potential releases of hazardous substances at the Site. This preliminary model will be used to guide investigation efforts during the RI and will be refined during the RI process as data are collected. The refined model will be presented in the RI report. In the sections below, we preliminarily identify potential sources of contamination, migration pathways, potentially affected media, and contaminant exposure routes to human or ecological receptors. A schematic of the preliminary Site conceptual model is presented on Figure 5.

## 4.1 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 throughout the Site, described in Section 2.2. Releases from these operations to surface soils at the Site are likely to have occurred based on visual observations of oil-stained surface soil and abrasive grit and paint chips throughout Site surface soils. Potential contaminant sources include:

- Paint and solvent storage and use at the Site may have resulted in accidental releases.
- Antifouling agents, such as copper or TBT, are commonly found in coatings on marine vessels and may have been released during sandblasting or scraping of hulls, or during painting of vessels. The use of TBT was partially banned by federal law in 1988, which reduced the amount of TBT in boat maintenance wastes. But, its use was not prohibited on aluminum hulls, outboard motors, or lower drive units for vessels under 25 meters in length, so it remains a potential constituent of boatyard maintenance waste.
- Mechanical repairs, including repairs performed by Westman Marine or at the DIY boat maintenance area, may have released petroleum hydrocarbons or polychlorinated biphenyls (PCBs) to Site soil.

Based on our preliminary understanding of Site conditions and potential contaminant sources, the potential pathways for contaminant migration at the Site include:

1. Transport of contaminants from the ground surface to shallow soil
2. Leaching of contaminants from soil into groundwater
3. Transport of contaminants in soil to outdoor air via wind or fugitive dust
4. Transport of volatile compounds from subsurface soil or groundwater to indoor or outdoor air via vapor migration
5. Transport of contaminants in soil to surface water and marine sediment via stormwater runoff
6. Transport of contaminants in groundwater to adjacent marine surface water and sediment
7. 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

8. Re-suspension 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.

With respect to item 4 above, there is currently no information that suggests volatile organic compounds (VOCs) are present in Site soil or groundwater at concentrations that would impact soil vapor quality. If conditions are encountered during the RI that suggest that Site soil vapor quality is potentially impacted by VOCs, the RI will be expanded to evaluate soil vapor quality by collecting subsurface soil vapor samples for VOC analysis. The scope of such a soil vapor investigation would be determined in consultation with Ecology.

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

1. Soil Groundwater
2. Surface water
3. Sediment

## 4.2 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. 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 was evaluated based on the current and anticipated future use of the Site, as follows:

- **Humans**: Because the Site is used for marine industrial purposes (commercial and light industrial use), employees working at the Site, construction workers conducting intrusive activities, and visitors or patrons of the DIY boat maintenance area are considered potential human receptors.
- **Terrestrial Ecological Receptors**: For the reasons described in Section 2.2.2, terrestrial ecological receptors (wildlife, soil biota, and plants) are not considered to be potential receptors.
- **Benthic and Aquatic Organisms**: Due to the Site's proximity to marine surface water, 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
- Benthic and aquatic organisms.

### 4.2.1 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. It has not yet been determined whether these exposure pathways are complete.

**Soil:**

- Direct contact (including incidental ingestion) by Site workers or visitors.
- Inhalation of dust or vapors (if applicable) 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.
- Inhalation of vapors released from groundwater impacted by volatile contaminants (if applicable)
- 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 via groundwater discharge through the biologically active zone of sediment (the upper 10 centimeters below the mudline). This may result in the uptake of contaminants in these organisms.
- Human ingestion of marine organisms that were impacted by releases from the Site.

# 5.0 PRELIMINARY SCREENING LEVELS

Preliminary screening levels (PSLs) have been developed for media of potential concern identified in Section 5.1 (i.e., soil, groundwater, surface water, and sediment). Constituents of potential concern (COPCs) are discussed in Section 5.1 and summarized in Tables 2 and 3. Previous investigations at the Site have tested for a limited range of analytical parameters in samples of surface sediment. As a result, the preliminary COPCs developed for the RI work plan are based on the results of the sediment investigation, limited observations from Site visits in 1993 and 2001, and also our understanding of other COPCs commonly associated with boatyard activities.

After additional characterization during the RI, Site screening levels will be developed consistent with the approach detailed in the Harris Avenue Shipyard RI/FS Screening Level Workbook. This approach includes statistical criteria regarding the frequency of detection in the development of COPCs, which is not yet possible for the Site. Figure 6 provides an example flowchart from the Harris Avenue Shipyard that will be followed and presented in the RI report as sufficient data are generated.

PSLs for media of potential concern that are adequately protective of the potential receptors and exposure pathways identified herein were developed in accordance with MTCA requirements, and are generally consistent with the approach presented in the Harris Avenue RI/FS Screening Level Workbook, subject to the limitations of the currently available data. PSLs for soil, groundwater, and sediment are presented in Tables 3, 4, and 5, respectively. Although surface water is a potentially affected medium, it is addressed through the development of groundwater PSLs that are protective of marine surface water rather than developing surface water PSLs directly.

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 at the practical quantitation limit (PQL) or natural background level 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 PSLs 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.

Sediment PSLs were developed based on site-specific COPCs and the application of MTCA and SMS requirements. Two SMS criteria are promulgated by Ecology as follows:

- The marine SQS (WAC 173-204-320), the concentration above which adverse effects to benthic organisms may occur.
- The sediment CSLs (WAC 173-204-520), the concentration above which adverse effects to benthic organisms are likely to occur.
- Criteria equivalent to the SQS and CSL values for TBT, which does not have promulgated SMS cleanup standards.

The SQS are the most stringent SMS numeric criteria and represent the goal for sediment cleanups. The suite of SMS analytes and the associated SQS and CSL are listed in Table 5. Also provided in Table 5 are the dry weight equivalents to the carbon normalized SMS criteria, which are based on the Puget Sound Apparent Effect Threshold (AET) values.

## 5.1 CONSTITUENTS OF POTENTIAL CONCERN

Because the environmental condition of soil and groundwater at the Site has not yet been investigated, in accordance with WAC 173-340-350, the COPCs were selected based on known operational practices and limited knowledge of potential releases. Westman Marine was a listed small-quantity generator of hazardous waste during its operations, and several Site visits in the 1990s by Ecology personnel revealed that housekeeping was an ongoing issue for this facility, as discussed in Section 3.1. The COPCs were selected based on the compounds of interest noted during Site visits and based on conditions encountered at other boatyards.

The COPCs for soil and groundwater are listed below and summarized in Table 2:

- Volatile organic compounds (VOCs)
- Semivolatile organic compounds [SVOCs, including naphthalenes and carcinogenic polycyclic aromatic hydrocarbons (PAHs)]
- 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)
- PCBs
- Organotins.

Although VOCs have been identified as COPCs for the Site, there is currently no evidence that VOCs are present in Site media of potential concern. As a result, PSLs for VOCs have not been developed for the vapor pathway at this time, but will be developed for VOCs that are detected during the RI.

## 5.2 PRELIMINARY SOIL SCREENING LEVELS

PSLs for soil were developed for the COPCs listed in Section 5.1. The soil PSLs are intended to be protective of human health and groundwater and are provided in Table 3. For human health, PSLs were developed 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 generally anticipated to be commercial or light industrial, Site visitors or public patrons of the facilities are not prohibited from these areas. Therefore, soil PSLs protective of human health were developed based on the requirements under WAC 173-340-740 for unrestricted land use. The Method B soil cleanup levels are based on exposure assumptions that, while appropriate for initial data screening, may be overly conservative for Site cleanup given the industrial/commercial nature of its use. Cleanup or remediation levels more consistent with Site use may be developed in the RI and/or Feasibility Study (FS) based on more applicable exposure scenarios for the Site. 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 PSLs 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 website 2012). The MTCA Method A soil cleanup levels for unrestricted site use were used to address total petroleum hydrocarbons (TPH) because MTCA Method B criteria are not available. Soil PSLs protective of groundwater were determined using the fixed parameter, three-phase partitioning model in accordance with WAC 173-340-747(4). The three-phase model provides a conservative estimate of the concentration of a contaminant in soil that is protective of groundwater PSLs. Because groundwater is not a current or likely future source of drinking water, the groundwater PSLs (discussed in Section 5.3) were developed based on protection of marine surface water, sediment recontamination, and human health in accordance with WAC 173-340-730. Some adjustments to PSLs were made so that the PSL was no less than the PQL or natural background metals concentrations in accordance with WAC 173-340-730(5)(c). Reporting limits from ALS Laboratories in Kelso, Washington and Analytical Resources, Inc., in Tukwila, Washington for the groundwater analytical methods were used as PQLs.

## 5.3 PRELIMINARY GROUNDWATER SCREENING LEVELS

PSLs for groundwater are developed in Table 4 for the COPCs listed in Section 5.1. Because human ingestion of constituents in groundwater is not a potential exposure pathway, potable groundwater cleanup levels were not developed for Site groundwater. PSLs for groundwater were developed to be protective of marine surface water and marine sediment recontamination.

In the absence of applicable criteria protective of these exposure pathways, MTCA Method A cleanup levels were used for TPH PSLs. For metals, PSLs were developed based on protection of marine surface water, in accordance with WAC 173-340-201A, 40 CFR 131, and marine surface water criteria from the Clean Water Act. Except for TPH and metals, the PSLs for groundwater were developed based on surface water standards protective of human health.

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

## 5.4 PRELIMINARY SEDIMENT SCREENING LEVELS

The SQS are the most stringent SMS numeric criteria and represent the goal for sediment cleanups. The SQS and CSL values used as sediment PSLs are listed in Table 5.

The PSLs for sediment were developed based on the protection of biological resources. Although the SMS state that the SQS and CSL values are also intended to be protective of human health, it is recognized that the SMS cleanup standards may not be protective of human health for bioaccumulative constituents such as PCBs or carcinogenic PAHs. As a result, it may be necessary to develop sediment cleanup levels that are protective of human health if bioaccumulative constituents are present in Site sediment. The need for such criteria will be evaluated if RI data indicate that bioaccumulative compounds resulting from Site releases are present.

# 6.0 CURRENT ENVIRONMENTAL SITE CONDITIONS

The current environmental conditions of the Site are not clear. However, indications of contamination were noted during Site visits that warrant investigation. Based on visual observations at Site, it is possible that shallow soil is impacted by contaminants common to boatyard activities including petroleum hydrocarbons, metals, organotins, VOCs, PCBs, and SVOCs.

Surface sediment samples BH-02, BH-03, and BH-11 through BH-14, were collected in the Site vicinity during the 2001 sediment investigation, as shown on Figure 4. The analytical results for these samples are summarized in Table 1. As indicated in the table, samples collected from locations BH-02, BH-03, BH-12, BH-13, and BH-14 exceeded the sediment screening level used for bulk TBT of 73 µg/kg. Additionally, the detected concentration of copper (estimated at 521 mg/kg) in the surface sediment sample collected from BH-02, the sample location closest to the marine railway and travel lift piers, exceeded the SQS and the CSL established in the SMS (WAC 173-204).

Significant data gaps exist that that require further investigation in order evaluate Site conditions and to develop an appropriate remedy. Primary data gaps identified for the Site include the following:

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

# 7.0 REMEDIAL INVESTIGATION SCOPE OF WORK

This section describes the RI scope of work that will be conducted to characterize environmental conditions at the Site. This RI scope of work is based on the preliminary understanding of Site conditions and the preliminary Site conceptual model described in this work plan. Results from the previous sediment investigation, Port compliance audits, and an Ecology Site visit provide some information regarding Site environmental conditions, but significant data gaps exist need to be filled to delineate the nature and extent of contamination to develop and evaluate potential remedial actions. The proposed upland and sediment investigations for the Site are discussed in the sections below and the proposed sampling locations are presented on Figure 7. Additional details for the investigations are presented in the Upland and Sediment Sampling and Analysis Plans (SAPs; Appendices C and D, respectively).

## 7.1 UPLAND SOIL INVESTIGATION

Site use has been limited to various typical boatbuilding or boatyard activities, and fish processing in the western portion of the Site in more recent years. It is not anticipated that fish processing has resulted in releases of hazardous substances, although Boundary Fish has reportedly stored limited quantities of degreaser, gasoline, and motor oil (TEC 2001), and previously operated petroleum hydrocarbon USTs in the Site vicinity. As a result, the RI will focus on evaluating potential impacts resulting from boatyard activities, but will consider the RI results in the context of adjacent activities that could have impacted Site environmental conditions.

The preliminary Site boundaries were developed from where it appears boatyard activities have been conducted based on review of historical aerial photographs as discussed in Section 2.2, engineering drawings provided by the Port, and observations during previous Site visits discussed in Section 3.1. Historical Site boatyard activities were conducted farther west toward Sigurdson Avenue than is currently apparent based on the presence of the side rails that previously extended approximately 150 ft west from the existing marine railway, as shown on Figures 3 and 7. The preliminary Site boundary to the west is based on the historical Site layout shown on Figure 3. To the south and east, the upland investigation will extend to the shoreline of Blaine Harbor, and to the north the investigation will extend to the paved road running perpendicular to Sigurdson Avenue, which is labeled in historical engineering drawings as “Berg Street.”

Because subsurface conditions have not been evaluated, the investigation described below is designed to provide Site-wide characterization data within the estimated boundaries of the Site. Proposed boring locations are distributed to provide Site-wide coverage for the RI soil investigation. Some locations were selected based on visual observations such as paint chips or oil staining on surface soil, or historical activities of interest. The proposed upland investigation consists of exploring soil conditions by field-screening methods and collecting soil samples for analytical testing purposes at 17 boring locations. The proposed boring locations are shown on Figure 7 and summarized in Table 7.

Borings will be advanced from the ground surface to depths of approximately 9 to 15 ft BGS, or deeper if necessary to advance at least 2 ft below the groundwater table observed at the time of drilling. If potential contamination is apparent based on the field-screening results in the lowest sampling interval for a boring, the exploration will be extended deeper in 2-ft increments to adequately delineate the depth of contamination. At each soil boring, samples for laboratory analysis will be collected from the ground surface to 4 ft BGS, as described below. However, if soil samples are collected in paved areas or in areas where recent surface filling and grading have been conducted, sample collection will begin immediately below the pavement base course layer.

Four intervals will be sampled at each boring location: 0 to 1 ft, 1 to 2 ft, 2 to 3 ft, and 3 to 4 ft BGS. The top interval (0 to 1 ft) will be immediately analyzed by the laboratory for the analytical parameters discussed below. The three remaining intervals (1 to 2 ft, 2 to 3 ft, and 3 to 4 ft) will be archived at the laboratory pending a review of the results for the top interval. The second interval (1 to 2 ft) will be analyzed for those constituents that are above PSLs in the top interval. Similarly, the third interval (2 to 3 ft) will be analyzed for constituents that are above PSLs in the second interval and the fourth sample will be analyzed for constituents that exceed the PSLs in the third sample.

Because Site soil within the depths of interest consist primarily of hydraulic fill, a soil sample will be collected at GP-17 from depth unlikely to be affected by current or historical operations and well above the groundwater table, to evaluate general fill quality. This boring will be extended to depth to also collect a groundwater sample from a presumably upgradient location to characterize upgradient groundwater quality.

Borings will be advanced using a truck-mounted, direct-push drilling rig. Soil will be classified using the Unified Soil Classification System and the description will be documented in a field Log of Exploration. Field personnel will screen the soil for indications of potential contamination and record the observations in the Log of Exploration as follows:

- Visual screening:
  - Personnel will check the soil for discoloration or staining, the presence of hydrocarbon sheen, the presence of paint chips, and the presence of sandblast grit
- VOC screening:
  - Personnel will screen samples for the presence of VOCs using a photoionization detector (PID)
- Olfactory screening:
  - Personnel will note unusual odors that are noticed during sample processing.

If potential contamination is identified through field screening, a soil sample will be collected from the potentially affected zone, 1 ft above the potentially affected zone, and 1 ft below the potentially affected zone, to vertically delineate the potentially affected area. The soil sample collected from the potentially affected zone will be analyzed immediately and the overlying and underlying samples will be archived at the laboratory pending the results of the sample collected from the potentially affected zone. The overlying and underlying samples will be tested for those constituents that are above PSLs in the sample from the potentially affected zone.

If areas of significant potential contamination are encountered, additional explorations may be advanced to delineate the limits of the potential contamination. For example, if field screening indicates the presence of petroleum hydrocarbon contamination that appears to be more extensive than incidental surface spillage, additional borings would be advanced to delineate the vertical and lateral limits of the release.

The sampling and analytical testing protocols for RI soil characterization are summarized in Table 6 and additional details are provided in the upland SAP (Appendix C). Soil samples will be analyzed for the analytical parameters listed below. Soil samples from locations WM-GP-5, WM-GP-6, and WM-GP-16 will be analyzed for organotins based on vessel maintenance activities in these areas. Soil samples from three boring locations (WM-GP-9, WP-GP-12, and WP-GP-14) will be analyzed for SVOCs. Soil samples from locations WM-GP-8, WM-GP-9, WM-GP-12, WM-GP-14, and WM-GP-16 will be analyzed for PCBs based on previous observations of stained surface soil in these locations. The general fill quality sample (WM-GP-17) will be tested for the analytical parameters identified below, plus total organic carbon (TOC), and mechanical grain-size distribution.

These selections may change based on observations during field screening in order to analyze the soil most likely to be impacted by these constituents. The remaining parameters will be analyzed at each boring location.

Laboratory soil analysis will include the following analytical parameters for selected samples:

- VOCs by U.S. Environmental Protection Agency (EPA) Method 8260C (all sampling locations exhibiting sustained PID detections above 5 parts per million (ppm) and/or olfactory indications of contamination)
- SVOCs by EPA Method 8270D (WM-GP-9, WM-GP-12, and WM-GP-14)
- PAHs by EPA Method 8270D SIM (all sampling locations)
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) by EPA Method 6020 (EPA Method 7471B for mercury) (all sampling locations)
- Petroleum hydrocarbon identification by Method NWTPH-HCID (all sampling locations)

- TPH-G, TPH-D, and/or TPH-O by Method NWTPH-G, or NWTPH-Dx conducted as follow-up analysis for samples with NWTPH-HCID detections; NWTPH-Dx follow-up analyses will include acid/silica gel cleanup to reduce organic interference
- PCBs by EPA Method 8082 (at sampling locations WP-GP-8, WM-GP-9, WM-GP-12, WM-GP-14, and WM-GP-16)
- Organotins by EPA Method 8270D SIM (at sampling locations WM-GP-5, WM-GP-6, and WM-GP-16).

## 7.2 UPLAND GROUNDWATER INVESTIGATION

The RI groundwater investigation will evaluate potential groundwater impacts and provide general characterization of Site hydrogeology. The proposed scope for the RI groundwater investigation is discussed below. In summary, the groundwater investigation will be conducted in two phases:

- **Phase I:** Collect and analyze groundwater grab samples from nine direct-push borings as shown on Figure 7.
- **Phase II:** Install groundwater monitoring wells at the Site, and collect and analyze groundwater samples from the completed wells.

The number of groundwater monitoring wells and the final locations will be decided in coordination with Ecology based on the results from the Phase I groundwater investigation. For planning purposes, it is assumed that up to seven monitoring wells will be required.

### 7.2.1 DIRECT-PUSH GROUNDWATER SAMPLES

Proposed groundwater sampling locations for the first phase of the groundwater investigation are shown on Figure 7, represented by blue coloring of the direct-push location symbol. It should be noted that proposed groundwater sampling locations are approximate and may be revised, as necessary, due to conditions in the field. Direct-push borings used for groundwater grab sample collection will be advanced a minimum of 4 ft into the groundwater table.

Each sample will be collected using a groundwater sampler consisting of a 4-ft-long, wire-wrapped, stainless steel screen (0.010-inch slot size) with a retractable protective steel sheath. The groundwater sampler will be advanced to the sample depth and the protective sheath will be retracted to expose the stainless steel screen to the formation. Low-flow purging will be performed for 10 minutes or until the purge water is clear using a peristaltic pump. During purging, pH, conductivity, and temperature will be measured using a flow-through cell. Groundwater grab samples will be collected into the appropriate sample containers using disposable polyethylene tubing and a peristaltic pump. To prevent degassing during sampling for VOCs, a pumping rate will be maintained below about 100 milliliters per minute.

Groundwater samples for dissolved metals analyses will be collected last and field-filtered through a 0.45 micron, in-line disposable filter. Groundwater samples that are analyzed for constituents that tend to heavily partition to soil, such as SVOCs, will be allowed to settle prior to analysis to prevent interference from suspended particulates. Groundwater grab samples from locations within 50 ft of the shoreline will be collected during low tide, as practicable, to minimize potential impacts from marine water on the sample.

More detailed procedures for groundwater sample collection and quality assurance are provided in the upland SAP (Appendix C). Groundwater grab samples will be analyzed for the COPCs identified in Section 5.1 and summarized in Section 7.2.4 and Table 7.

### 7.2.2 MONITORING WELL INSTALLATION PROCEDURES

Groundwater monitoring wells will be installed at the Site at locations selected based on the results of the Phase I investigation described in the previous section. As described in the Reporting section (Section 8.0), the Port will submit a technical memorandum presenting the results of the direct-push groundwater investigation, and the proposed locations for RI monitoring wells. RI monitoring wells will be installed following Ecology approval of the proposed locations.

The groundwater monitoring wells will provide groundwater quality and hydrogeological characterization data for the RI. The monitoring wells will be constructed in accordance with Washington State Minimum Standards for Construction and Maintenance of Wells (WAC 173-160; Ecology 2006). The monitoring wells will be drilled using conventional hollow-stem auger techniques with 4.25-inch inside diameter augers. Landau Associates field personnel familiar with environmental sampling and construction of resource protection wells will oversee the drilling and well installation activities, and maintain a detailed record of the well construction. Soil samples will be collected from the saturated zone at the time of drilling, and at least three samples from the Site will be submitted for mechanical grain-size analyses to aid in the hydrogeologic characterization discussed in Section 7.2.3.

The monitoring wells will be constructed with 2-inch-diameter, flush-threaded, Schedule 40 PVC pipe and 10-ft screens with 0.010-inch machine-slotted casing and filter pack material consisting of pre-washed, pre-sized number 20/40 silica sand. The well screens will be placed at a depth intended to intersect the water table through the full range of seasonal and tidal groundwater level fluctuations. Based on groundwater level observations from a nearby location (the Blaine Marina Inc site), it is anticipated that a 10-ft screen extending from 5 to 15 ft BGS will be sufficient to intersect the water table during range of water levels anticipated to occur at the Site. The actual length of screen and screen interval will be selected in the field based on observed conditions. The filter pack will be placed from the bottom of the well to approximately 1 ft above the top of the screen. Filter pack material will be placed slowly and carefully to avoid bridging of material. A bentonite seal will be placed above the filter pack material to within about 3 ft of the ground surface. Grout will be used to backfill the boring to the subgrade for placement of the protective cover. A flush-mounted monument will be cemented in place for each monitoring well.

All wells will be developed prior to sampling to remove particulates entrained during the well construction process and improve hydraulic communication with the surrounding aquifer. Development will be accomplished by repeatedly surging the well with a surge block and purging the well until the water runs clear, but no less than five well casing volumes. During development, the purged groundwater will be monitored for the following field parameters:

- pH
- Conductivity
- Temperature
- Turbidity.

The wells will be developed until the turbidity of the purged groundwater decreases to 5 nephelometric turbidity units, if practicable. If the well dewaters during the initial surging and purging effort, one final well casing volume will be removed after the well has fully recharged, if practicable.

### 7.2.3 HYDROGEOLOGIC CHARACTERIZATION

A hydrogeologic evaluation will be conducted to characterize the groundwater flow direction and migration rate. The elevation of all monitoring wells will be determined at the top of the casing by land-surveying to the nearest 0.01 ft. All wells will be gauged at the time of groundwater sampling to collect the data needed to evaluate groundwater flow direction.

The mechanical grain-size data from the three Site soil samples collected from the saturated zone at the time of drilling will be used to estimate the hydraulic conductivity for the uppermost hydrostratigraphic unit. The hydraulic conductivity data, in conjunction with the hydraulic gradient determined from monitoring well gauging, will be used to estimate Site groundwater velocities.

### 7.2.4 GROUNDWATER ANALYSES

During the first phase of the groundwater investigation, groundwater grab samples will be analyzed for the following COPCs identified in Section 5.1:

- VOCs by EPA Method 8260C (all locations)
- SVOCs by EPA Method 8270D (WM-GP-9, WM-GP-12, WM-GP-14)
- PAHs by EPA Method 8270D SIM (all locations)

- Dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) by EPA Method 6020 (EPA Method 7471B for mercury) (all locations)
- Petroleum hydrocarbon identification by Method NWTPH-HCID (all locations)
- TPH-G, TPH-D, and/or TPH-O by Method NWTPH-G, or NWTPH-Dx conducted as follow-up analysis for samples with NWTPH-HCID detections; NWTPH-Dx follow-up analyses will include acid/silica gel cleanup to reduce organic interference.

In addition to the laboratory analyses described above, pH, specific conductance, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity will be measured in the field during sample collection.

In the second phase of the groundwater investigation, groundwater samples collected from the monitoring wells will be analyzed for COPCs detected in grab samples at concentrations above laboratory reporting limits. This analytical list will be developed in coordination with Ecology based on the results of the Phase I investigation.

## 7.3 SURFACE WATER INVESTIGATION

Based on Site reconnaissance of the shoreline conducted in 2013, no stormwater catch basins or outfalls appear to be present at the Site. Based on these findings, no surface water bodies or known points of discharge are present on the Site uplands. Currently, stormwater appears to infiltrate into the ground surface in unpaved areas, and flow overland into the marine railway, as illustrated by the drainage patterns on Figure 7.

If active outfalls are determined to be present during the RI, a stormwater sample will be collected from the outfall during a rainfall event and tested for the full range of analytical parameters identified for groundwater in Section 7.2. Additionally, a surface sediment sample will be collected from marine sediment at the outfall location and tested for SMS chemicals listed in WAC 173-204-400, including metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), SVOCs, PCBs, and conventional parameters (grain size, total organic carbon, total volatile solids, total solids, ammonia, and total sulfides).

## 7.4 SEDIMENT INVESTIGATION

As discussed in Section 5.2, there is a potential for COPCs to migrate from the uplands portion of the Site to sediment in groundwater or stormwater runoff, or through direct release to sediment in the marine railway well. The proposed RI sediment investigation is based on this conceptual model and the findings of the 2001 sediment quality investigation discussed in Section 3.2. A summary of the sediment sampling protocol is provided in Table 8.

As shown on Figure 7, the proposed sediment investigation will be conducted in aquatic areas near the shoreline, and up to approximately 200 ft from the shoreline. A total of 15 sediment sampling locations are proposed for the RI, including six core locations and nine surface sediment locations. Surface sediment samples will also be collected at each core location.

Sediment sampling locations designated with “SSED” are proposed surface sediment sample locations, and locations designated “SEDCOR” are proposed sediment core sampling locations. Sediment core locations are limited to those areas that could be subject to dredging as part of future Site development or for general marina maintenance dredging. For the purposes of the RI, it is assumed that dredging would not be required in the future in areas with a mudline elevation of –12 ft mean lower low water (MLLW) or deeper.

The sediment investigation will be phased to evaluate whether a good statistical correlation can be developed between TBT porewater and bulk concentrations. TBT porewater screening levels are considered more representative of impacts to aquatic organisms than bulk criteria, so TBT porewater-based criteria are preferred over bulk TBT criteria. However, a large volume of sediment, three to four sediment cores, is required to obtain sufficient porewater for TBT porewater analysis, so testing sediment cores for TBT porewater significantly increases the RI sediment characterization costs. As a result, it is more cost-effective to develop a bulk TBT screening level based on the TBT porewater criteria using bulk/porewater data from surface sediment testing (where large volumes of sediment are easier to obtain), and then limiting sediment core testing to bulk TBT analysis. Based on correlations developed for similar sites, a linear regression analysis may provide an acceptable correlation between bulk and porewater TBT concentrations.

In order to evaluate whether TBT bulk concentrations correlate well to TBT porewater concentrations, the sediment investigation will be phased to conduct the marine surface sediment investigation first. Marine sediment surface samples will be analyzed for both porewater and bulk organotins and the results will be evaluated to determine whether an acceptable correlation exists between bulk and porewater TBT concentrations. The Port will prepare a technical memorandum for Ecology’s review and concurrence, along with a recommendation for proceeding with the second phase of the marine sediment investigation. If an acceptable bulk/porewater correlation exists, marine sediment core samples will be analyzed only for bulk organotins. If an acceptable correlation does not exist, sufficient sediment cores will be collected to test core samples for TBT porewater, which will likely require three to four cores from each sampling location.

Sediment cores will be subdivided into 1.5-ft samples to provide adequate sample volume for the planned analyses. The first core sample will start 1 ft below the mudline because the surface sediment sample will be considered representative of the upper 1 ft of sediment. Sediment cores will generally be extended to –14 ft MLLW, up to a maximum core length of 7 ft. The number of sediment samples tested at the laboratory will be determined based on the lithology observed during core processing. Core samples down to the interpreted depth of native sediment will be initially tested and the deeper remaining core samples will be archived for potential future testing based on the analytical results for the initially tested samples. If the deepest initially tested sample exceeds one or more of the sediment PSLs, the underlying archived sample (from at least 6 inches below the native sediment interface) will be tested for the constituents that exceed the PSLs, and testing will continue progressively downward until no PSL exceedances are detected, or the lowest collected sample is tested.

Riprap located along the shoreline may influence the selection of the final sampling locations and could result in difficulty with sample recovery. Sediment sampling locations may require modification in the field if riprap is encountered.

Five sample locations (WM-SG-9, WM-SC-4, WM-SC-2, WM-SG-11, and WM-SG-12) are positioned adjacent to 2001 sampling locations in order to compare the results and evaluate potential changes over time.

WM-SC-1 is within the marine railway well, and WM-SC-2, WM-SG-10, and WM-SG-11 are spaced about 100 ft apart heading away from the shoreline to complete a series of four explorations that will be used to evaluate potential releases associated with marine railway operations. WM-SG-14 is also located within the marine railway well and will be used to evaluate sediment quality where potential releases could have occurred related to former Site usage. The location of WM-SC-3 was selected to evaluate sediment conditions near the travel lift piers. Sample WM-SG-15 is located east of the saw-tooth dock, and will be used to evaluate conditions associated with the upper marina. A surface sediment grab sample (SG) will be collected at each of the sediment core (SC) locations.

Each sediment sample (both surface sediment and sediment cores) will undergo analysis for SMS chemicals listed in WAC 173-204-400, including metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), SVOCs, PCBs, and conventional parameters (grain size, total organic carbon, total volatile solids, total solids, ammonia, and total sulfides).

## 7.5 SAMPLING AND ANALYSIS PLANS

To guide field investigations, two SAPs were prepared to specify the type, quality, and quantity of data necessary to support selection of a cleanup action. The upland SAP (Appendix C) was prepared in accordance with WAC 173-340-820 and Ecology’s Guidance on Sampling and Data Analysis Methods (Ecology Publication 94-49; Ecology 1995). The marine sediment SAP (Appendix D) was prepared in accordance with WAC 173-340-820, Ecology Publication 94-49, and the Puget Sound SMS in Chapter 173-204 WAC. The SAPs are intended to provide consistent field and laboratory analytical procedures to guide the collection of data that are accurate, defensible, and of adequate quality to meet the objectives of the project.  To this end, the SAPs provide procedures for the collection of representative samples from the Site, accurate documentation of field observations, decontamination to prevent cross-contamination, and proper management and disposal for investigation-derived wastes.

In addition to following the procedures outlined in the SAPs, field personnel will follow personal protection standards and mandatory safety procedures outlined in the Health and Safety Plan (Appendix B).

# 8.0 REPORTING

As specified in the Agreed Order, reporting will include submittal of separate RI and FS reports. Although prepared as separate documents, the RI and FS reports will be issued as a single package for public review once Ecology has approved the revised FS report.

The Agreed Order also requires the Port to submit an RI data summary technical memorandum following completion of the RI to provide a basis for determining whether any additional RI activities are needed to fill data gaps prior to preparing the RI report. In addition to these documents, the Port will submit a Phase I groundwater monitoring technical memorandum that summarizes the results of the direct-push groundwater quality monitoring and presents proposed groundwater monitoring well locations to Ecology for review.

The RI and FS reports will be prepared consistent with the RI/FS Annotated Outline developed by the Port and Ecology for Bellingham Bay MTCA sites. The following sections briefly describe the organization for the RI and FS reports.

## 8.1 REMEDIAL INVESTIGATION REPORT

The RI report will be prepared consistent with the requirements of WAC 173-340-350 and Annotated Outline, and will include, at a minimum, the sections listed below:

1. Introduction
    a. Site Description and Background
    b. Document Organization
2. Project Background
    a. Site History
    b. Objective of the RI
3. Environmental Setting
    a. Physical Conditions
    b. Geology and Hydrogeology
    c. Natural Resources
    d. Historic and Cultural Resources
    e. Land and Navigation Uses
4. Site Screening Levels
    a. Exposure Pathways and Receptors
    b. Screening Levels
5. Nature and Extent of Contamination

    a. Constituents of Concern
    b. Nature and Extent
6. Contaminant Fate and Transport
    a. Source Control
    b. Attenuation/Transport Processes
7. Conceptual Site Model
    a. Contaminants and Sources
    b. Nature and Extent of Contamination
    c. Fate and Transport Processes
    d. Exposure Pathways and Receptors
8. RI Conclusions.

## 8.2 FEASIBILITY STUDY REPORT

The FS report will identify and evaluate various remedial alternatives and recommend a cleanup action consistent with the requirements of WAC 173-340-360 through WAC 173-340-390 and WAC 173-340-840. The report will include, at a minimum, the sections listed below:

1. Introduction
    a. Site Description and Background
    b. Document Organization
2. Cleanup Requirements
    a. Proposed Cleanup Levels
    b. Remedial Action Objectives
    c. Potentially Applicable Laws
3. Screening of Remedial Technologies
4. Description of Remedial Alternatives
5. Detailed Evaluation of Alternatives
    a. MTCA (and SMS) Evaluation Criteria
    b. Evaluation of Alternatives
    c. MTCA Disproportionate Cost Analysis
        i. Comparative Evaluation of Alternatives
        ii. MTCA Disproportionate Cost Analysis
6. Summary and Conclusions
    a. Description of the Preferred Alternative
    b. Basis for Selection

c. Implementation of Site Cleanup.

# 9.0 SCHEDULE

The Agreed Order establishes the RI/FS schedule, which is summarized below. The schedule requirements of the Agreed Order are in parentheses.

- **Draft RI work plan** (submit to Ecology within 90 days of the Agreed Order).
- **Revised RI work plan** (submit to Ecology within 60 days of receiving Ecology's comments)
- **RI field activities** (complete within 180 days following Ecology's approval of the final RI work plan)
- **RI Phase I groundwater monitoring technical memorandum** (not an Agreed Order requirement – to be submitted within 30 days of validation of direct-push groundwater quality data)
- **RI data summary technical memorandum** (submit to Ecology within 75 days following validation of all RI data)
- **Draft RI report** (submit to Ecology within 180 days following completion of the RI work)
- **Revised draft RI report** (submit to Ecology within 75 days following receipt of Ecology's comments on the draft RI report)
- **Draft FS report** (submit to Ecology within 90 days following Ecology's approval of the RI report)
- **Revised draft FS report** (submit to Ecology within 60 days of receiving Ecology's comments)
- **Final RI and FS reports** (incorporate changes based on public comment; submit to Ecology within 45 days of completion of the public comment period)
- **Draft Cleanup Action Plan** (submit to Ecology within 90 days following Ecology's approval of the final RI and FS reports).

# 10.0 USE OF THIS REPORT

This work plan will become an integral and enforceable part of the Agreed Order No. DE 9001 between the Port of Bellingham and the Washington State Department of Ecology. 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. 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 Pacific Northwest 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 Davis, P.E., C.H.M.M.
Senior Project Engineer

Lawrence D. Beard, P.E., L.G.
Principal

LDB/JMD/ccy

# 11.0 REFERENCES

Bellingham, Port of. 2007. *Wharf District Master Plan, Blaine, Washington*. November.

Bellingham, Port of. 2001. Letter: *Port of Bellingham Environmental Compliance Assessment Program*. From Mike Stoner, Environmental Manager, Port of Bellingham, to Jim Prill and George Hawes, Westman Marine, c/o Dawson Construction, Inc. January 25.

Bellingham, Port of. 1993. *Environmental Compliance Assessment Visual Inspection Checklist*. Company: Westman Marine, Inc. August 24.

Ecology. 2010. *Boatyard General Permit Inspection Report*. Washington State Department of Ecology. July 21.

Ecology. 2006. *Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160 WAC*. Washington State Department of Ecology. December 22.

Ecology. 1995. *Guidance on Sampling and Data Analysis Methods*. Publication No. 94-49. Toxics Cleanup Program, Washington State Department of Ecology. January.

Ecology. 1994. *Natural Background Soil Metals Concentrations in Washington State*. Publication No. 94-115. Toxics Cleanup Program, Washington State Department of Ecology. October.

Ecology. 1993. Letter: *Technical Assistance Visit to Westman Marine (WAD988502050)*. From David S. Misko, Solid and Hazardous Waste Section, Washington State Department of Ecology, to Doug Ward, Dawson Construction Company. July 19.

Ecology website. 2012. *CLARC: Cleanup Levels and Risk Calculations*. https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx. Accessed May.

EDR. 2011. *The EDR Radius Map Report with Geocheck, Blaine Marina Tank Farm Site, 214 Sigurdson Avenue, Blaine, Washington*. Inquiry No.: 3209005.2s. Environmental Data Resources Inc. November 17.

Landau Associates. 2012. *Geotechnical Engineering Services, Blaine Marina Fuel Pier Bulkhead Replacement, Bellingham, Washington*. Prepared for the Port of Bellingham. April 6.

Landau Associates. 2002. Report: *Sediment Quality Investigation, Blaine Harbor, Blaine, Washington*. Prepared for Port of Bellingham. April 2.

Lapen. 2000. *Geologic Map of the Bellingham 1:100,000 Quadrangle, Washington*. Open File Report 2000-5. Washington Division of Geology and Earth Resources, Washington State Department of Natural Resources.

Michelsen, T., T.C. Shaw, and S. Stirling. 1996. *Testing, Reporting and Evaluation of Tributyltin Data in PSDDA and SMS Programs*. Final Puget Sound Dredged Disposal Analysis Issue Paper/Sediment Management Standards Technical Information Memorandum.

Stratum Group. 2013. Report: *Underground Storage Tank Site Assessment, Soil and Groundwater Sampling, Boundary Fish Company, 223 Sigurdson Avenue, Blaine, Washington 98230*. Prepared for Boundary Fish Company. January 10.

TEC. 2001. *Uplands Source Assessment Report in Support of Sediment Characterization Study for Blaine Harbor, Blaine, Washington*. The Environmental Co., Inc. Prepared for Landau Associates. June 7.

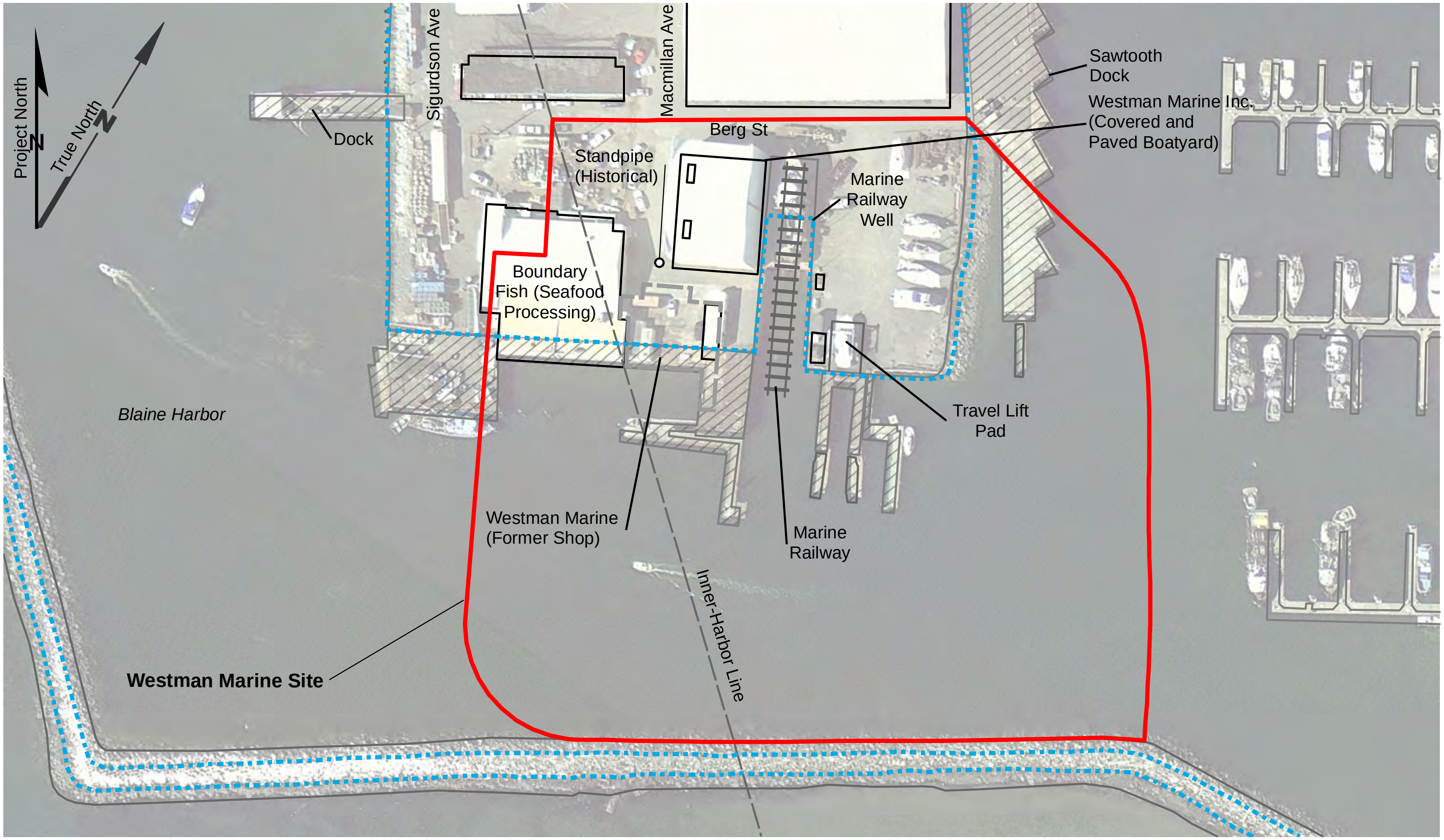
Data Source: ESRI 2008

Y:\Projects\001035\010.014\RI-FS_Workplan\Figure_1.mxd

LANDAU ASSOCIATES

| Westman Marine Site<br>Blaine Harbor<br>Blaine, Washington | **Vicinity Map** | Figure<br>1 |
|---|---|---|

Y:\Projects\001035\010.014\RI-FS_Workplan\Figure_2.mxd 8/13/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet



## Legend

🟥 Preliminary Westman Marine Site Boundary; Site Limits to be Determined in the RI/FS

▨ Structure Over Water

— Existing Building Location

······ MHHW - 9.5ft

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

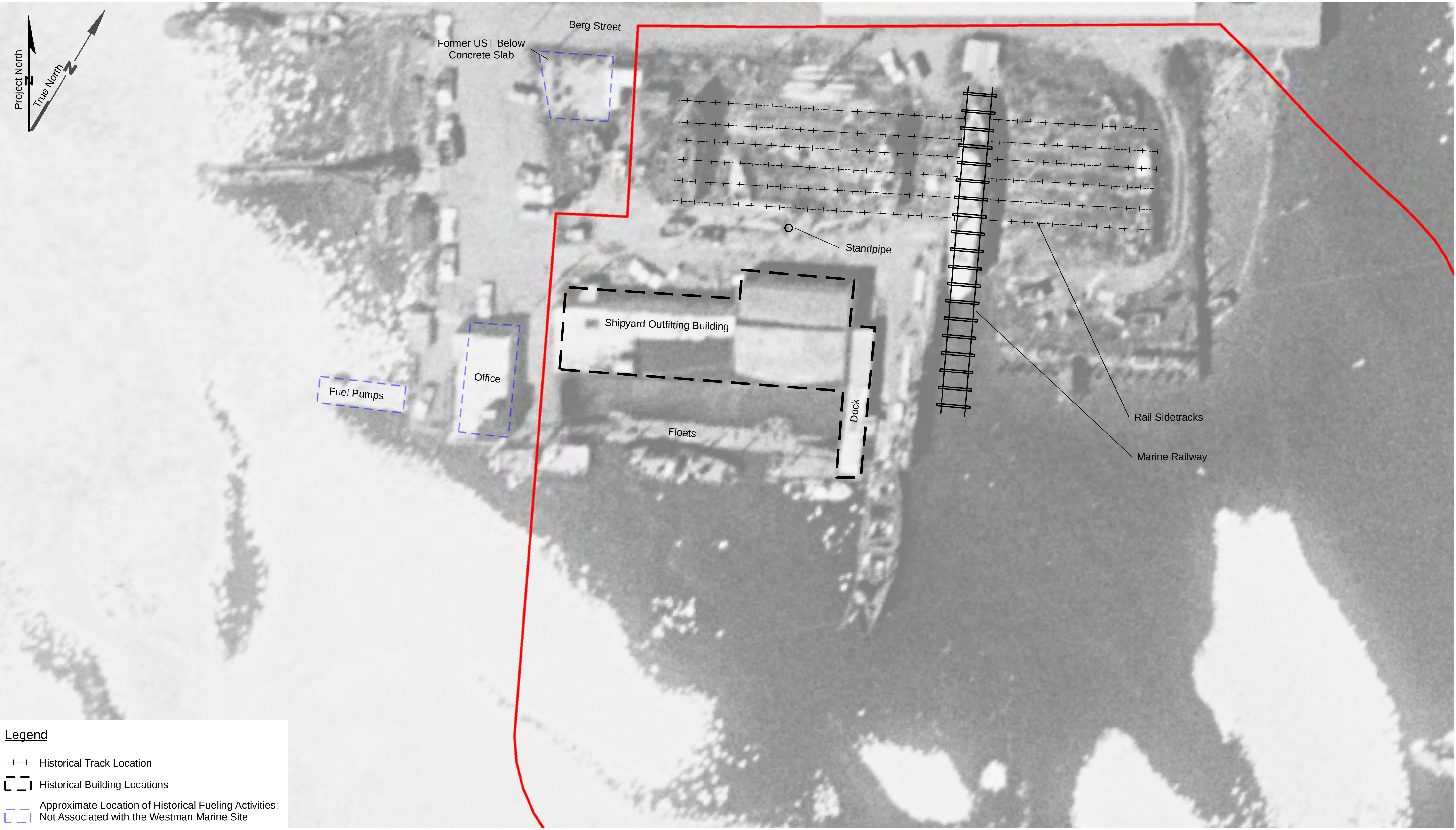
0 120 240
Scale in Feet

Landau Associates

Westman Marine Site
Blaine Harbor
Blaine, Washington

**Westman Marine 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; Site Limits to be Determined in the RI/FS

Note

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

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

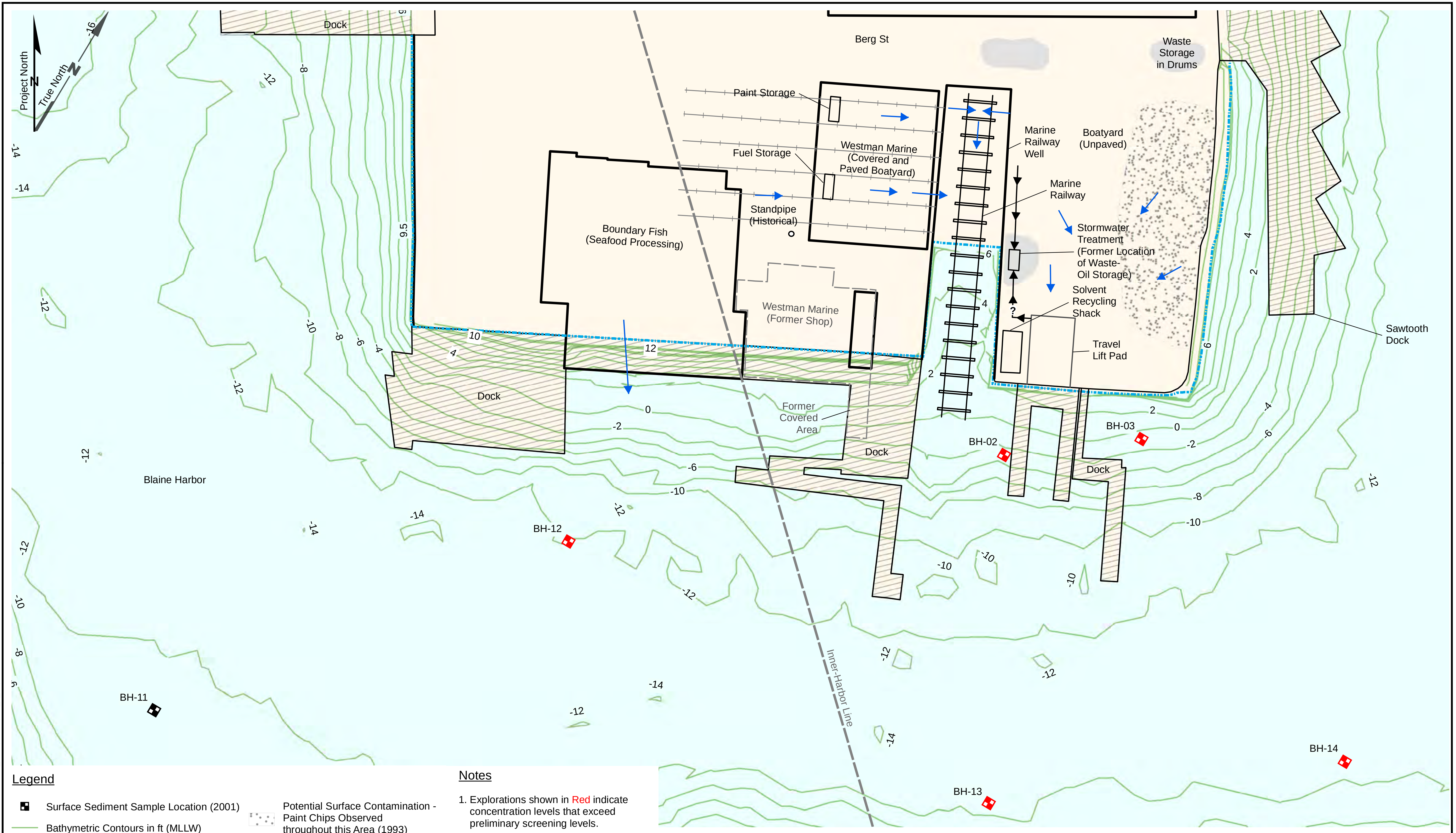
Westman Marine Site
Blaine Harbor
Blaine, Washington

**Historical Site Layout - 1966**

Figure
3

Landau Associates

Y:\Projects\001035\010.014\RI-FS_Workplan\Figure_3_Hist.mxd 8/13/2013 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

⁘ Potential Surface Contamination - Paint Chips Observed throughout this Area (1993)

▒ Potential Surface Contamination - Staining Observed in these Areas (1993)

▨ Structure Over Water

## Notes

1. Explorations shown in Red indicate concentration levels that exceed preliminary screening levels.
2. 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.

LANDAU ASSOCIATES

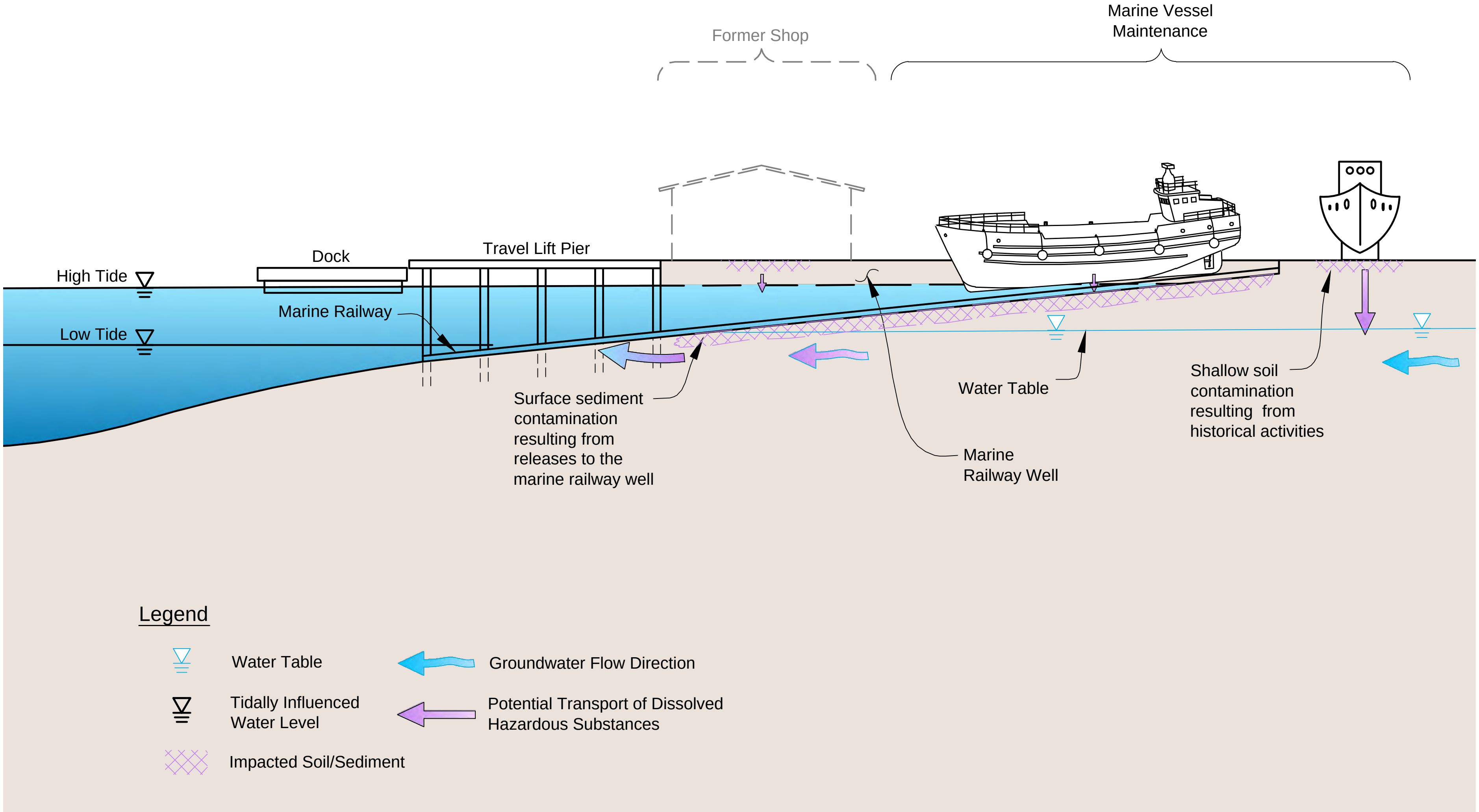
Westman Marine
Blaine Harbor
Blaine, Washington

**Previous Site Observations and Investigations**

Figure
4

Y:\Projects\001035\010.014\RI-FS_Workplan\Figure_4_Expl.mxd 8/13/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

LANDAU ASSOCIATES, INC. | V:\001\035\010.014\Figure 5 Conceptual.dwg (A) "Figure 5" 4/1/2013



Not to Scale

LANDAU ASSOCIATES

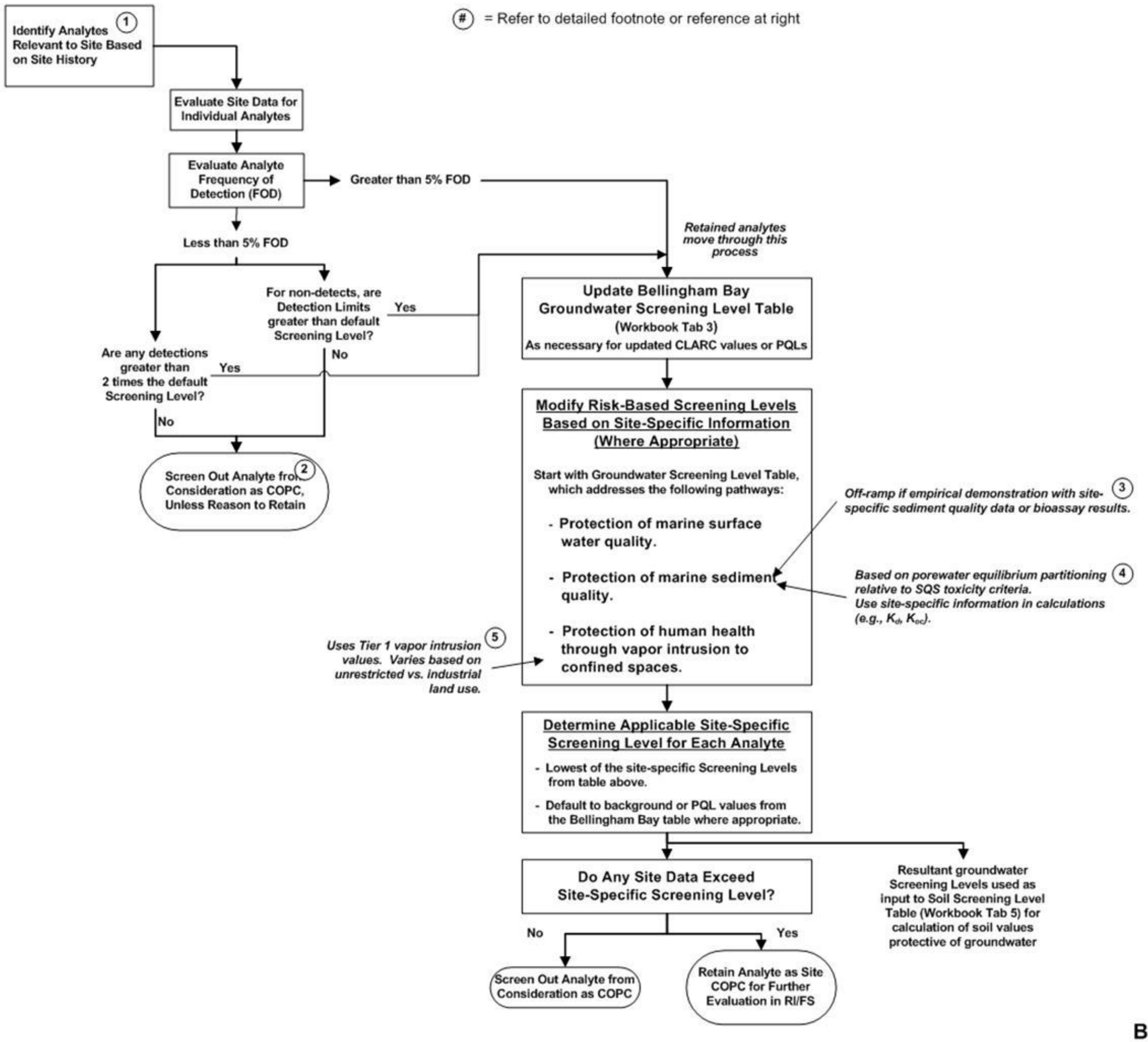
Westman Marine Site
Blaine Harbor
Blaine, Washington

**Conceptual Site Model**

Figure
5

## GROUNDWATER SCREENING LEVEL FLOWCHART

**This flowchart illustrates steps in comparing site data to Screening Levels to determine site Contaminants of Potential Concern (COPCs) for Groundwater**



### FOOTNOTES

① Analytical groups selected should be based on site history, including operational practices and release mechanisms, such that all possible contaminants suspected of being present are analyzed during the RI/FS process (WAC 173-340-350).

② Analytes will be retained if they are less than 5 percent Frequency of Detect (FOD) and less than 2 times the Screening Level only if there is a site-specific reason to retain, such as a known association with site activity (USEPA's *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual* 1989).

③ 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.

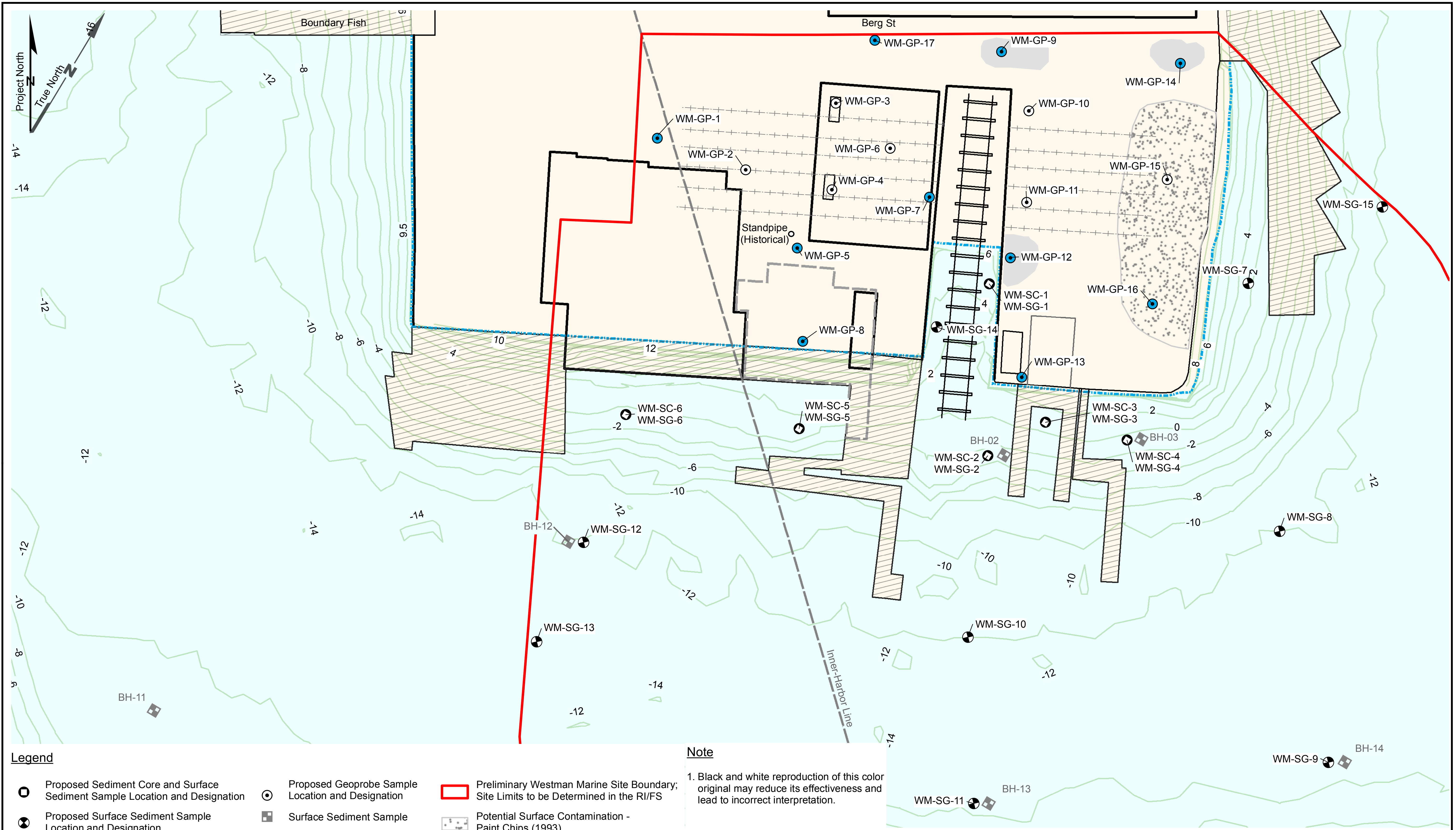
④ Groundwater concentrations that are protective of sediments are calculated using an equilibration partitioning method. Site-specific data (e.g., distribution coefficient [$K_d$], soil organic carbon water partitioning coefficient [$K_{oc}$], etc.) can be used to calculate if porewater is protective of sediments. In the Groundwater Screening Level Table (Workbook Tab 3), the equilibrium partitioning equation is used with default parameters and is defined to achieve sediment concentrations protective of benthic toxicity.

⑤ The Groundwater Screening Level Table (Workbook Tab 3) includes values protective of vapor intrusion from Table B-1 of Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, Draft 2009.* Values vary based on site-specific land use (i.e., industrial or unrestricted). Evaluation of this pathway is applicable only if certain criteria can be satisfied. For instance, a preliminary empirical assessment may show that site-specific groundwater concentrations are not great enough to negatively impact indoor air. Additionally, if existing and planned site structures are not within close proximity to subsurface contamination, vapor intrusion is not currently posing a threat to indoor air receptors and no further evaluation is required.

**WORKBOOK TAB 2**
**GROUNDWATER FLOWCHART**
**Bellingham Bay Nearshore Site Screening Level Workbook**

LANDAU ASSOCIATES

| Westman Marine Site<br>Blaine Harbor<br>Blaine, Washington | **Groundwater Screening-Level Flowchart** | Figure<br>6 |
|---|---|---|



## Legend

○ Proposed Sediment Core and Surface Sediment Sample Location and Designation

◐ Proposed Surface Sediment Sample Location and Designation

● Proposed Groundwater Grab Sample Location and Designation

⊙ Proposed Geoprobe Sample Location and Designation

▚ Surface Sediment Sample

-+-+- Historical Track Location (1966)

— Bathymetric Contours (MLLW)

🟥 Preliminary Westman Marine Site Boundary; Site Limits to be Determined in the RI/FS

⁚ Potential Surface Contamination - Paint Chips (1993)

▒ Potential Surface Contamination - Staining (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.

Y:\Projects\001035\010.014\RI-FS_Workplan\Figure_7_Proposed.mxd 8/13/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

LANDAU ASSOCIATES

Westman Marine
Blaine Harbor
Blaine, Washington

**Proposed Investigation Sample Locations**

Figure
7

# TABLE 1
## SUMMARY OF 2001 MARINE SEDIMENT ANALYTICAL RESULTS
## WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Sample ID | | | BH-02 | BH-03 | BH-11 | BH-12 | BH-13 | BH-14 |
|---|---|---|---|---|---|---|---|---|
| **Sample Date** | **SQS (a)** | **CSL (b)** | **9/27/2001** | **9/27/2001** | **9/27/2001** | **9/27/2001** | **9/27/2001** | **9/27/2001** |
| **Metals (mg/kg)** | | | | | | | | |
| Arsenic | 57 | 93 | 5 | 3 | | 14 | 12 | 14 |
| Cadmium | 5.1 | 6.7 | 0.5 | 0.3 | | 0.7 | 0.6 | 0.4 |
| Chromium | 260 | 270 | 16.3 | 13.2 | | 22.5 | 21.5 | 19.6 |
| Copper | 390 | 390 | 521 J | 77.5 J | | 95.8 | 53 | 61 |
| Lead | 450 | 530 | 20 J | 21 J | | 12 | 9 | 7 |
| Mercury | 0.41 | 0.59 | 0.3 J | 0.07 J | | 0.09 U | 0.08 U | 0.15 |
| Silver | 6.1 | 6.1 | 0.3 | 0.2 U | | 0.5 U | 0.5 U | 0.5 U |
| Zinc | 410 | 960 | 184 | 67.2 | | 113 J | 80 J | 69.3 J |
| | | | | | | | | |
| **PCBs (mg/kg OC) (c)** | | | | | | | | |
| Aroclor 1016 | NA | NA | 2.3 U | 7.0 U | | | | |
| Aroclor 1242 | NA | NA | 2.3 U | 7.0 U | | | | |
| Aroclor 1248 | NA | NA | 3.5 | 7.0 U | | | | |
| Aroclor 1254 | NA | NA | 2.9 | 7.0 U | | | | |
| Aroclor 1260 | NA | NA | 2.3 U | 7.0 U | | | | |
| Aroclor 1221 | NA | NA | 4.5 U | 14.1 U | | | | |
| Aroclor 1232 | NA | NA | 2.3 U | 7.0 U | | | | |
| Total PCBs (d) | 12 | 65 | 6.3 | 14.1 U | | | | |
| | | | | | | | | |
| **PAHs (mg/kg OC) (c)** | | | | | | | | |
| Naphthalene | 99 | 170 | 2.3 U | 7.0 U | | 0.9 J | 1.2 U | 0.9 J |
| Acenaphthylene | 66 | 66 | 5.2 | 7.0 U | | 3.3 | 1.7 | 2.4 |
| Acenaphthene | 16 | 57 | 4.5 | 7.0 U | | 1.9 | 0.8 J | 1.3 J |
| Fluorene | 23 | 79 | 5.5 | 7.0 U | | 3.0 | 1.2 | 2.4 |
| Phenanthrene | 100 | 480 | 40.5 | 19.6 | | 35.0 | 12.5 | 27.1 |
| Anthracene | 220 | 1,200 | 14.3 | 10.0 | | 11.4 | 4.8 | 6.0 |
| 2-Methylnaphthalene | 38 | 64 | 2.3 U | 7.0 U | | 0.7 J | 1.2 U | 1.4 U |
| LPAH (d)(e) | 370 | 780 | 70.0 | 29.6 | | 55.5 | 20.9 | 40.2 |
| Fluoranthene | 160 | 1,200 | 142.9 | 81.5 | | 85.7 | 27.5 | 47.1 |
| Pyrene | 1,000 | 1,400 | 101.2 | 59.3 | | 71.4 | 28.1 | 43.6 |
| Benzo(a)anthracene | 110 | 270 | 42.9 | 28.9 | | 31.4 | 13.8 M | 15.7 |
| Chrysene | 110 | 460 | 86.9 | 81.5 | | 55.7 | 21.9 | 30.0 |
| Benzo(b)fluoranthene | NA | NA | 54.8 | 48.1 | | 40.0 | 16.3 | 21.4 |
| Benzo(k)fluoranthene | NA | NA | 45.2 | 37.0 | | 32.1 | 15.0 | 17.1 |
| Total Benzofluoranthenes (f) | 230 | 450 | 100.0 | 85.2 | | 72.1 | 31.3 | 38.6 |
| Benzo(a)pyrene | 99 | 210 | 33.3 | 28.1 | | 27.1 | 12.5 | 15.0 |
| Indeno(1,2,3-c,d)pyrene | 34 | 88 | 16.7 | 14.1 | | 11.4 | 5.7 | 7.9 |
| Dibenz(a,h)anthracene | 12 | 33 | 4.4 | 7.0 U | | 3.2 | 1.6 | 2.1 |

# TABLE 1
# SUMMARY OF 2001 MARINE SEDIMENT ANALYTICAL RESULTS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Sample ID | | | BH-02 | BH-03 | BH-11 | BH-12 | BH-13 | BH-14 |
|---|---|---|---|---|---|---|---|---|
| Sample Date | SQS (a) | CSL (b) | 9/27/2001 | 9/27/2001 | 9/27/2001 | 9/27/2001 | 9/27/2001 | 9/27/2001 |
| Benzo(g,h,i)perylene | 31 | 78 | 14.3 | 10.0 | | 8.6 | 4.4 | 6.0 |
| HPAH (d)(g) | 960 | 5,300 | 542.5 | 388.5 | | 366.8 | 146.8 | 206.0 |
| | | | | | | | | |
| **SVOCs (mg/kg OC) (c)** | | | | | | | | |
| 1,2-Dichlorobenzene | 2.3 | 2.3 | 2.3 U | 7.0 U (h) | | 1.4 U | 1.2 U | 1.4 U |
| 1,3-Dichlorobenzene | NA | NA | 2.3 U | 7.0 U | | 1.4 U | 1.2 U | 1.4 U |
| 1,4-Dichlorobenzene | 3.1 | 9 | 2.3 U | 7.0 U (h) | | 1.4 U | 1.2 U | 1.4 U |
| 1,2,4-Trichlorobenzene | 0.81 | 1.8 | 2.3 U (h) | 7.0 U (h) | | 1.4 U (h) | 1.2 U (h) | 1.4 U (h) |
| Hexachlorobenzene | 0.38 | 2.3 | 0.1 U | 0.3 U | | 1.4 U (h) | 1.2 U (h) | 1.4 U (h) |
| Dimethylphthalate | 53 | 53 | 2.5 | 7.0 U | | 1.6 | 1.0 J | 2.9 |
| Diethylphthalate | 61 | 110 | 2.3 U | 7.0 U | | 1.4 U | 1.2 U | 1.4 U |
| Di-n-Butylphthalate | 220 | 1,700 | 2.3 U | 7.0 U | | 1.4 U | 0.7 J | 1.4 U |
| Butylbenzylphthalate | 4.9 | 64 | 2.3 U | 7.0 U (h) | | 1.2 MJ | 1.0 J | 1.4 U |
| bis(2-Ethylhexyl)phthalate | 47 | 78 | 26.2 | 29.6 | | 17.1 | 8.8 | 6.6 |
| Di-n-octyl phthalate | 58 | 4,500 | 2.3 U | 7.0 U | | 1.4 MJ | 1.2 U | 1.4 U |
| Dibenzofuran | 15 | 58 | 2.9 | 7.0 U | | 1.4 M | 1.2 U | 1.3 MJ |
| Hexachlorobutadiene | 3.9 | 6.2 | 0.1 U | 0.3 U | | 1.4 U | 1.2 U | 1.4 U |
| N-Nitrosodiphenylamine | 11 | 11 | 2.3 U | 7.0 U | | 1.4 U | 1.2 U | 1.4 U |
| | | | | | | | | |
| **SVOCs (µg/kg)** | | | | | | | | |
| Phenol | 420 | 1,200 | 20 | 28 | | 14 MJ | 78 | 53 |
| 2-Methylphenol | 63 | 63 | 19 U | 19 U | | 19 U | 19 U | 19 U |
| 4-Methylphenol | 670 | 670 | 19 U | 19 U | | 15 J | 19 U | 19 U |
| 2,4-Dimethylphenol | 29 | 29 | 19 U | 19 U | | 19 U | 19 U | 19 U |
| Pentachlorophenol | 360 | 690 | 100 | 96 U | | 97 U | 93 U | 94 U |
| Benzyl Alcohol | 57 | 73 | 19 U | 19 U | | 19 U | 19 U | 19 U |
| Benzoic Acid | 650 | 650 | 190 U | 190 U | | 190 U | 190 U | 190 U |
| | | | | | | | | |
| **Organotins (µg/kg)** | | | | | | | | |
| Tributyltin (as chloride) | NA | NA | 420 | 160 | 32 | 160 | 110 | 140 |
| Tributyltin (as TBT ion) | 73 (i) | NA | 370 | 140 | 28 | 140 | 100 | 130 |
| | | | | | | | | |
| **Conventionals** | | | | | | | | |
| Total Organic Carbon (percent) | NA | NA | 0.84 | 0.27 | | 1.4 | 1.6 | 1.4 |
| Total Solids (percent) | NA | NA | 59.7 | 70.2 | | 56.6 | 51.9 | 57.6 |
| Preserved Total Solids (percent) | NA | NA | 60.9 | 67.8 | | | | |
| N-Ammonia (mg-N/kg) | NA | NA | 8.8 | 12 | | | | |
| Sulfide (mg/kg) | NA | NA | 790 | 110 | | | | |
| Fecal Coliform (CFU/g) | NA | NA | 36 U | 28 U | | | | |

# TABLE 1
## SUMMARY OF 2001 MARINE SEDIMENT ANALYTICAL RESULTS
## WESTMAN MARINE SITE – BLAINE, WASHINGTON

OC = Organic Carbon.
NA = Not available.
U = Indicates compound was analyzed for, but was not detected at the given detection limit.
J = Estimated value.
M = Indicates an estimated value of analyte detected and confirmed by analyst with low spectral match parameters.
SQS = Sediment quality standard.
CSL = Cleanup screening level.
Boxed results exceed the SQS.
Shaded results exceed the CSL.
(a) SMS sediment quality standard (Chapter 173-204 WAC).
(b) SMS cleanup screening level (Chapter 173-204 WAC).
(c) 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.
(d) 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.
(e) 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.
(f) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.
(g) 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.
(h) Method detection limits exceed the SQS or CSL criteria.
(i) TBT bulk sediment screening level established by Ecology, which is conceptually equivalent to the SQS.

# TABLE 2
# CONSTITUENTS OF POTENTIAL CONCERN IN SOIL AND GROUNDWATER
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Analyte | Rationale for Inclusion as COPC |
|---|---|
| **Volatile Organic Compounds (VOCs)** | Various solvents have been stored and used at the Site. Poor housekeeping noted during Site visits may have resulted in releases of VOCs to the ground surface. |
| **Petroleum Hydrocarbons**<br>TPH-G<br>TPH-D<br>TPH-O | Fuel products stored and used at the Site. Site inspections noted potential surface staining indicating the potential for TPH releases to the ground surface. |
| **Semivolatile Organic Compounds (SVOCs)**<br>- Including PAHs | SVOCs were detected in sediment samples at the Site and are likely attributable to historical Site usage. |
| **Metals**<br>Arsenic<br>Cadmium<br>Chromium<br>Copper<br>Lead<br>Mercury<br>Zinc | Metals may have been released to the environment during marine vessel construction or repair. In addition to the MTCA-5 metals, copper and zinc have been included as COPCs since they are common constituents in bottom paints. |
| **Organotins** | Organotins were detected in sediment samples at the Site and are likely attributable to releases from bottom paints during boatyard activities at the Site. |
| **Polychlorinated Biphenyls (PCBs)** | PCBs have been associated with boatyard activities at other sites and will be investigated in areas where soil staining has been observed that may be related to heavy oil contamination. |

Notes:

COPC = Constituent of Potential Concern
PAH = Polycyclic Aromatic Hydrocarbon
TPH-D = Diesel-Range Total Petroleum Hydrocarbons
TPH-G = Gasoline-Range Total Petroleum Hydrocarbons
TPH-O = Heavy Oil-Range Total Petroleum Hydrocarbons
VOC = Volatile Organic Compound
PCBs = Polychlorinated Biphenyls

# TABLE 3
# PRELIMINARY SOIL SCREENING LEVELS
# 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)* | | | | | | | | | |
| | 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) | **Saturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (g) | Soil, Method A, Unrestricted Land Use, Table Value (mg/kg) (a, c) | Soil, Method B, Most-Restrictive Standard Formula Value, Direct Contact (ingestion only), Unrestricted Land Use (mg/kg) (b, c) | Natural Background Concentrations (Ecology 1994) (mg/kg) (h) | Applicable Practical Quantitation Level (PQL) for RI Analyses (mg/kg) (i) | **Unsaturated Soil** | | **Saturated Soil** | |
| *ANALYTE (BY GROUP)* | | | | | *(gwl-u)* | *(gwl-s)* | *(mA)* | *(mB)* | *(back)* | *(pql)* | | | | |
| ***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 | 0.5 | | *29* | *0* | 0.29 | 0.015 | 20 | 0.67 | 7 | 0.5 | 7 | *(back)* | 7 | *(back)* |
| 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 | 36 | *(back)* | 36 | *(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 | 0.16 | *(gwl-u)* | 0.07 | *(back)* |
| Zinc | 81 | | *62* | *0* | 100 | 5 | | 24,000 | 85 | 1 | 100 | *(gwl-u)* | 5 | *(gwl-s)* |
| ***Volatile Organic Compounds*** | | | | | | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | 0 | | | | | | | 38 | | 0.005 | 38 | *(mB)* | 38 | *(mB)* |
| 1,1,1-Trichloroethane | 930,000 | *140* | | *0.71* | 7,500 | 400 | | 160,000 | | 0.005 | 7,500 | *(gwl-u)* | 400 | *(gwl-s)* |
| 1,1,2 - Trichlorotrifluoroethane | 0 | | | | | | | 2,400,000 | | 0.005 | 2,400,000 | *(mB)* | 2,400,000 | *(mB)* |
| 1,1,2,2-Tetrachloroethane | 4 | *79* | | *0.014* | 0.022 | 0.0015 | | 5 | | 0.005 | 0.022 | *(gwl-u)* | 0.0015 | *(gwl-s)* |
| 1,1,2-Trichloroethane | 16 | *75* | | *0.037* | 0.089 | 0.0058 | | 18 | | 0.005 | 0.089 | *(gwl-u)* | 0.0058 | *(gwl-s)* |
| 1,1-Dichloroethane | 0 | *53* | | *0.23* | | | | 16,000 | | 0.005 | 16,000 | *(mB)* | 16,000 | *(mB)* |
| 1,1-Dichloroethene | 3.2 | *65* | | *1.1* | 0.023 | 0.0011 | | 4,000 | | 0.005 | 0.023 | *(gwl-u)* | 0.005 | *(pql)* |
| 1,2,3-Trichloropropane | | | | | | | | 0.033 | | 0.005 | 0.033 | *(mB)* | 0.033 | *(mB)* |
| 1,2,4-Trichlorobenzene | 0.48 | *1,700* | | *0.058* | 0.018 | 0.00095 | | 35 | | 0.01 | 0.018 | *(gwl-u)* | 0.01 | *(pql)* |
| 1,2-Dibromo-3-chloropropane | | | | | | | | 1.3 | | 0.02 | 1.3 | *(mB)* | 1.3 | *(mB)* |
| 1,2-Dibromoethane (EDB) | 2 | *66* | | | 0.011 | 0.00071 | | 0.5 | | 0.02 | 0.02 | *(pql)* | 0.02 | *(pql)* |
| 1,2-Dichlorobenzene | 6.1 | *380* | | *0.078* | 0.072 | 0.0041 | | 7,200 | | 0.005 | 0.072 | *(gwl-u)* | 0.005 | *(pql)* |
| 1,2-Dichloroethane (EDC) | 37 | *38* | | *0.04* | 0.18 | 0.012 | | 11 | | 0.005 | 0.18 | *(gwl-u)* | 0.012 | *(gwl-s)* |
| 1,2-Dichloropropane | 15 | *47* | | *0.12* | 0.077 | 0.005 | | | | 0.005 | 0.077 | *(gwl-u)* | 0.005 | *(gwl-s)* |
| 1,3,5-Trimethylbenzene | 0 | | | | | | | 800 | | 0.02 | 800 | *(mB)* | 800 | *(mB)* |
| 1,4-Dichlorobenzene | 5 | *620* | | *0.1* | 0.083 | 0.0045 | | | | 0.005 | 0.083 | *(gwl-u)* | 0.005 | *(pql)* |
| 2-Butanone | 0 | | | | | | | 48,000 | | 0.02 | 48,000 | *(mB)* | 48,000 | *(mB)* |
| 2-Chlorotoluene | | | | | | | | 1,600 | | 0.02 | 1,600 | *(mB)* | 1,600 | *(mB)* |
| 4-Methyl-2-pentanone | 0 | | | | | | | 6,400 | | 0.02 | 6,400 | *(mB)* | 6,400 | *(mB)* |
| Acetone | | *0.58* | | *0.0016* | | | | 72,000 | | 0.02 | 72,000 | *(mB)* | 72,000 | *(mB)* |
| Acrolein | 20 | | | | | | | 40 | | 0.1 | 40 | *(mB)* | 40 | *(mB)* |
| Acrylonitrile | 5 | | | | | | | 1.9 | | 0.02 | 1.9 | *(mB)* | 1.9 | *(mB)* |
| Benzene | 23 | *62* | | *0.23* | 0.13 | 0.008 | | 18 | | 0.005 | 0.13 | *(gwl-u)* | 0.008 | *(gwl-s)* |
| Bromodichloromethane | 0.5 | *55* | | *0.066* | 0.0026 | 0.00017 | | 16 | | 0.005 | 0.005 | *(pql)* | 0.005 | *(pql)* |
| Bromoform | 140 | *130* | | *0.022* | 0.93 | 0.058 | | 130 | | 0.005 | 0.93 | *(gwl-u)* | 0.058 | *(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)* |
| Carbon tetrachloride | 0.5 | *150* | | *1.3* | 0.0046 | 0.00022 | | 14 | | 0.005 | 0.005 | *(pql)* | 0.005 | *(pql)* |
| Chlorobenzene | 100 | *220* | | *0.15* | 0.87 | 0.051 | | 1,600 | | 0.005 | 0.87 | *(gwl-u)* | 0.051 | *(gwl-s)* |
| Chloroform | 470 | *53* | | *0.15* | 2.5 | 0.16 | | 800 | | 0.005 | 2.5 | *(gwl-u)* | 0.16 | *(gwl-s)* |

# TABLE 3
# PRELIMINARY SOIL SCREENING LEVELS
# 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)* | | | | | | | | | |
| | 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) | **Saturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (g) | Soil, Method A, Unrestricted Land Use, Table Value (mg/kg) (a, c) | Soil, Method B, Most-Restrictive Standard Formula Value, Direct Contact (ingestion only), Unrestricted Land Use (mg/kg) (b, c) | Natural Background Concentrations (Ecology 1994) (mg/kg) (h) | Applicable Practical Quantitation Level (PQL) for RI Analyses (mg/kg) (i) | **Unsaturated Soil** | | **Saturated Soil** | |
| *ANALYTE (BY GROUP)* | | | | | *(gwl-u)* | *(gwl-s)* | *(mA)* | *(mB)* | *(back)* | *(pql)* | | | | |
| cis-1,2-Dichloroethene (DCE) | 0 | *36* | | *0.17* | | | | 160 | | 0.005 | 160 | *(mB)* | 160 | *(mB)* |
| Dibromochloromethane | 0.5 | *63* | | *0.032* | 0.0027 | 0.00017 | | 12 | | 0.005 | 0.005 | *(pql)* | 0.005 | *(pql)* |
| Dibromomethane | | | | | | | | 800 | | 0.005 | 800 | *(mB)* | 800 | *(mB)* |
| Dichlorodifluoromethane | 0 | | | | | | | 16,000 | | 0.005 | 16,000 | *(mB)* | 16,000 | *(mB)* |
| Ethylbenzene | 2,100 | *200* | | *0.32* | 18 | 1 | | 8,000 | | 0.005 | 18 | *(gwl-u)* | 1 | *(gwl-s)* |
| Hexachlorobutadiene | 0.2 | *54,000* | | *0.33* | 0.22 | 0.011 | | 13 | | 0.01 | 0.22 | *(gwl-u)* | 0.011 | *(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)* |
| o-Xylene | 0 | *240* | | *0.21* | | | | 16,000 | | 0.005 | 16,000 | *(mB)* | 16,000 | *(mB)* |
| Styrene | 0 | *910* | | *0.11* | | | | 16,000 | | 0.005 | 16,000 | *(mB)* | 16,000 | *(mB)* |
| Tetrachloroethene (PCE) | 0.5 | *270* | | *0.75* | 0.0054 | 0.00028 | | 1.9 | | 0.005 | 0.0054 | *(gwl-u)* | 0.005 | *(pql)* |
| Toluene | 15,000 | *140* | | *0.27* | 110 | 6.4 | | 6,400 | | 0.005 | 110 | *(gwl-u)* | 6.4 | *(gwl-s)* |
| trans-1,2-Dichloroethene | 10,000 | *38* | | *0.39* | 54 | 3.2 | | 1,600 | | 0.005 | 54 | *(gwl-u)* | 3.2 | *(gwl-s)* |
| Trichloroethene (TCE) | 0.5 | *94* | | *0.42* | 0.0033 | 0.00019 | | 11 | | 0.005 | 0.005 | *(pql)* | 0.005 | *(pql)* |
| Trichlorofluoromethane | 0 | | | | | | | 24,000 | | 0.005 | 24,000 | *(mB)* | 24,000 | *(mB)* |
| Vinyl acetate | 0 | *5.3* | | *0.021* | | | | 80,000 | | 0.02 | 80,000 | *(mB)* | 80,000 | *(mB)* |
| Vinyl chloride | 0.5 | *19* | | *1.1* | 0.0031 | 0.00015 | | 0.67 | | 0.005 | 0.005 | *(pql)* | 0.005 | *(pql)* |
| 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 3
# PRELIMINARY SOIL SCREENING LEVELS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

|  | Most Stringent Unrestricted Land Use Value from Groundwater Screening Level Table (refer to Table 4) (µg/L) | *APPLICABLE SOIL VALUES* | | | | | | | Natural Background Concentrations (Ecology 1994) (mg/kg) (h) | Applicable Practical Quantitation Level (PQL) for RI Analyses (mg/kg) (i) | ***Soil Screening Level (mg/kg)*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ***Groundwater Protection (a,b)*** | | | | | ***Direct Contact (e)*** | |  |  |  |  |  |  |
|  |  | *Constants and Coefficients (c)* | | | *Calculated Values (d)* | |  |  |  |  |  |  |  |  |
|  |  | $K_{oc}$ (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) | **Saturated Soil** Concentration Protective of Leachability to Groundwater for **Unrestricted** Land Use (mg/kg) (g) | Soil, Method A, Unrestricted Land Use, Table Value (mg/kg) (a, c) | Soil, Method B, Most-Restrictive Standard Formula Value, Direct Contact (ingestion only), Unrestricted Land Use (mg/kg) (b, c) |  |  | **Unsaturated Soil** |  | **Saturated Soil** |  |
| *ANALYTE (BY GROUP)* |  |  |  |  | *(gwl-u)* | *(gwl-s)* | *(mA)* | *(mB)* | *(back)* | *(pql)* |  |  |  |  |
| ***Other Semivolatile Organic Compounds*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1,2,4-Trichlorobenzene | 0.48 | *1,700* |  | *0.058* | 0.018 | 0.00095 |  | 35 |  | 0.02 | 0.02 | *(pql)* | 0.02 | *(pql)* |
| 1,2-Dichlorobenzene | 6.1 | *380* |  | *0.078* | 0.072 | 0.0041 |  | 7,200 |  | 0.02 | 0.072 | *(gwl-u)* | 0.02 | *(pql)* |
| 1,4-Dichlorobenzene | 5 | *620* |  | *0.1* | 0.083 | 0.0045 |  |  |  | 0.02 | 0.083 | *(gwl-u)* | 0.02 | *(pql)* |
| 2,3,4,6-Tetrachlorophenol |  | *280* |  |  |  |  |  | 2,400 |  | 0.02 | 2,400 | *(mB)* | 2,400 | *(mB)* |
| 2,4,5-Trichlorophenol | 3,600 | *1,600* |  | *0.00018* | 130 | 6.8 |  | 8,000 |  | 0.1 | 130 | *(gwl-u)* | 6.8 | *(gwl-s)* |
| 2,4,6-Trichlorophenol | 3 | *380* |  | *0.00032* | 0.035 | 0.002 |  | 80 |  | 0.1 | 0.1 | *(pql)* | 0.1 | *(pql)* |
| 2,4-Dichlorophenol | 190 | *150* |  | *0.00013* | 1.3 | 0.083 |  | 240 |  | 0.1 | 1.3 | *(gwl-u)* | 0.1 | *(pql)* |
| 2,4-Dimethylphenol | 550 | *210* |  | *0.000082* | 4.5 | 0.27 |  | 1,600 |  | 0.05 | 4.5 | *(gwl-u)* | 0.27 | *(gwl-s)* |
| 2,4-Dinitrophenol | 3,500 | *0.01* |  | *0.000018* | 14 | 1 |  | 160 |  | 0.2 | 14 | *(gwl-u)* | 1 | *(gwl-s)* |
| 2-Chloronaphthalene | 1,000 |  |  |  |  |  |  | 6,400 |  | 0.02 | 6,400 | *(mB)* | 6,400 | *(mB)* |
| 2-Chlorophenol | 97 | *390* |  | *0.016* | 1.1 | 0.066 |  | 400 |  | 0.02 | 1.1 | *(gwl-u)* | 0.066 | *(gwl-s)* |
| 2-Methylphenol |  | *91* |  | *0.000049* |  |  |  | 4,000 |  | 0.02 | 4,000 | *(mB)* | 4,000 | *(mB)* |
| 2-Nitroaniline |  |  |  |  |  |  |  | 800 |  | 0.1 | 800 | *(mB)* | 800 | *(mB)* |
| 3,3'-Dichlorobenzidine | 5 | *720* |  | *0.00000016* | 0.092 | 0.005 |  | 2.2 |  | 0.1 | 0.1 | *(pql)* | 0.1 | *(pql)* |
| 4-Chloroaniline |  | *66* |  | *0.000014* |  |  |  | 5 |  | 0 | 5 | *(mB)* | 5 | *(mB)* |
| 4-Methylphenol |  |  |  |  |  |  |  | 400 |  | 0.02 | 400 | *(mB)* | 400 | *(mB)* |
| Aniline |  |  |  |  |  |  |  | 180 |  | 0.1 | 180 | *(mB)* | 180 | *(mB)* |
| Azobenzene |  |  |  |  |  |  |  | 9.1 |  | 0.1 | 9.1 | *(mB)* | 9.1 | *(mB)* |
| Benzoic acid |  | *0.6* |  | *0.000063* |  |  |  | 320,000 |  | 0.2 | 320,000 | *(mB)* | 320,000 | *(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-chloro-1-methylethyl) ether | 37 |  |  |  |  |  |  | 14 |  | 0.1 | 14 | *(mB)* | 14 | *(mB)* |
| Bis(2-chloroethyl) ether | 1 | *76* |  | *0.00074* | 0.0055 | 0.00036 |  | 0.91 |  | 0.02 | 0.02 | *(pql)* | 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)* |
| Di-n-octyl phthalate | 1 | *83,000,000* |  | *0.0027* | 1,700 | 83 |  |  |  | 0.02 | 1,700 | *(gwl-u)* | 83 | *(gwl-s)* |
| Hexachlorobenzene | 1 | *80,000* |  | *0.054* | 1.6 | 0.08 |  | 0.63 |  | 0.02 | 1.6 | *(gwl-u)* | 0.08 | *(gwl-s)* |
| Hexachlorobutadiene | 0.2 | *54,000* |  | *0.33* | 0.22 | 0.011 |  | 13 |  | 0.02 | 0.22 | *(gwl-u)* | 0.02 | *(pql)* |
| Hexachlorocyclopentadiene | 1,100 | *200,000* |  | *1.1* | 4,400 | 220 |  | 480 |  | 0.1 | 480 | *(mB)* | 220 | *(gwl-s)* |
| Hexachloroethane | 3.3 | *1,800* |  | *0.16* | 0.13 | 0.0069 |  | 71 |  | 0.02 | 0.13 | *(gwl-u)* | 0.02 | *(pql)* |
| Isophorone | 600 | *47* |  | *0.00027* | 3 | 0.2 |  | 1,100 |  | 0.02 | 3 | *(gwl-u)* | 0.2 | *(gwl-s)* |
| m,p-Cresol (2:1 ratio) |  |  |  |  |  |  |  | 4,000 |  | 0.02 | 4,000 | *(mB)* | 4,000 | *(mB)* |
| Nitrobenzene | 690 | *120* |  | *0.00098* | 4.4 | 0.28 |  | 160 |  | 0.02 | 4.4 | *(gwl-u)* | 0.28 | *(gwl-s)* |
| N-Nitroso-di-n-propylamine | 1 | *24* |  | *0.000092* | 0.0045 | 0.00031 |  | 0.14 |  | 0.02 | 0.02 | *(pql)* | 0.02 | *(pql)* |
| N-Nitrosodiethanolamine |  |  |  |  |  |  |  | 0.36 |  | 0.1 | 0.36 | *(mB)* | 0.36 | *(mB)* |
| N-Nitrosodimethylamine | 3 |  |  |  |  |  |  | 0.02 |  | 0.1 | 0.1 | *(pql)* | 0.1 | *(pql)* |
| N-Nitrosodiphenylamine | 6 | *1,300* |  | *0.00021* | 0.18 | 0.0095 |  | 200 |  | 0.02 | 0.18 | *(gwl-u)* | 0.02 | *(pql)* |
| 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)* |
| 2,4-Dinitrotoluene | 3.4 | *96* |  | *0.0000038* | 0.02 | 0.0013 |  | 160 |  | 0.1 | 0.1 | *(pql)* | 0.1 | *(pql)* |
| 2,6-Dinitrotoluene |  | *69* |  | *0.000031* |  |  |  | 80 |  | 0.1 | 80 | *(mB)* | 80 | *(mB)* |

# TABLE 3
# PRELIMINARY SOIL SCREENING LEVELS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | | APPLICABLE SOIL VALUES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Groundwater Protection (a,b) | | | | | Direct Contact (e) | | | | Soil Screening Level (mg/kg) | |
| | | Constants and Coefficients (c) | | | Calculated Values (d) | | | | | | | |
| ANALYTE (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** |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | | | | | | | | | |
| Aroclor 1016 | 0.01 | 110,000 | | | 0.022 | 0.0011 | | 5.6 | | 0.033 | 0.033 *(pql)* | 0.033 *(pql)* |
| 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)* |

(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).

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.

**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 = Toxic equivalency quotient
TPH = Total petroleum hydrocarbons
WAC = Washington Administrative Code

# TABLE 4
# PRELIMINARY GROUNDWATER SCREENING LEVELS
# 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* | | | | | |
| *ANALYTE (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)* |
| Diesel Range Hydrocarbons | | | | | | | | | | | | 500 | 250 | 500 *(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 | 0.5 *(pql)* |
| 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)* |
| Mercury | | 0.94 | | | 0.15 | | | *52* | | 0.41 | 7.9 | 2 | 0.001 | 0.15 *(hh-ntr)* |
| Zinc | 81 | 81 | 81 | 26,000 | | 17,000 | | *62* | | 410 | 6,600 | | 4 | 81 *(ma-wac)* |
| ***Volatile Organic Compounds (µg/L)*** | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | | | | | | 930,000 | *140* | | | | | | 0.5 | 930,000 *(sw-b)* |
| 1,1,2,2-Tetrachloroethane | | | | 4 | 11 | 6.5 | *79* | | | | | | 0.5 | 4 *(hh-cwa)* |
| 1,1,2-Trichloroethane | | | | 16 | 42 | 25 | *75* | | | | | | 0.5 | 16 *(hh-cwa)* |
| 1,1-Dichloroethene | | | | 7,100 | 3.2 | 23,000 | *65* | | | | | | 0.5 | 3.2 *(hh-ntr)* |
| 1,2,4-Trichlorobenzene | | | | 70 | | 2 | *1,700* | | 0.81 | | 0.48 | | 0.2 | 0.48 *(sed)* |
| 1,2-Dibromoethane (EDB) | | | | | | | *66* | | | | | | 2 | 2 *(pql)* |
| 1,2-Dichlorobenzene | | | | 1,300 | 17,000 | 4,200 | *380* | | 2.3 | | 6.1 | | 0.2 | 6.1 *(sed)* |
| 1,2-Dichloroethane (EDC) | | | | 37 | 99 | 59 | *38* | | | | | | 0.5 | 37 *(hh-cwa)* |
| 1,2-Dichloropropane | | | | 15 | | | *47* | | | | | | 0.5 | 15 *(hh-cwa)* |
| 1,3-Dichlorobenzene | | | | 960 | 2,600 | | | | | | | | 0.2 | 960 *(hh-cwa)* |
| 1,4-Dichlorobenzene | | | | 190 | 2,600 | | *620* | | 3.1 | | 5 | | 0.2 | 5 *(sed)* |
| Acrolein | | | | 290 | 780 | | | | | | | | 20 | 20 *(pql)* |
| Acrylonitrile | | | | 0.25 | 0.66 | 0.4 | | | | | | | 5 | 5 *(pql)* |
| Benzene | | | | 51 | 71 | 23 | *62* | | | | | | 0.5 | 23 *(sw-b)* |
| bis(2-chloroisopropyl)ether | | | | 65,000 | 170,000 | | | | | | | | 2 | 65,000 *(hh-cwa)* |
| Bromodichloromethane | | | | 17 | 22 | 28 | *55* | | | | | | 0.5 | 0.5 *(pql)* |
| Bromoform | | | | 140 | 360 | 220 | *130* | | | | | | 0.5 | 140 *(hh-cwa)* |
| Bromomethane | | | | 1,500 | 4,000 | 970 | *9* | | | | | | 0.5 | 970 *(sw-b)* |
| Carbon tetrachloride | | | | 1.6 | 4.4 | 4.9 | *150* | | | | | | 0.5 | 0.5 *(pql)* |
| Chlorobenzene | | | | 1,600 | 21,000 | 5,000 | *220* | | | | | | 0.5 | 100 *(vi-b)* |
| Chloroform | | | | 470 | 470 | 6,900 | *53* | | | | | | 0.5 | 470 *(hh-cwa)* |
| Dibromochloromethane | | | | 13 | 34 | 21 | *63* | | | | | | 0.5 | 0.5 *(pql)* |
| Ethylbenzene | | | | 2,100 | 29,000 | 6,900 | *200* | | | | | | 0.5 | 2,100 *(hh-cwa)* |
| Hexachlorobutadiene | | | | 18 | 50 | 30 | *54,000* | | 3.9 | | 0.072 | | 0.2 | 0.2 *(pql)* |
| Methylene chloride | | | | 590 | 1600 | 960 | *10* | | | | | | 2 | 590 *(hh-cwa)* |
| Tetrachloroethene (PCE) | | | | 3.3 | 8.9 | 0.39 | *270* | | | | | | 0.5 | 0.5 *(pql)* |
| Toluene | | | | 15,000 | 200,000 | 19,000 | *140* | | | | | | 0.5 | 15,000 *(hh-cwa)* |

# TABLE 4
## PRELIMINARY GROUNDWATER SCREENING LEVELS
## WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | *APPLICABLE GROUNDWATER VALUES* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *Protection of Marine Sediment Recontamination* | | | | | | | |
| | *Marine Surface Water Criteria* | | | | | | *Partitioning/Distribution Coefficients (a)* | | *Marine Sediment Quality Standards* | | | | | |
| | Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC | Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 | Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 | Surface Water ARAR - Human Health – Marine – Clean Water Act §304 | Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 | Surface Water, Method B, Most Restrictive, Standard Formula (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)** | **Method A Cleanup Levels** | **Applicable Practical Quantitation Level (PQL) for RI Analyses (d)** | ***Groundwater Screening Level*** |
| *ANALYTE (BY GROUP)* | *(ma-wac)* | *(ma-cwa)* | *(ma-ntr)* | *(hh-cwa)* | *(hh-ntr)* | *(sw-b)* | | | | | *(sed)* | *(MA)* | *(pql)* | |
| trans-1,2-Dichloroethene | | | | 10,000 | | 33,000 | *38* | | | | | | 0.5 | 10,000 *(hh-cwa)* |
| Trichloroethene (TCE) | | | | 30 | 81 | 6.7 | *94* | | | | | | 0.5 | 0.5 *(pql)* |
| Vinyl chloride | | | | 2.4 | 530 | 3.7 | *19* | | | | | | 0.5 | 0.5 *(pql)* |
| 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 in ug/L | | | | | | | *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 in ug/L | | | | | | | *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 in ug/L | | | | | | | *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 in ug/L | | | | | | | *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)*** | | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | | | | 70 | | 2 | *1,700* | | 0.81 | | 0.48 | | 1 | 1 *(pql)* |
| 1,2-Dichlorobenzene | | | | 1,300 | 17,000 | 4,200 | *380* | | 2.3 | | 6.1 | | 1 | 6.1 *(sed)* |
| 1,3-Dichlorobenzene | | | | 960 | 2,600 | | | | | | | | 1 | 960 *(hh-cwa)* |
| 1,4-Dichlorobenzene | | | | 190 | 2,600 | | *620* | | 3.1 | | 5 | | 1 | 5 *(sed)* |
| 2,4,5-Trichlorophenol | | | | 3,600 | | | *1,600* | | | | | | 5 | 3,600 *(hh-cwa)* |
| 2,4,6-Trichlorophenol | | | | 2.4 | 6.5 | 3.9 | *380* | | | | | | 3 | 3 *(pql)* |
| 2,4-Dichlorophenol | | | | 290 | 790 | 190 | *150* | | | 0.029 | | | 3 | 190 *(sw-b)* |
| 2,4-Dimethylphenol | | | | 850 | | 550 | *210* | | | | | | 4 | 550 *(sw-b)* |
| 2,4-Dinitrophenol | | | | 5,300 | 14,000 | 3,500 | *0.01* | | | | | | 20 | 3,500 *(sw-b)* |
| 2-Chloronaphthalene | | | | 1,600 | | 1,000 | | | | | | | 1 | 1,000 *(sw-b)* |
| 2-Chlorophenol | | | | | | 97 | *390* | | | | | | 1 | 97 *(sw-b)* |
| 3,3'-Dichlorobenzidine | | | | 0.028 | 0.077 | 0.046 | *720* | | | | | | 5 | 5 *(pql)* |
| Benzyl butyl phthalate | | | | 1,900 | | 8.2 | *14,000* | | 4.9 | | 0.35 | | 1 | 1 *(pql)* |
| Bis(2-chloro-1-methylethyl) ether | | | | | | 37 | | | | | | | 1 | 37 *(sw-b)* |
| Bis(2-chloroethyl) ether | | | | 0.53 | 1.4 | 0.85 | *76* | | | | | | 1 | 1 *(pql)* |
| Bis(2-ethylhexyl) phthalate | | | | 2.2 | 5.9 | 3.6 | *110,000* | | 47 | | 0.43 | | 3 | 3 *(pql)* |
| Diethyl phthalate | | | | 44,000 | 120,000 | 28,000 | *82* | | 61 | | 740 | | 1 | 740 *(sed)* |

# TABLE 4
## PRELIMINARY GROUNDWATER SCREENING LEVELS
## 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* | | | | | |
| *ANALYTE (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*** |
| Dimethyl phthalate | | | | 1,100,000 | 2,900,000 | | *31.59* | | 53 | | 1700 | | 1 | 1,700 *(sed)* |
| Di-n-butyl phthalate | | | | 4,500 | 12,000 | 2,900 | *1,600* | | 220 | | 140 | | 1 | 140 *(sed)* |
| Di-n-octyl phthalate | | | | | | | *83,000,000* | | 58 | | 0.0007 | | 1 | 1 *(pql)* |
| Hexachlorobenzene | | | | 0.00029 | 0.00077 | 0.00047 | *80,000* | | 0.38 | | 0.0048 | | 1 | 1 *(pql)* |
| Hexachlorobutadiene | | | | 18 | 50 | 30 | *54,000* | | 3.9 | | 0.072 | | 3 | 3 *(pql)* |
| Hexachlorocyclopentadiene | | | | 1,100 | 17,000 | 3,600 | *200,000* | | | | | | 5 | 1,100 *(hh-cwa)* |
| Hexachloroethane | | | | 3.3 | 8.9 | 5.3 | *1,800* | | | | | | 2 | 3.3 *(hh-cwa)* |
| Isophorone | | | | 960 | 600 | 1,600 | *47* | | | | | | 1 | 600 *(hh-ntr)* |
| Nitrobenzene | | | | 690 | 1,900 | 1,800 | *120* | | | | | | 1 | 690 *(hh-cwa)* |
| N-Nitroso-di-n-propylamine | | | | 0.51 | | 0.82 | *24* | | | | | | 1 | 1 *(pql)* |
| N-Nitrosodimethylamine | | | | 3 | 8.1 | 4.9 | | | | | | | 3 | 3 *(hh-cwa)* |
| N-Nitrosodiphenylamine | | | | 6 | 16 | 9.7 | *1,300* | | 11 | | 8.5 | | 1 | 6 *(hh-cwa)* |
| Pentachlorophenol | 7.9 | 7.9 | 7.9 | 3 | 8.2 | 1.5 | *590* | | | 0.36 | | | 10 | 10 *(pql)* |
| Phenol in ug/L | | | | 1700000 | 4600000 | 560,000 | *29* | *0.725* | | 0.42 | 580 | | 1 | 580 *(sed)* |
| 2,4-Dinitrotoluene | | | | 3.4 | 9.1 | 1,400 | *96* | | | | | | 1 | 3.4 *(hh-cwa)* |

(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 = Carcinigenic 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 = Toxic 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 5
# PRELIMINARY SEDIMENT SCREENING LEVELS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | *APPLICABLE SEDIMENT VALUES* | | | |
|---|---|---|---|---|
| | ***Protection of Benthic Toxicity (1)*** | | | |
| | WAC 173-204 Sediment Management Standards (SMS) | | WAC 173-204 Dry Weight Equivalents of SMS Criteria | |
| *ANALYTE (BY GROUP)* | SMS SQS | SMS CSL | Dry Weight SQS Equivalent | Dry Weight CSL Equivalent |
| ***Metals*** | **mg/kg-dry wt** | **mg/kg-dry wt** | **mg/kg-dry wt** | **mg/kg-dry wt** |
| Arsenic | 57 | 93 | 57 | 93 |
| Cadmium | 5.1 | 6.7 | 5.1 | 6.7 |
| Chromium (Total) | 260 | 270 | 260 | 270 |
| Copper | 390 | 390 | 390 | 390 |
| Lead | 450 | 530 | 450 | 530 |
| Mercury | 0.41 | 0.59 | 0.41 | 0.59 |
| Silver | 6.1 | 6.1 | 6.1 | 6.1 |
| Zinc | 410 | 960 | 410 | 960 |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | **mg/kg OC (a)** | **mg/kg OC (a)** | **µg/kg dry wt** | **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 (b) | 370 | 780 | 5,200 | 5,200 |
| Total HPAH (c) | 960 | 5,300 | 12,000 | 17,000 |
| ***Other Semivolatile Organics*** | | | | |
| ***Chlorinated Benzenes*** | **mg/kg OC (a)** | **mg/kg OC (a)** | **µg/kg dry wt** | **µg/kg dry wt** |
| 1,2,4-Trichlorobenzene | 0.81 | 1.8 | 31 | 51 |
| 1,2-Dichlorobenzene | 2.3 | 2.3 | 35 | 50 |
| 1,4-Dichlorobenzene | 3.1 | 9 | 110 | 110 |
| Hexachlorobenzene | 0.38 | 2.3 | 22 | 70 |
| ***Other Semivolatile Organics*** | **µg/kg dry wt** | **µg/kg dry wt** | **µg/kg dry wt** | **µg/kg dry wt** |
| 2,4-Dimethylphenol | 29 | 29 | 29 | 29 |
| 2-Methylphenol | 63 | 63 | 63 | 63 |
| 4-Methylphenol | 670 | 670 | 670 | 670 |
| Benzoic acid | 650 | 650 | 650 | 650 |
| Benzyl alcohol | 57 | 73 | 57 | 72 |
| Pentachlorophenol | 360 | 690 | 360 | 690 |
| Phenol | 420 | 1,200 | 420 | 1,200 |
| ***Phthalate Esters*** | **mg/kg OC (a)** | **mg/kg OC (a)** | **µg/kg dry wt** | **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 |

# TABLE 5
# PRELIMINARY SEDIMENT SCREENING LEVELS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | ***APPLICABLE SEDIMENT VALUES*** | | | |
|---|---|---|---|---|
| | ***Protection of Benthic Toxicity (1)*** | | | |
| | WAC 173-204 Sediment Management Standards (SMS) | | WAC 173-204 Dry Weight Equivalents of SMS Criteria | |
| *ANALYTE (BY GROUP)* | SMS SQS | SMS CSL | Dry Weight SQS Equivalent | Dry Weight CSL Equivalent |
| ***Other Carbon Normalized*** | **mg/kg OC (a)** | **mg/kg OC (a)** | **µg/kg dry wt** | **µg/kg dry wt** |
| Hexachlorobutadiene | 3.9 | 6.2 | 11 | 120 |
| Dibenzofuran | 15 | 58 | 540 | 540 |
| N-Nitrosodiphenylamine | 11 | 11 | 28 | 40 |
| ***Polychlorinated Biphenyls (PCBs)*** | **mg/kg OC (a)** | **mg/kg OC (a)** | **µg/kg dry wt** | **µg/kg dry wt** |
| Total PCBs | 12 | 65 | 130 | 1,000 |
| ***Organotins (Bulk)(d)*** | **µg/kg dry wt** | **-** | **-** | **-** |
| TBT as TBT ion | 73 (f) | - | - | - |
| ***Organotins (Porewater)(d)*** | **µg/L** | **µg/L** | **-** | **-** |
| TBT as TBT ion | 0.05 | 0.15 (e) | - | - |

**Numerical Criteria Notes:**

(a) The listed values represent concentrations in parts per million "normalized" on a total organic carbon basis. To normalize to total organic carbon, the dry-weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment

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

(c) 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.

(d) No SMS criteria available. Criterial from Michelsen et al. 1996 PSDDA Issue Paper and DMMP Guideline Chemestry Values.

(e) DMMP screening level and biological trigger value

(f) DMMP screening level and biological trigger value; for use when pore water extraction not possible

**Process Notes:**

(1) The SMS numeric criteria as promulgated are based on protection of benthic toxicity. If site-specific bioassay data indicate no adverse affects to benthic organisms, the sediment can be considered to “pass” the applicable sediment quality standards (SQS) of WAC 173-204-320 through 340 even though it may exceed these chemical criteria (WAC 173-204-310(2)). It can then be concluded that the protection of benthic toxicity pathway is protective and does not require further evaluation.

**Abbreviations:**

CSL = Cleanup screening level
HPAH = High molecular weight polycyclic aromatic hydrocarbon
LPAH = Low molecular weight polycyclic aromatic hydrocarbon
MCUL = Maximum cleanup level
OC = Organic carbon
SMS = Sediment Management Standards
SQS = Sediment Quality Standards
TBT = Tributyltin
WAC = Washington Administrative Code
wt = Weight

# TABLE 6
## SUMMARY OF REMEDIAL INVESTIGATION SOIL AND GROUNDWATER SAMPLE LOCATIONS
## WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Location ID | Location Description | Rationale for Sample Collection | Surface Conditions | Soil Sampling Protocol Overview | Soil Analytical Testing | Groundwater Analytical Testing |
|---|---|---|---|---|---|---|
| WM-GP-1 | Northwest corner of the Site; near western boundary of historical sidetracks; in parking lot north of Boundary Fish seafood processing facility. | Evaluate soil and groundwater conditions near historical boatyard activities and northwestern Site boundary. | Asphalt Pavement | Field screening for contamination will be conducted on soil cores from ground surface to 12 ft BGS (or deeper if contamination is suspected in deeper soils).<br>Soil samples will be collected for the full suite of analyses from the upper 4 ft of soil in 1-ft intervals. Samples will be homogenized using equal portions of soil from throughout the depth interval; samples for VOCs and TPH-G will be discrete samples from the most likely contaminated soil within the interval and will NOT be homogenized.<br>If pavement is present, the uppermost soil samples will be collected below the pavement and base course material.<br>**0 to 1 ft: Analyze**<br>1 to 2 ft: Archive<br>2 to 3 ft: Archive<br>3 to 4 ft: Archive<br>If field screening indicates potential contamination deeper in the exploration, a sample will be collected and analyzed for the full suite of analyses and a sample will be collected from 1 ft above and 1ft below this potential contamination and archived at the laboratory. | WM-GP-1: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-1: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-2 | Northwestern portion of the Site in parking lot near northeast corner of Boundary Fish seafood processing facility. | Evaluate soil conditions near area of historical boatyard activities. | Asphalt Pavement | | WM-GP-2: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | - |
| WM-GP-3<br>WM-GP-4<br>WP-GP-6 | Locations are distributed within the present shipyard area under the canopy that currently provides cover for operations. WM-GP-3 is near former paint storage; WM-GP-4 is near former fuel storage. | Evaluate soil conditions near area of historical and current boatyard activities. | Asphalt Pavement | | WM-GP-3: TPH-Dx, PAHs, metals<br>WM-GP-4: TPH-Dx, PAHs, metals<br>WM-GP-6: TPH-Dx, PAHs, metals, organotins<br>*(TPH-G and VOCs based on field screening)* | - |
| WM-GP-5 | Southwest of covered boatyard area, near location of historical standpipe shown on Figure 7. | Evaluate soil and groundwater conditions associated with boatyard activities. Investigate for COPCs downgradient of the standpipe identified in historical engineering drawings. | Asphalt Pavement | | WM-GP-5: TPH-Dx, PAHs, metals, organotins<br>*(TPH-G and VOCs based on field screening)* | WM-GP-5: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-7<br>WM-GP-8 | Along western edge of the marine railway, underneath the canopy (WM-GP-7) and in the former shop area (WM-GP-8). | Evaluate soil and groundwater conditions near former and and current boatyard activities. | Asphalt Pavement | | WM-GP-7: TPH-Dx, PAHs, metals, PCBs<br>WM-GP-8: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-7: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals<br>WM-GP-8: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-9<br>WM-GP-10<br>WM-GP-11<br>WM-GP-12<br>WM-GP-13 | North of the marine railway and along its eastern edge. | Evaluate soil and groundwater conditions near area of historical and current boatyard activities in locations where surface staining may indicate release of COPCs to ground surface, near the solvent recycling shack, and near the stormwater treatment system. | Gravel | | WM-GP-9: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-10: TPH-Dx, PAHs, metals<br>WM-GP-11: TPH-Dx, PAHs, metals<br>WM-GP-12: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-13: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-9: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-12: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-13: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-14<br>WM-GP-15<br>WM-GP-16 | Eastern portion of the Site; in the DIY boat maintenance area where paint chips have been observed in surface soils (WM-GP-15 and WM-GP-16) and and in the northeast corner of the Site where waste containers were once stored (WM-GP-14). | Evaluate soil and groundwater conditions near area of historical and current shipyard activities. Potentially contaminated surface soil observed at these locations. | Gravel | | WM-GP-14: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-15: TPH-Dx, PAHs, metals<br>WM-GP-16: TPH-Dx, PAHs, metals, organotins, PCBs<br>*(TPH-G and VOCs based on field screening)* | WM-GP-14: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-16: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-17 | Northern portion of the Site; presumably away from impacts related to Site activities | Background sample; evaluate fill quality in a location unimpacted by previous Site activites | Asphalt Pavement | | WM-GP-17: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>*(TPH-G and VOCs based on field screening)* | WM-GP-17: TPH-G, TPH-Dx, SVOCs, PAHs, dissolved metals |

# TABLE 6
# SUMMARY OF REMEDIAL INVESTIGATION SOIL AND GROUNDWATER SAMPLE LOCATIONS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

Note:

Soil samples collected for TPH-G or VOC analyses will be collected discretely (not a composite) by EPA Method 5035 from unhomogenized soil.

BGS = Below Ground Surface

Metals = Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Zinc
PAHs = Polycyclic Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
SVOCs = Semivolatile Organic Compounds
TPH-Dx = Total Petroleum Hydrocarbons - Diesel and motor-oil range
TPH-G = Total Petroleum Hydrocarbons - Gasoline Range
VOCs = Volatile Organic Compounds

# TABLE 7
# SUMMARY OF REMEDIAL INVESTIGATION MARINE SEDIMENT SAMPLE LOCATIONS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Location ID | Location Description (a) | Rationale for Sample Collection | Sediment Analytical Testing |
|---|---|---|---|
| | | | |
| ***Surface Sediment Samples*** | | | |
| WM-SG-7 | East of the upland areas, between the shore and the sawtooth dock | Evaluate sediment conditions near the upland area where boatyard activities were performed and paint chips were observed in surface soils | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-8 | Approximately 90 ft southeast of the upland area | Evaluate sediment conditions away from the immediate vicinity of the uplands area | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-9 | Approximately 200 ft south-southeast of the upland area; near historical sediment sampling location BH-14 | Evaluate sediment conditions away from the immediate vicinity of the uplands area; evaluate changes over time by comparing results to historical data from BH-14 | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-10 | Approximately 130 ft south of the marine railway well | Evaluate sediment conditions away from the immediate vicinity of the uplands area | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-11 | Approximately 240 ft south of the marine railway well | Evaluate sedimentconditions away from the immediate vicinity of the uplands area | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-12 | Approximately 100 ft south of the shoreline near the southwest corner of the upland area of the Site; near historical sampling location BH-12 | Evaluate sediment conditions away from the immediate vicinity of the uplands area; evaluate changes over time by comparing results to historical data from BH-12 | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-13 | Approximately 150 ft south of the shoreline near the southwest corner of the upland area | Evaluate sediment conditions away from the immediate vicinity of the uplands area | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-14 | Within the marine railway well | Evaluate sediment conditions associated with former Site activities in this area | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| WM-SG-15 | East of the sawtooth dock | Evaluate sediment conditions at the eastern boundary of the Site | Metals, SVOCs, PCBs, bulk and porewater organotins, conventional parameters |
| ***Sediment Core Samples (b)*** | | | |
| WM-SC-1 (and WM-SG-1) | In the sediment along the eastern boundary of the marine railway inlet | Evaluate sediment conditions within the marine railway well | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |
| WM-SC-2 (and WM-SG-2) | Along the marine railway, approximately 100 ft south of WM-SC-1; near historical sampling location BH-02 | Evaluate sediment conditions along the marine railway alignment outside of the marine railway well; evaluate changes in conditions over time by comparing results to historical data from BH-02 | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |
| WM-SC-3 (and WM-SG-3) | At the travel lift pier | Evaluate sediment conditions associated with the activity at the travel lift pier | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |
| WM-SC-4 (and WM-SG-4) | Near southeast corner of the uplands; east of the travel lift; near historical sampling location BH-03 | Evaluate sediment conditions near the shore; evaluate changes in sediment conditions over time by comparing results to historical data from BH-03 | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |
| WM-SC-5 (and WM-SG-5) | South of the upland area of the Site; near the former shop | Evaluate sediment conditions near the shore associated with historical Site uses | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |
| WM-SC-6 (and WM-SG-6) | South of the upland area of the Site; west of the former shop | Evaluate sediment conditions near the shore associated with historical Site uses | Metals, SVOCs, PCBs, Conventional Parameters, bulk and porewater organotins[c] |

Notes:

(a) Directions in this table are provided in reference to "Map North." Figures for this work plan are oriented to the northwest.

(b) Surface sediment samples also collected at each sediment core location.

(c) Organotin analyses from sediment core sample locations will be either bulk or porewater, depending on whether an acceptable correlation between these two measurements has been established for this Site.

SVOCs = Semivolatile Organic Compounds
PCBs = Polychlorinated Biphenyls
Metals = Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Silver, Zinc

Conventional Parameters = Grain size, total organic carbon, total volatile solids, total solids, ammonia, and total sulfides

## APPENDIX A

# Historical Aerial Photographs

LANDAU
ASSOCIATES

Westman Marine Site
Blaine Harbor
Blaine, Washington

**1949 Aerial Photograph**

Figure
A-1

Westman Marine Site
Blaine Harbor
Blaine, Washington

**1956 Aerial Photograph**

Figure
A-2

LANDAU ASSOCIATES

Westman Marine Site
Blaine Harbor
Blaine, Washington

**2010 Aerial Photograph**

Figure
A-3

APPENDIX B

# Health and Safety Plan

# WORK LOCATION PERSONNEL PROTECTION AND SAFETY EVALUATION FORM

**Attach Pertinent Documents/Data**
**Fill in Blanks <u>As Appropriate</u>**

| | | | |
|---|---|---|---|
| Job No.: | 0001035.010 | | |
| Prepared by: | Jeremy Davis | Reviewed by: | Christine Kimmel |
| Date: | May 31, 2013 | Date: | June 10, 2013 |

## A. WORK LOCATION DESCRIPTION

1. **Project Name:** Westman Marine
2. **Location:** Blaine Harbor; Blaine, Washington
3. **Anticipated Activities:** Direct-push soil and groundwater investigation; sediment investigation, exploration using hollow-stem auger drill method
4. **Size:** 1.5 Acres
5. **Surrounding Population:** Commercial/Industrial
6. **Buildings/Homes/Industry:** Boatyard, fish processing, commercial buildings, parking lots
7. **Topography:** Generally flat
8. **Anticipated Weather:** Possible cold rain and wind, possible sunny and hot
9. **Unusual Features:** Active boatyard with moving equipment (forklifts, manlifts, boatlifts)
10. **Site History:** Historical property usage was primarily as a boatyard for marine vessel repair and maintenance - since 1949. Hazardous materials stored at Westman Marine included gasoline, antifreeze, hydraulic oil, chain lubricant, methyl ethyl ketone and other solvents, and paints. Westman Marine was a listed small-quantity generator of hazardous waste during its operations. Similar activities and storage may be continuing at the Site. Site visits in the 1990s by the Washington State Department of Ecology (Ecology) and the Port revealed that housekeeping was an ongoing issue for this facility and there was evidence of potential surface contamination including numerous minor spills on the ground surface, and paint chips and sandblast grit noticed in surface soil. So, while there are no existing analytical data for the Site uplands, it is anticipated that at least localized areas of affected soil are present.

## B. HAZARD DESCRIPTION

1. **Background Review:** ☐ Complete ☒ Partial

   If partial, why? No analytical data exists for upland portion of this site yet. Historical site uses and neighboring site conditions were used when considering hazards.

**2. Hazardous Level:** ☐ B ☐ C ☒ D ☐ Unknown

**Justification:** Limited contact with environmentally impacted media

**3. Types of Hazards:** (Attach additional sheets as necessary)

A. ☒ Chemical ☒ Inhalation ☐ Explosive

☐ Biological ☒ Ingestion ☐ O2 Def. ☐ Skin Contact

Describe: Likely hazards at the Site are exposure to soil or soil dust containing boatyard contaminants such as metals, tributyltin (TBT), carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and paints or solvents. Other possible hazards could consist of petroleum hydrocarbons and polychlorinated biphenyls (PCBs). Respirators will be kept on site and will be worn if necessary (as described below).

B. ☒ Physical ☒ Cold Stress ☒ Noise ☒ Heat Stress ☒ Other

Describe: Physical hazards from equipment and overhead equipment falls are possible during drilling. Hard hats will be worn. Noise hazards associated with drilling equipment. Ear protection will be used. Eye contact with drill rig operators or other signaling methods will be used near operating equipment. Reflective vests will be worn and cones will be placed in the work area for traffic safety and to warn pedestrians of the construction zone. Personnel will stand outside radius of extended drill mast unless necessary to perform sampling activities. During the sediment investigation, sediment samples will be collected from boats using basic principles of water safety, including using U.S. Coast Guard-approved personal floatation devices (PFDs), avoiding standing near the edge of the boat, securing workers with lifeline if work must be conducted over edge, avoiding sampling on stormy days or when seas are high, using caution when transferring from land to sea – making sure barges and boats are firmly secured to dock or pier before boarding or disembarking.

C. ☐ Radiation

Describe:

**4. Nature of Hazards:**

☒ Air

Describe: Possible exposure via inhalation of dust or vapors from soil or groundwater that has been impacted by contaminants. Exposure to possible volatile organic components (VOCs) and volatile petroleum hydrocarbons is possible. Breathing zone vapors will be analyzed with a photoionization detector (PID). Visual observations will be conducted for evidence of airborne dust greater than background concentrations.

| | |
|---|---|
| ☒ Soil | Describe: Exposure to possible metals, semivolatile organic compounds, PCBs, VOCs, cPAHs, petroleum hydrocarbons, and organotins in soil. Nitrile gloves and long-sleeved shirts will be worn when handling soil and equipment to minimize dermal contact with soil. Conduct screening with PID and visual indication for potentially impacted soil. Visual inspections of dust levels will be used to limit inhalation exposure to possibly contaminated soil dust. |
| ☒ Surface Water | Describe: Sediment work will be conducted overwater in a boat. Risk of drowning, PFD will be worn. |
| ☒ Groundwater | Describe: Possible exposure via splashing during drilling activities and sampling activities. Nitrile gloves and safety glasses will be worn when handling groundwater and sampling equipment. |
| ☐ Other | Describe: |

## 5. Chemical Contaminants of Concern ☐ N/A

| Contaminant | PEL (ppm) | IDLH/STEL (ppm) | Source/Quantity Characteristics | Route of Exposure | Symptoms of Acute Exposure | Instruments Used to Monitor Contaminant |
|---|---|---|---|---|---|---|
| Petroleum Hydrocarbons | 100 | 400 | Petroleum concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | Nervous excitation, insomnia, gastrointestinal symptoms, encephalopathy, anxiety, delirium, delusions, convulsions, and acute psychosis | PID meter |
| Benzene | 1.0 | 500/5.0 | Benzene concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | Irritated eyes, skin, nose, and respiratory system, giddiness, headache, nausea, staggered gait, dermatitis, fatigue, anorexia (carcinogenic) | PID meter |
| Toluene | 100 | 500/150 | Toluene concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | Headache, dizziness, drowsiness, coordination problems, coma | PID meter |
| Ethylbenzene | 100 | 800/125 | Ethylbenzene concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | Nervous system depression, headaches, dizziness, nausea, convulsions, coma | PID meter |
| Xylene | 100 | 900/150 | Xylene concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | | PID meter |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lead | 0.05 mg/m3 | NV/100 mg/m3 | Lead concentrations in soil and groundwater are unknown. | Inhalation, ingestion | Lassitude, insomnia, anorexia, constipation, kindney disease | Dust control |
| Mercury | 0.05 mg/m3 | NV/10 mg/m3 | Mercury concentrations in soil and groundwater are unknown. | Inhalation and skin/eye contact | Irritation of eyes/skin, cough, chest pain, breathing difficulty, metallic taste, salivation, difficulty swallowing, gastrointestinal symptoms | Dust control |
| Arsenic | 0.002 mg/m3 | NV/5.0 mg/m3 | Arsenic concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, skin and/or eye contact, ingestion | Dermatitis, gastrointestinal disturbances, respiratory irritation | Dust control |
| Cadmium | 0.005 mg/m3 | NV/9.0 mg/m3 | Cadmium concentrations in soil and groundwater are unknown. | Inhalation, ingestion | Cough, difficulty breathing, chest tightness, chills, muscle aches, nausea, vomiting, diarrhea, loss of sense of smell | Dust control |
| Chromium | 0.5 mg/m3 | NV/250 mg/m3 | Chromium concentrations in soil and groundwater are unknown. | Inhalation, ingestion, skin and/or eye contact | Irritation of eyes and/or skin, lung fibrosis | Dust control |
| Copper | 1.0 mg/m3 | NV/100 mg/m3 | Copper concentrations in soil and groundwater are unknown. | Inhalation, ingestion, skin and/or eye contact | Irritation of eyes, nose, or pharynx, metallic taste, dermatitis | Dust control |
| Zinc | 15 mg/m3 | NV/500 mg/m3 | Zinc concentrations in soil and groundwater are unknown. | Inhalation, ingestion, skin and/or eye contact | Chills, muscle ache, nausea, fever, dry throat, cough, metallic taste, headache, blurred vision, low | Dust control |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | back pain, vomiting, malaise | |
| PCBs | 0.001 mg/m3 | 5.0/0.5 mg/m3 | PCB concentrations in soil and groundwater are unknown. | Inhalation, skin absorption, ingestion, skin and/or eye contact | Irritation of eyes, chloracne | Dust control |
| cPAHs (benzo(a)pyrene | 0.2 mg/m3 | 10 mg/m3 | cPAH contamination may be present in soil | Inhalation, ingestion, dermal contact | Acute exposure symptoms unclear. Chronic exposure linked to cancer. | Dust control |

---

Notes:

## 6. Physical Hazards of Concern ☐ N/A

| Hazard | Description | Location | Procedures Used to Monitor Hazard |
|---|---|---|---|
| Noise | Heavy equipment noise | Around drill rig | Wear hearing protection. |
| Slip, trip, and fall | Working around berms, curbs, foundations, etc. | Site-wide | Mark and discuss hazardous terrain. Maintain clean work area. |
| Heavy equipment | Drill rig on site | Site-wide | Communicate with equipment operator prior to beginning work. Make eye contact when wanting access to area around rig.Wear highly visible safety vest. |
| Drowning or hypothermia | Personnel could fall into Blaine Harbor during sediment investigation | Off shore | Basic practices of boater safety will be followed. Boat will be securely tied to the shore when boarding or disembarking; personnel will not stand over the edge of the boat unless safely tied-off; personnel will wear U.S. Coast Guard-approved PFDs at all times when working off shore. |

## 7. Work Location Instrument Readings ☐ N/A

Location: ______________________

Percent $O_2$: ______________________ Percent LEL: ______________________

Radioactivity: ______________________ PID: ______________________

FID: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

---

Location: ______________________

Percent $O_2$: ______________________ Percent LEL: ______________________

Radioactivity: ______________________ PID: ______________________

FID: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

---

Location: ______________________

Percent $O_2$: ______________________ Percent LEL: ______________________

Radioactivity: ______________________ PID: ______________________

FID: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

---

Location: ______________________

Percent $O_2$: ______________________ Percent LEL: ______________________

Radioactivity: ______________________ PID: ______________________

FID: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

Other: ______________________ Other: ______________________

## 8. Hazards Expected In Preparation For Work Assignment ☐ N/A

Describe:

## C. PERSONAL PROTECTIVE EQUIPMENT

### 1. Level of Protection

☐ A ☐ B ☐ C ☒ D

Location/Activity: Observation of drilling operations. Soil and groundwater sample collection. U.S. Coast Guard-approved PFDs are required when working off shore during the sediment investigation.

☐ A ☐ B ☒ C ☐ D

Location/Activity: If action levels are met or exceeded.

### 2. Protective Equipment (specify probable quantity required)

**Respirator** ☐ N/A

☐ SCBA, Airline

☐ Full-Face Respirator

☒ Half-Face Respirator (Cart. organic vapor) (Only if upgrade to Level C)

☐ Escape mask

☐ None

☐ Other:

☒ Other: Hearing protection

**Clothing** ☐ N/A

☐ Fully Encapsulating Suit

☐ Chemically Resistant Splash Suit

☐ Apron, Specify:

☒ Tyvek Coverall (Only if upgrade to Level C)

☐ Saranex Coverall

☒ Other: U.S. Coast Guard approved PFD (when working near or over water)

☒ Other: Safety Vest

**Head & Eye** ☐ N/A

☒ Hard Hat

☐ Goggles

☐ Face Shield

☒ Safety Eyeglasses

☐ Other:

**Hand Protection** ☐ N/A

☒ Undergloves; Type:

☐ Gloves; Type:

☐ Overgloves; Type:

☐ None

☐ Other:

**Foot Protection** ☐ N/A

☐ Neoprene Safety Boots with Steel Toe/Shank

☐ Disposable Overboots

☒ Other: Steel-toed boots

**3. Monitoring Equipment** ☐ N/A

☐ CGI ☒ PID

☐ $O^2$ Meter ☐ FID

☐ Rad Survey ☐ Other

☐ Detector Tubes (optional)

Type:

## D. DECONTAMINATION

### PERSONAL DECONTAMINATION

☒ Required ☐ Not Required

***If required, describe:***

Personnel will decontaminate by washing with soap and water prior to eating and departing from the Site. Avoid hand to mouth contact. Disposable PPE will be discarded as solid waste.

### EQUIPMENT DECONTAMINATION

☒ Required ☐ Not Required

***If required, describe and list equipment:***

All sampling equipment will be decontaminated using wet decontamination procedures:

- Wash and scrub equipment with Alconox/tap water solution.
- Rinse with tap water.
- Rinse with de-ionized water.
- Repeat entire procedure or any parts of the procedure as necessary.

To decontaminate equipment with NAPL or free product:

- Soak a disposable towel with hexane solvent
- Wipe equipment to remove NAPL
- Dispose used towel in a trash bag as solid waste
- Proceed with above equipment three-step decontamination process.

**Down-the-hole drilling equipment will be decontaminated using a high pressure stream cleaner between sampling intervals.**

## E. PERSONNEL

| | Name | Work Location Title/Task | Medical Current | Fit Test Current |
|---|---|---|---|---|
| 1. | **Christophe Venot** | **Drilling observation/sample collection** | ☒ | ☒ |
| 2. | **Matt Moroney** | **Drilling observation/sample collection** | ☒ | ☒ |
| 3. | **Steve Shaw** | **Offshore sediment sample collection** | ☒ | ☒ |
| 4. | **Evelyn Harper** | **Offshore sediment sample collection** | ☒ | ☒ |
| 5. | | | ☐ | ☐ |
| 6. | | | ☐ | ☐ |
| 7. | | | ☐ | ☐ |
| 8. | | | ☐ | ☐ |
| 9. | | | ☐ | ☐ |
| 10. | | | ☐ | ☐ |

**Site Safety Coordinator:** **Christophe Venot**

## F. ACTIVITIES COVERED UNDER THIS PLAN

| Task No. | Description | Preliminary Schedule |
|---|---|---|
| 1 | Field investigation (direct-push soil and groundwater sampling) | Fall 2013 to Summer 2014 |
| 2 | Field investigation (well installation with hollow-stem auger) | Fall 2013 to Summer 2014 |
| 3 | Field investigation (sediment sampling) | Fall 2013 to Summer 2014 |

## G. SUBCONTRACTOR'S HEALTH AND SAFETY PROGRAM EVALUATION ☐ N/A

Name and Address of Subcontractor:
Cascade Drilling
19404 Woodinville Snohomish Road
Woodinville, Washington 98072

### EVALUATION CRITERIA

| Item | Adequate | Inadequate | Comments |
|---|---|---|---|
| Medical Surveillance Program | ☒ | ☐ | |
| Personal Protective Equipment Availability | ☒ | ☐ | |
| Onsite Monitoring Equipment Availability | ☒ | ☐ | |
| Safe Working Procedures Specification | ☒ | ☐ | |
| Training Protocols | ☒ | ☐ | |
| Ancillary Support Procedures (if any) | ☒ | ☐ | |
| Emergency Procedures | ☒ | ☐ | |
| Evacuation Procedures Contingency Plan | ☒ | ☐ | |
| Decontamination Procedures Equipment | ☒ | ☐ | |
| Decontamination Procedures Personnel | ☒ | ☐ | |

**GENERAL HEALTH AND SAFETY PROGRAM EVALUATION**: ☒ Adequate ☐ Inadequate

Additional Comments: Contractor health and safety program has been reviewed and is adequate, and maintained by Cascade as a condition of contract between Landau Associates and Cascade Drilling (Basic Subcontractor Services Agreement No. 09CASCADE).

Evaluation Conducted By: Christine Kimmel

Date: June 10, 2013

## EMERGENCY FACILITIES AND NUMBERS

Hospital: PeaceHealth St. Joseph Medical Center, Bellingham, Washington
2901 Squalicum Parkway
Bellingham, WA 98225

Directions: See Attachment B

Telephone: (360) 734-5400

Emergency Transportation Systems (Fire, Police, Ambulance) – 911

Emergency Routes – Map (Attachment B)

Emergency Contacts:

| | **Offsite** | **Onsite** |
|---|---|---|
| Jeremy Davis | 425-778-0907 | 206-601-7614 (cell) |
| Larry Beard | 425-778-0907 | 206-999-0690 (cell) |
| Christine Kimmel | 425-778-0907 | 206-786-3801 (cell) |

**<u>In the event of an emergency, do the following:</u>**

1. Call for help as soon as possible. Call 911. Give the following information:
   - WHERE the emergency is – use cross streets or landmarks
   - PHONE NUMBER you are calling from
   - WHAT HAPPENED – type of injury
   - WHAT is being done for the victim(s)
   - YOU HANG UP LAST – let the person you called hang up first.

2. If the victim can be moved, paramedics will transport to the hospital. If the injury or exposure is not life-threatening, decontaminate the individual first. If decontamination is not feasible, wrap the individual in a blanket or sheet of plastic prior to transport.

## HEALTH AND SAFETY PLAN
## APPROVAL/SIGN OFF FORMAT

I have read, understood, and agreed with the information set forth in this Health and Safety Plan (and attachments) and discussed in the Personnel Health and Safety briefing.

| | | |
|---|---|---|
| Name | Signature | Date |
| Name | Signature | Date |
| Name | Signature | Date |
| Name | Signature | Date |
| Name | Signature | Date |
| Site Safety Coordinator | Signature | Date |
| Christine Kimmel | | |
| Landau Health and Safety Manager | Signature | Date |
| Project Manager | Signature | Date |

Personnel Health and Safety Briefing Conducted By:

| | | |
|---|---|---|
| Jeremy Davis | | |
| Name | Signature | Date |

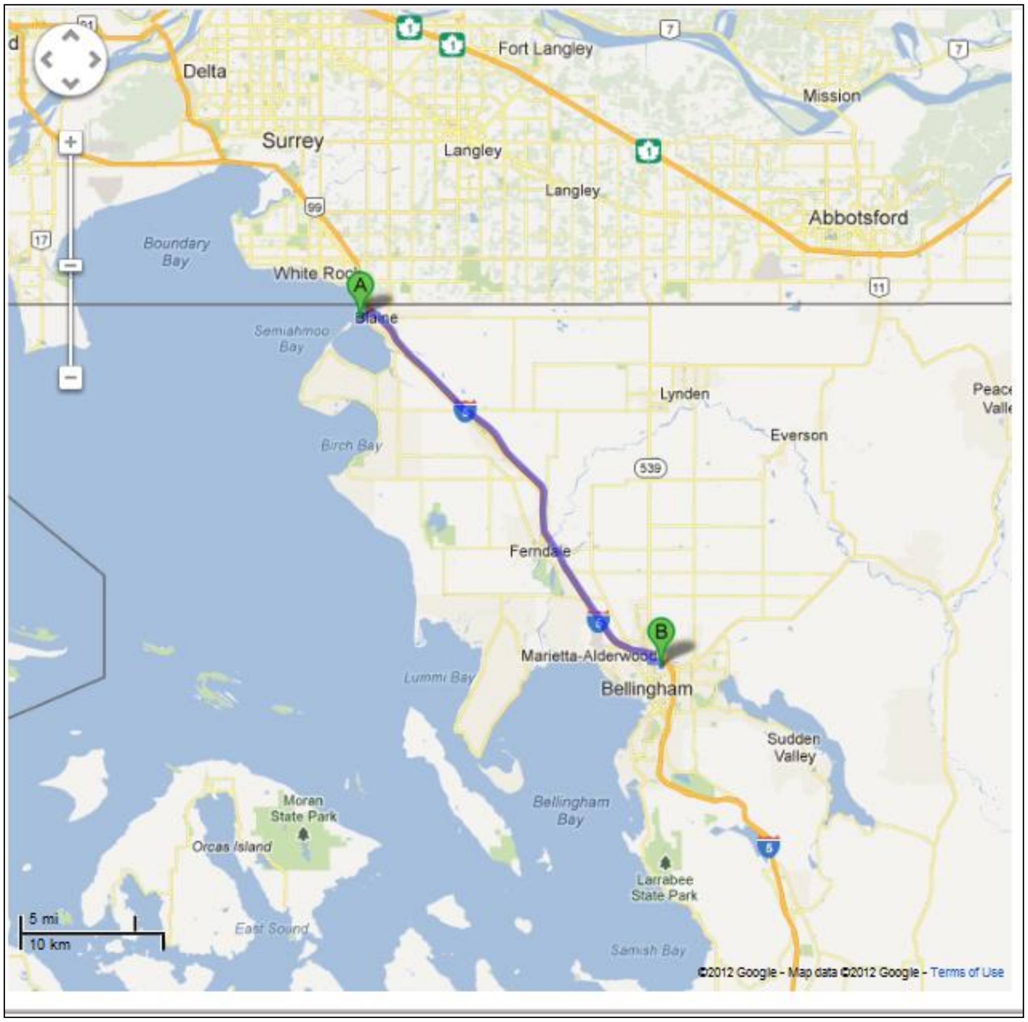
# ATTACHMENT A

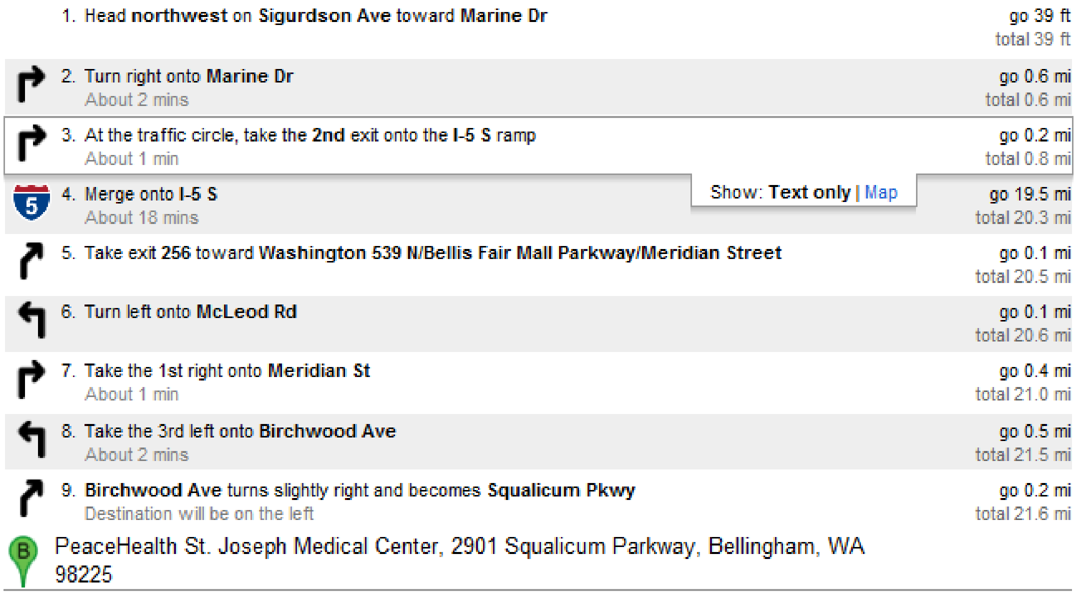
## ACTION LEVELS FOR RESPIRATORY PROTECTION

| Monitoring Parameter | Reading | Level of Protection |
|---|---|---|
| VOCs | >10 ppm and <25 ppm | Upgrade to half-face respirator with HEPA filters |
| VOCs | >25 ppm and <100 ppm | Remain in half-face respirator and temporarily stop work until ambient conditions return to background |
| VOCs | >100 ppm | Stop Work, contact H&S Manager |
| Visible Dust | Greater than background | Upgrade to half-face respirator or temporarily stop work until ambient conditions return to background or apply water for dust suppression |

# ATTACHMENT B

# MAP AND DIRECTIONS TO HOSPITAL





1. Head **northwest** on **Sigurdson Ave** toward **Marine Dr** — go 39 ft, total 39 ft
2. Turn right onto **Marine Dr** — About 2 mins — go 0.6 mi, total 0.6 mi
3. At the traffic circle, take the **2nd** exit onto the **I-5 S** ramp — About 1 min — go 0.2 mi, total 0.8 mi
4. Merge onto **I-5 S** — About 18 mins — go 19.5 mi, total 20.3 mi
5. Take exit **256** toward **Washington 539 N/Bellis Fair Mall Parkway/Meridian Street** — go 0.1 mi, total 20.5 mi
6. Turn left onto **McLeod Rd** — go 0.1 mi, total 20.6 mi
7. Take the 1st right onto **Meridian St** — About 1 min — go 0.4 mi, total 21.0 mi
8. Take the 3rd left onto **Birchwood Ave** — About 2 mins — go 0.5 mi, total 21.5 mi
9. **Birchwood Ave** turns slightly right and becomes **Squalicum Pkwy** — Destination will be on the left — go 0.2 mi, total 21.6 mi

B PeaceHealth St. Joseph Medical Center, 2901 Squalicum Parkway, Bellingham, WA 98225

APPENDIX C

# Upland Sampling and Analysis Plan

# Upland Sampling and Analysis Plan
# Westman Marine Site
# Blaine, Washington

August 21, 2013

Prepared for

**Port of Bellingham**
**Bellingham, Washington**

LANDAU
ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

# TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1

2.0 FIELD INVESTIGATION PROCEDURES 2-1
  2.1 SOIL INVESTIGATION 2-1
    2.1.1 Soil Sample Collection Methods – Direct-Push Borings 2-2
    2.1.2 Soil Laboratory Analysis 2-4
  2.2 DIRECT-PUSH GROUNDWATER INVESTIGATION 2-4
    2.2.1 Groundwater Laboratory Analysis 2-5
  2.3 GROUNDWATER INVESTIGATION – MONITORING WELLS 2-6
    2.3.1 Monitoring Well Installation and Construction 2-6
    2.3.2 Monitoring Well Development 2-7
    2.3.3 Sample Collection 2-8
    2.3.4 Laboratory Analysis 2-9
  2.4 SCHEDULE 2-10
  2.5 SAMPLE CONTAINERS, PRESERVATION, AND STORAGE 2-10
  2.6 SAMPLE TRANSPORTATION AND HANDLING 2-10
  2.7 SURVEYING 2-10
    2.7.1 Water Level Measurements 2-11
  2.8 EQUIPMENT DECONTAMINATION 2-11
    2.8.1 Water Level Indicator 2-11
    2.8.2 Sampling Equipment 2-11
    2.8.3 Heavy Equipment 2-12
  2.9 INVESTIGATION-DERIVED WASTE MANAGEMENT 2-12
    2.9.1 Soil Cuttings 2-12
    2.9.2 Liquid Waste 2-12

3.0 QUALITY ASSURANCE 3-1
  3.1 DATA QUALITY OBJECTIVES 3-1
    3.1.1 Precision 3-1
    3.1.2 Accuracy 3-2
    3.1.3 Representativeness 3-2
    3.1.4 Completeness 3-2
    3.1.5 Comparability 3-2
  3.2 FIELD AND LABORATORY QUALITY CONTROL SAMPLES 3-3
    3.2.1 Blind Field Duplicate 3-3
    3.2.2 Field Trip Blanks 3-3
    3.2.3 Field Rinsate Blanks 3-3
    3.2.4 Laboratory Method Blanks 3-4
    3.2.5 Laboratory Control Sample 3-4
    3.2.6 Surrogate Spikes 3-4
    3.2.7 Laboratory Matrix Spike 3-4
    3.2.8 Laboratory Duplicate 3-4
  3.3 CORRECTIVE ACTIONS 3-5
  3.4 DATA VERIFICATION AND VALIDATION 3-6

4.0 DATA MANAGEMENT PROCEDURES 4-1

5.0 REFERENCES 5-1

## FIGURES

Figure Title

C-1 Vicinity Map
C-2 Proposed Upland Investigation Sampling Locations

## TABLES

Table Title

C-1 Proposed Investigation Location Summary
C-2 Sample Containers, Preservatives, and Holding Times
C-3 Quantitation Limit Goals – Soil
C-4 Quantitation Limit Goals – Groundwater

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AST | Aboveground Storage Tank |
| BGS | Below Ground Surface |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| COPC | Constituent of Potential Concern |
| CSV | Comma Separated Value |
| DO | Dissolved Oxygen |
| DQO | Data Quality Objective |
| Ecology | Washington State Department of Ecology |
| EDB | Ethylene Dibromide |
| EDC | Ethylene Dichloride |
| EIM | Environmental Information Management |
| EPA | U.S. Environmental Protection Agency |
| ft | Feet |
| GPS | Global Positioning Device |
| mL | Milliliter |
| MSD | Matrix Spike Duplicate |
| MTBE | Methyl Tert-Butyl Ether |
| NAPL | Non-Aqueous Phase Liquid |
| NAVD88 | North American Vertical Datum of 1988 |
| NTU | Nephelometric Turbidity Unit |
| ORP | Oxidation Reduction Potential |
| oz | Ounce |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| PID | Photoionization Detector |
| Port | Port of Bellingham |
| QA | Quality Assurance |
| QC | Quality Control |
| RI | Remedial Investigation |
| RPD | Relative Percent Difference |
| SAP | Sampling and Analysis Plan |
| Site | Blaine Marina Inc. Site |
| TPH-D | Diesel-Range Total Petroleum Hydrocarbons |
| TPH-G | Gasoline-Range Total Petroleum Hydrocarbons |
| TPH-O | Oil-Range Total Petroleum Hydrocarbons |
| VOC | Volatile Organic Compound |
| WAC | Washington Administrative Code |

This page intentionally left blank.

# 1.0 INTRODUCTION

This sampling and analysis plan (SAP) describes the procedures for conducting field activities during the remedial investigation (RI) within the upland portion of the Westman Marine site (Site) located at 214 Sigurdson Avenue, Blaine, Washington (Figure C-1). This SAP is an appendix to the Westman Marine Site RI Work Plan, one of the required deliverables under Agreed Order No. DE 9001 between the Port of Bellingham (Port) and the Washington State Department of Ecology (Ecology). The primary objective of this SAP is to provide sampling and analysis procedures and methodologies consistent with accepted procedures so that the data collected will be adequate for use in characterizing Site upland environmental conditions. This SAP was prepared consistent with the requirements of Washington Administrative Code (WAC) 173-340-820. It provides field, sampling, and analytical procedures to be used during the upland RI.

Investigation of the upland portion of the Site will focus on characterization of soil and groundwater quality. As discussed in Section 7.0 of the RI Work Plan, further investigation of Site soil and groundwater is needed to evaluate the nature and extent of potential Site upland contamination associated with boatyard activities.

Based on the proximity to the nearby marine surface waters of Blaine Harbor, surface sediments will also be evaluated, as described in the RI Work Plan. Marine sediment sampling procedures are described in the Sediment Investigation SAP (Appendix D to the RI Work Plan).

The goal of the investigation is to delineate the vertical and horizontal extent of contamination associated with the Site. Soil and groundwater investigation locations were selected based on an investigation approach that provides coverage across the most of the Site, with sample locations generally focused in areas previously noted as having environmental concerns. This includes areas where boat maintenance activities occurred, surface staining was observed, or locations where chemicals were known to be stored. Proposed sampling locations are presented on Figure 2. It should be noted that the proposed boring locations are approximate, and may be adjusted based on observed Site conditions, available access, and the location of utilities. Because the conceptual site model for potential contamination at this Site is based on surface releases and subsequent transport, the upland soil investigation is primarily focused on shallow soils. The investigation will proceed until the horizontal and vertical extents of contamination are identified. To accomplish this, sampling may be required deeper than indicated in this plan, or additional boring locations may be required.

# 2.0 FIELD INVESTIGATION PROCEDURES

This section presents the field procedures for the soil, groundwater, and soil vapor investigation at the Site. The investigation will begin with an initial phase of work that includes advancing direct-push borings to collect soil, groundwater, and soil vapor samples. Soil vapor samples will be analyzed for the presence of volatile compounds to evaluate potential contaminants in the vapor phase that may impact human health. During the second phase of the investigation, groundwater monitoring wells will be installed in locations based on the analytical results of the initial phase of investigation. Groundwater from the monitoring wells will be collected for analysis twice as part of the RI.

## 2.1 SOIL INVESTIGATION

This section describes the activities to be conducted to collect and screen soil samples from direct-push borings. The subsurface soil investigation will consist of advancing at least 17 borings, which is expected to take 3 days of direct-push drilling. Borings will be advanced by either a truck-mounted or track-mounted (limited access), direct-push drill rig. Each boring will extend from the ground surface to at least 2 feet (ft) below the groundwater table. Soil and groundwater grab samples will be collected from the borings as described below and in Table C-1. Groundwater levels near the shoreline are likely to be significantly influenced by changing tides. During the recent work at a nearby project in April 2013, groundwater was measured to be between 8 and 11.5 ft below ground surface (BGS) depending on tide and distance from the shoreline. Based on these nearby observations, we anticipate borings could extend 9 to 15 ft BGS for this investigation. Boring depths will extend deeper than indicated in this SAP if field screening indicates contamination extends deeper into the soil, although this is not anticipated since contamination is expected to be limited to the shallow soils (less than 4 ft BGS). All drilling will be conducted in accordance with applicable Washington State well construction regulations (Chapter 173-160 WAC).

As shown on Figure C-2, there are 17 proposed RI soil boring locations distributed throughout the Site, generally located in areas of interest associated with former property usage or previous observations of concern. The rationale for the proposed sampling locations is presented in Table C-1. The final location of each soil boring is subject to being modified as necessary based on the presence of utilities or other obstructions. Depending on the location of utilities compared to areas critical for the investigation, an “air knife” may be used to inspect the proposed boring locations for subsurface utilities in highly congested areas, or for locations that require precisely locating utilities for sample collection.

A Site reconnaissance will be conducted prior to intrusive activities to identify obstructions to planned boring locations (i.e., utilities, equipment, materials), and to evaluate the condition of certain features that may affect the approach to or need for investigation at that location. If practicable, boring locations will be relocated to avoid obstructions. However, if locations are obstructed by equipment or materials, and a viable alternative location is not available nearby, the Port will coordinate with applicable tenants to move the obstruction to allow sampling.

After the completion of each boring, the soil borehole will be backfilled to the ground surface with bentonite chips. Surface restoration will match existing conditions (e.g., if borings are advanced through asphalt, an asphalt patch will be used for surface completion). Soil sample collection methods are described in Sections 2.1.1, and analytical testing methods are outlined in Section 2.1.2.

### 2.1.1 SOIL SAMPLE COLLECTION METHODS – DIRECT-PUSH BORINGS

Soil samples will be collected continuously from ground surface to the target depth using an approximately 2-inch-diameter, 5-ft-long, hammer-driven sampler with a disposable acrylic liner. The sampler will be advanced to the top of the sample interval with the piston in a locked position. The piston tip will then be loosened and the sampler will be advanced over the desired depth interval, thereby coring the soil inside the sampler’s disposable, single- use liner. The sampler will then be withdrawn to retrieve the soil sample confined within the liner. The liner will be cut to remove the soil sample for inspection and logging. Between boring successive boring locations , the core sampler, including the piston tip and rods, will be decontaminated (as specified in Section 2.6), and a new liner will be placed into the sampler.

Soil samples collected from each sampling core will be classified in accordance with the Unified Soil Classification System. Soil classification will include observing and recording physical characteristics, such as visual classification by grain size, grading, subordinate constituents, color, density, and apparent moisture content. Soil samples will also be screened for contamination by visual inspection for staining/discoloration, unusual odors, and for the presence of volatile organic compounds (VOCs) using a photoionization detector (PID).

Field data, including sampling depths, sampling methods, sample recoveries, soil types, stratifications, visual or olfactory indications of contamination, PID readings, and other pertinent information will be recorded on a field boring log. The logs will also contain the name of the drilling contractor, the type of drilling equipment used, start and finish dates, probe diameter, probe number, and a generalized sketch showing the location of each probe. Geographical coordinates of each probe location will be recorded using a portable Global Positioning System (GPS) instrument.

The core will be divided into sample intervals as identified in Table C-1 and soil from within the sampling interval will be homogenized using decontaminated stainless steel bowls and spoons. The homogenized sample volumes will then be placed into the appropriate laboratory-supplied sample containers. Samples collected for VOC and gasoline-range total petroleum hydrocarbon (TPH-G) analysis will be collected from the undisturbed soil prior to homogenization, using VOC sample collection methodology recommended by the Environmental Protection Agency (EPA) Method 5035 described below. As indicated in Table C-1, VOC and TPH-G samples will be collected only from sample locations exhibiting sustained PID readings greater than 5 ppm and/or olfactory indication of VOC or gasoline-range compounds.

Four intervals will be sampled at each boring location: 0 to 1 ft, 1 to 2 ft, 2 to 3 ft, and 3 to 4 ft BGS. If pavement is present at the boring location, the uppermost sample will be collected beneath the pavement and base course material. The top interval (0 to 1 ft) will be immediately analyzed by the laboratory for the analytical parameters discussed below. The three remaining intervals (1 to 2 ft, 2 to 3 ft, and 3 to 4 ft) will be archived at the laboratory pending a review of the results for the top interval. The second interval (1 to 2 ft) will be analyzed for those constituents that are above preliminary screening levels (PSLs) in the top interval. Similarly, the third interval (2 to 3 ft) will be analyzed for constituents that are above PSLs in the second interval and the fourth sample will be analyzed for constituents that exceed the PSLs in the third sample. If obvious signs of contamination are indicated by field screening, a discrete sample will be collected from the area with the greatest level of observed contamination.

For soil samples collected for VOC and TPH-G analyses, field personnel will follow EPA soil sampling method 5035A, consistent with Ecology's memorandum on collecting soil samples for VOC analysis (Ecology 2004a). If the soil consists primarily of course sand or finer-grained material, the EPA method described below will be used. If soil containing significant gravel content is encountered, EPA Method 5035A is not effective and the previously accepted method of placing larger sample volumes in a larger sample container will be used.

The EPA 5035A soil sampling method is intended to reduce volatilization and biodegradation of samples. The EPA 5035A procedure for soil sample collection is as follows:

- Collect soil "cores" using coring devices (i.e., EnCore® sampler, EasyDraw Syringe®, or a Terra Core™ sampling device). Each "core" will consist of approximately 5 grams of soil. Collect three discrete "cores" from each sampling location. One EasyDraw Syringe or Terra Core device will be used to collect the three discrete "cores"; however, if the EnCore samplers are used, three sampling devices are required.
- Remove excess soil from coring device. If the EasyDraw Syringe or Terra Core sampling device is used for sample collection, place the "cored" soil directly into unpreserved 40 milliliter (mL) vials with a stirbar. If the EnCore sampler is used, close the sampler for transport to the laboratory.
- Collect one 2-oz jar of representative soil for moisture content and laboratory screening purposes. Fill the jar to minimize headspace.

Soil samples will be collected and preserved consistent with the method-specific requirements and sample hold times in Table C-2.

### 2.1.2 SOIL LABORATORY ANALYSIS

Soil samples from the borings will be submitted for laboratory analyses as described in Section 2.1.1 and in Table C-1, and are as summarized below.

Laboratory soil analysis will include the following analytical parameters for selected samples:

- VOCs by U.S. Environmental Protection Agency (EPA) Method 8260C [all sampling locations exhibiting sustained PID detections above 5 parts per million (ppm) and/or olfactory indications of VOC contamination]
- SVOCs by EPA Method 8270D (WM-GP-9, WM-GP-12, WM-GP-14, and WM-GP-17)
- PAHs by EPA Method 8270D SIM (all sampling locations)
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) by EPA Method 6020 (EPA Method 7471B for mercury) (all sampling locations)
- Petroleum hydrocarbon identification by Method NWTPH-HCID (all sampling locations)
- TPH-G, diesel- and/or oil-range total petroleum hydrocarbons (TPH-D, and/or TPH-O) by Method NWTPH-G, or NWTPH-Dx (conducted as follow-up analysis for samples with NWTPH-HCID detections; NWTPH-Dx follow-up analyses will include acid/silica gel cleanup to reduce organic interference)
- PCBs by EPA Method 8082 (at sampling locations WM-GP-8, WM-GP-9, WM-GP-12, WM-GP-14, WM-GP-16, and WM-GP-17)
- Organotins by EPA Method 8270D SIM (at sampling locations WM-GP-5, WM-GP-6, and WM-GP-16).

Quantitation limit goals are presented in Table C-3 and are established to meet PSLs for both saturated and unsaturated soil.

## 2.2 DIRECT-PUSH GROUNDWATER INVESTIGATION

This section describes the activities to be conducted to collect and analyze groundwater grab samples from direct-push borings. The investigation will consist of conducting groundwater sampling at each of the borings advanced during the soil investigation. Procedures for advancing the direct-push borings are provided in Section 2.1.

Groundwater grab samples will be collected using a groundwater sampler consisting of a 4-ft-long, wire-wrapped, stainless steel screen (0.010-inch slot size) with a retractable protective steel sheath. The groundwater sampler will be advanced to the sample depth and the protective sheath will be retracted to expose the stainless steel screen to the formation. Low-flow purging will be performed for 10 minutes or until the purge water is clear using a peristaltic pump. During purging, pH, specific conductance, and temperature will be measured using a flow-through cell.

Groundwater samples will be collected into the appropriate sample containers using disposable polyethylene tubing and a peristaltic pump. To prevent degassing during sampling for VOCs, a pumping rate will be maintained below about 100 milliliters per minute (mL/min). The VOC containers will be filled completely so that no headspace remains. Samples will be chilled to 4°C immediately after collecting the sample. Groundwater for dissolved lead analyses will be collected last and field-filtered through a 0.45 micron, in-line disposable filter and preserved, as specified in Table C-2. A note will be made on the sample label, sample collection form, and chain-of-custody form to indicate the sample for dissolved metals analysis has been field-filtered and preserved, including the type of preservative used. Groundwater samples will be submitted to the laboratory under a signed chain-of-custody form for analysis as described in Section 2.2.1.

### 2.2.1 GROUNDWATER LABORATORY ANALYSIS

Each groundwater grab sample will be submitted to the laboratory for the following analyses:

- PAHs by EPA Method 8270D SIM (all locations)
- Dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) by EPA Method 6020 (EPA Method 7471B for mercury) (all locations)
- Petroleum hydrocarbon identification by Method NWTPH-HCID (all locations)
- TPH-G, TPH-D, and/or TPH-O by Method NWTPH-G, or NWTPH-Dx (conducted as follow-up analysis for samples with NWTPH-HCID detections; NWTPH-Dx follow-up analyses will include acid/silica gel cleanup to reduce organic interference)
- VOCs by EPA Method 8260C (all locations)
- SVOCs by EPA Method 8270D (WM-GP-9, WM-GP-12, WM-GP-14, WM-GP-17).

Quantitation limit goals are presented in Table C-4.

Both filtered and unfiltered samples will be collected for all metals analyses. Unfiltered metals samples will be tested initially, and filtered metals samples will be tested only if metals concentrations exceed the screening level in the unfiltered sample. Dissolved metals samples will be field-filtered prior to analysis. Groundwater collected from direct-push borings tends to have significantly higher turbidity than those collected from groundwater monitoring wells due to the entrainment of particles in the water sample.

Particulates in groundwater can result in a high bias of the analytical results for organic compounds that partition heavily to soil, such as TPH-O, SVOCs, and PCBs. This is particularly a concern for groundwater samples that are collected from temporary wells installed in direct-push borings because turbidity is typically elevated in groundwater samples that are collected from temporary wells. As a result, analytical results for TPH-O, SVOCs, and PCBs collected from direct-push borings will be used for screening purposes, and any exceedance of the screening levels will be further evaluated using monitoring wells to obtain more representative groundwater samples.

Groundwater samples will be collected and preserved consistent with the method-specific requirements shown in Table C-2. Analyses will be conducted within the specified holding times shown in Table C-2. All samples will be archived by the laboratory under chain-of-custody protocol until Landau Associates directs the laboratory that they may be discarded.

## 2.3 GROUNDWATER INVESTIGATION – MONITORING WELLS

This section describes the activities to be conducted to collect groundwater samples from groundwater monitoring wells. Groundwater monitoring wells will be installed at the Site to evaluate groundwater conditions at the Site boundaries (to be determined during the RI process, and which generally define the point of compliance). Prior to installing the monitoring wells, as described below, the Port in consultation with Ecology will select well installation locations based on the results of groundwater grab samples discussed above. The Port may also prepare a revised list of constituents of potential concern (COPCs) for samples collected from wells based on the results of the direct-push groundwater investigation described in Section 2.2. The list of groundwater COPCs may need to be revised because the initial phase of groundwater sampling from direct-push borings includes parameters that have not been previously tested for at the Site, and the first phase of the investigation may adequately demonstrate that those compounds are not present at this Site.

### 2.3.1 MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring wells will be constructed by a drilling contractor licensed in the state of Washington using the hollow-stem auger drilling method. Prior to initiation of drilling, or any other invasive subsurface activity, the locations of each proposed exploration will be checked in the field to identify aboveground utilities or physical limitations that would prevent drilling at the proposed location. In addition, a public utility locate service will be contacted to locate underground utilities at the perimeter of the Site and a private utility locate service will be contacted to identify potential underground utilities. Based on the findings by the utility locating service, an adjustment to the boring location may be required. Additionally, it may be necessary to use an “air knife” to carefully inspect the subsurface and confirm the locations of utilities prior to advancing the drilling auger. The final location for each borehole will be based on the findings of the field check.

The monitoring wells will be constructed in accordance with Washington State Minimum Standards for Construction and Maintenance of Wells (WAC 173-160; Ecology 2006). Landau Associates field personnel familiar with environmental sampling and construction of resource protection wells will oversee the drilling and well installation activities, and maintain a detailed record of the well construction. The monitoring wells will be drilled using conventional hollow-stem auger techniques with

4.25-inch inside diameter augers. The monitoring wells will be constructed with 2-inch-diameter, flush-threaded, Schedule 40 polyvinyl chloride (PVC) pipe and 10-ft screens. Wells will be constructed using 0.010-inch machine-slotted casings and filter pack material consisting of pre-washed, pre-sized number 20/40 silica sand to minimize sample turbidity.

The well screen location will be selected based on observed conditions. Based on water level measurements collected at the Blaine Marina Inc. site, we anticipate the screens will be placed from 5 to 15 ft BGS to intersect the water table. The filter pack will be placed from the bottom of the well to approximately 1 ft above the top of the screen. Filter pack material will be placed slowly and carefully to avoid bridging of material. A bentonite seal will be placed above the filter pack material to within about 3 ft of ground surface. Grout will be used to backfill the boring to the subgrade for placement of the protective cover.

The well names and the identification numbers assigned by Ecology will be marked on the well identification tags supplied by Ecology and will be attached to each well casing following well installation. Before and between drilling of each boring and at completion of the project, downhole drilling equipment will be cleaned using a high-pressure hot water or steam washer as described in Section 2.9.

Water levels will be measured at least three times in association with the well installation: during drilling, following the well installation, and following the well development. In addition, water levels will be measured in all Site wells within an hour of each other prior to conducting groundwater sampling events. Water level measurement procedures are discussed in Section 2.8.1.

### 2.3.2 MONITORING WELL DEVELOPMENT

The monitoring wells will be developed after construction to remove formation material from the well borehole and the filter pack prior to groundwater level measurement and sampling. Development will be achieved by repeatedly surging the well with a surge block and purging the well until the water runs clear, but no less than five well casing volumes. During development, the purged groundwater will be monitored for the following field parameters:

- pH
- Specific conductance
- Temperature
- Turbidity
- Oxidation reduction potential (ORP)
- Dissolved oxygen (DO).

The wells will be developed until the turbidity of the purged groundwater decreases to 5 nephelometric turbidity units (NTUs) and until the stabilization criteria in Section 2.3.3 are met, if practicable. If the well dewaters during the initial surging and purging effort, one final well casing volume will be removed after the well has fully recharged, if practicable. Well development activities will be recorded on a Well Development form.

### 2.3.3 SAMPLE COLLECTION

The initial groundwater samples will be collected at least 1 week after well development. Samples will be collected during low tide, at a time during the tide cycle selected to minimize influence on the sample by marine surface water as discussed in Section 2.4. For the RI, one round of groundwater sampling will be conducted during the wet season (November through April) and one round of groundwater sampling will be completed during the dry season (June through October). Collection of groundwater samples will be completed at each monitoring well using the following procedures:

- Immediately following removal of each well monument cover, the wellhead will be observed for damage, leakage, and staining. Additionally, immediately following removal of the wellhead cap, any odors will be recorded and the condition of the well opening will be observed. Any damage, leakage, or staining to the wellhead or well opening will be recorded.
- Prior to sampling, each well will be purged using a pump that is attached to dedicated purge and sample collection tubing (the types of pumps used may vary depending on purge volume and depth and include a centrifugal pump, a peristaltic pump, and an electric submersible pump). Purging will begin with a low pumping rate. The rate will be adjusted upward slowly to minimize drawdown (with a target drawdown of less than 0.33 ft) during purging.
- Field parameters, including pH, temperature, specific conductance, DO, ORP, and turbidity, will be continuously monitored during purging using a flow cell. Purging of the well will be considered to be complete when all field parameters become stable for three successive readings. The successive readings should be within +/– 0.1 pH units for pH, +/– 3 percent for specific conductance, and +/– 10 percent for DO and turbidity.
- Purge data will be recorded on a Groundwater Sample Collection form including purge volume; time of commencement and termination of purging; any observations regarding color, turbidity, or other factors that may have been important in evaluation of sample quality; and field measurements of pH, specific conductance, temperature, DO, and turbidity.
- Following the stabilization of field parameters, the flow cell will be disconnected and groundwater samples will be collected. Sample data will be recorded on a Groundwater Sample Collection form, including sample number and time collected, the observed physical characteristics of the sample (e.g., color, turbidity, etc.), and field parameters (pH, specific conductance, temperature, and turbidity).
- Four replicate field measurements of temperature, pH, specific conductance, DO, ORP, and turbidity will be obtained using the following procedures:
  - A 250-mL plastic beaker will be rinsed with de-ionized water followed by sample water.

  - The electrodes and temperature compensation probe will be rinsed with de-ionized water followed by sample water.
  - The beaker will be filled with sample water; the probes will be placed in the beaker until the readings are stabilized. Temperature, pH, specific conductance, DO, and turbidity measurements will be recorded on the Groundwater Sample Collection form.
  - The above step will be repeated to collect the remaining replicates.
- Any problems or significant observations will be noted in the "comments" section of the Groundwater Sample Collection form.
- Groundwater samples will be collected into the appropriate sample containers using a peristaltic pump. To prevent degassing during sampling for VOCs, a pumping rate will be maintained below about 100 mL/min. The VOC containers will be filled completely so that no headspace remains. Samples will be chilled to 4°C immediately after collecting the sample. Clean gloves will be worn when collecting each sample.
- Groundwater for dissolved metals analyses will be collected last and field-filtered through a 0.45 micron, in-line disposable filter. Dissolved metal samples will be preserved, as specified in Table C-2. A note will be made on the sample label, sample collection form, and chain-of-custody form to indicate the sample has been field-filtered and preserved, including the type of preservative used.
- Groundwater samples will be submitted to the laboratory for analysis as described in Section 2.2.4.

### 2.3.4 LABORATORY ANALYSIS

Groundwater COPCs will be evaluated in consultation with Ecology based on the results of the initial phase of the groundwater investigation. Unless a change in the list below is decided upon in coordination with Ecology based on the results of groundwater grab sampling, groundwater samples collected from monitoring wells will be analyzed for the same parameters analyzed during the first phase of groundwater investigation, as follows:

- PAHs by EPA Method 8270D SIM
- Dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) by EPA Method 6020 (EPA Method 7471B for mercury)
- Petroleum hydrocarbon identification by Method NWTPH-HCID
- TPH-G, TPH-D, and/or TPH-O by Method NWTPH-G, or NWTPH-Dx (conducted as follow-up analysis for samples with NWTPH-HCID detections; NWTPH-Dx follow-up analyses will include acid/silica gel cleanup to reduce organic interference)
- VOCs by EPA Method 8260C
- SVOCs by EPA Method 8270D.

Groundwater samples will be collected and preserved consistent with the method-specific requirements shown in Table C-2. Analyses will be conducted within the specified holding times shown in Table C-2. All samples will be archived by the laboratory under the chain-of-custody protocol until Landau Associates directs the laboratory that they may be discarded.

## 2.4 SCHEDULE

Based on the Site's close proximity to tidally influenced marine surface water, groundwater sampling will be conducted when the tide is low to reduce potential dilution of groundwater samples that could be caused by water flowing inland from Blaine Harbor. For samples along the shoreline, the optimal sample timing is likely to be within 2 hours before and after low tide. It is not expected that tidal cycles will significantly impact the results of soil sampling.

## 2.5 SAMPLE CONTAINERS, PRESERVATION, AND STORAGE

Soil and groundwater samples submitted to the analytical laboratory for analyses will be collected in the appropriate sample container provided by the analytical laboratory. The samples will be preserved by cooling to a temperature of 4°C or as required by the analytical method. Maximum holding and extraction times until analysis is performed will be strictly adhered to by field personnel and the analytical laboratory. Sample containers, preservatives, and holding times for each chemical analysis are shown in Table C-2.

## 2.6 SAMPLE TRANSPORTATION AND HANDLING

The transportation and handling of soil and groundwater samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the release of samples. Samples will be logged on a chain-of-custody form and will be kept in coolers on ice until delivery to the analytical laboratory. The chain-of-custody form will accompany each shipment of samples to the laboratory.

## 2.7 SURVEYING

The location of each direct-push sampling location will be surveyed using GPS equipment to facilitate accurate placement of these features on project figures and drawings, as well as for submittal to Ecology. Monitoring well locations and reference elevations will be professionally surveyed to the nearest 0.01 ft for use in evaluating groundwater and lithologic unit elevations. Both the top of the monitoring well casing elevation and ground surface elevation adjacent to the monitoring well will be measured. This information will be used to develop groundwater elevation contour maps. North American Vertical Datum of 1988 (NAVD88) will be used as the reference elevation datum. Surveying will be accomplished after completion of the well installations.

### 2.7.1 WATER LEVEL MEASUREMENTS

Water level measurements will be obtained at each monitoring well prior to purging and sample collection. All water levels will be measured using an electronic water level indicator and will be recorded to the nearest 0.01 ft. Measurements will be taken from the top of the well casing.

## 2.8 EQUIPMENT DECONTAMINATION

The decontamination procedures described below are to be used by field personnel to clean drilling, sampling, and related field equipment. Deviation from these procedures must be documented in field records.

### 2.8.1 WATER LEVEL INDICATOR

The tape from the water level indicator will be washed with Alconox soap and rinsed with distilled water between each well measurement. It is not expected that non-aqueous phase liquid (NAPL) will be encountered during this investigation. However, if NAPL is encountered, a paper towel wetted with hexane will be used to clean the NAPL from the indicator. Following the cleaning with hexane, the indicator will be washed with Alconox soap and rinsed with distilled water. If odors persist on the indicator, the process will be repeated.

### 2.8.2 SAMPLING EQUIPMENT

All reusable sampling equipment used (e.g., stainless steel bowls, stainless steel spoons, hand augers, direct-push core samplers, etc.) will be decontaminated using a three-step process, as follows:

1. Scrub surfaces of equipment that would be in contact with the sample with brushes using an Alconox solution
2. Rinse and scrub equipment with clean tap water
3. Rinse equipment a final time with de-ionized water to remove tap water impurities.

Decontamination of the reusable sampling equipment will occur between collection of each sample. Decontamination of sampling equipment that contains a visible sheen will include a hexane rinse (or other appropriate solvent) prior to the tap water rinse. Groundwater sampling equipment in contact with groundwater is dedicated to a specific sampling location and will not be used at more than one location; therefore, no sampling equipment decontamination is necessary.

### 2.8.3 HEAVY EQUIPMENT

Heavy equipment (e.g., the drilling rigs and drilling equipment that is used downhole, or that contacts material and equipment going downhole) will be cleaned by a hot water, high-pressure wash before each use and at completion of the project. Potable tap water will be used as the cleansing agent.

## 2.9 INVESTIGATION-DERIVED WASTE MANAGEMENT

This section describes the management of investigation-derived waste including soil cuttings, well development water, purge water, and decontamination water generated during well installation, well development, and groundwater sampling activities.

### 2.9.1 SOIL CUTTINGS

Soil cuttings from boreholes will be temporarily stored in 55-gallon drums. Only a small volume of soil cuttings are derived from direct-push borings; soil cuttings from the uplands investigation are expected to be contained in one 55-gallon drum. A sufficient supply of drums will be made available by the drilling subcontractor for soil cuttings in case additional storage is needed. Disposal of the soil cuttings will be in accordance with appropriate regulations. A soil composite cutting sample will be collected from the material in the drum. Samples from each drum will be analyzed for parameters required for disposal.

### 2.9.2 LIQUID WASTE

Decontamination water, purge water, and monitoring well development water generated during soil and groundwater sampling and monitoring well installation will be temporarily stored in 55-gallon drums. Disposal methods will be determined based on the analytical results for the soil and groundwater samples.

# 3.0 QUALITY ASSURANCE

The overall goal of the project quality assurance (QA) program is to provide a reasonable degree of confidence in project data and results through establishment of a rigorous system of quality and performance checks on data collection, analysis, and reporting activities, as well as to provide for appropriate and timely corrective action to achieve compliance with established performance and quality criteria.

This section presents data quality objectives (DQOs) and the quality control (QC) procedures developed to meet these DQOs, sample handling and chain-of-custody procedures, laboratory control samples, performance and system audits, corrective actions, and data validation.

## 3.1 DATA QUALITY OBJECTIVES

Results from the upland investigation activities will be used to document and evaluate current environmental conditions at the Site. The sample results must be precise, accurate, representative, complete, and comparable to a degree commensurate with this use.

The QA procedures presented are based on DQOs that were developed in accordance with Ecology guidelines (Ecology 2004).

The target control limits (the range within which project data of acceptable quality should fall) for data quality will be laboratory acceptance limits generated according to EPA guidelines (EPA 2005a). The target control limits will be used to evaluate data acceptability and are considered to be QC goals for data acceptance.

Completeness of the project will be calculated as the percentage of data generated that is accepted as valid through the data validation process.

Comparability is an expression of the confidence with which one data set can be compared to another. Statistical tests used to determine data precision, accuracy, and completeness are described in the following subsections. Statistical definitions for representativeness and comparability are also provided in the following subsections.

### 3.1.1 PRECISION

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. Precision is best expressed in terms of the standard deviation or relative percent difference (RPD). QA/QC sample types that test precision include field and laboratory duplicates and matrix or blank spike duplicates. The estimate of precision of duplicate measurements will be expressed as RPD, which is calculated:

$$RPD = \left| \frac{D_1 - D_2}{(D_1 + D_2)/2} \right| x\,100$$

where: $D_1$ = first sample value

$D_2$ = second sample value (duplicate).

The RPDs will be routinely calculated and compared with DQO control limits. RPD control limits for field duplicate samples will be 50 percent.

### 3.1.2 ACCURACY

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property) X, with an accepted reference or true value T, usually expressed as the difference between the two values (X–T), the difference as a percentage of the reference or true value (100 (X–T)/T), or as a ratio (X/T). Accuracy is a measure of the bias in a system and is expressed as the percent recovery of spiked (matrix or surrogate spike) samples:

$$Percent\ Recovery = \frac{(Spiked\ Sample\ Result - Unspiked\ Sample\ Result)}{Amount\ of\ Spike\ Added}\ x\,100$$

The percent recovery will be routinely calculated and checked against DQO control limits.

### 3.1.3 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Representativeness can be evaluated using replicate samples, additional sampling locations, and blanks.

### 3.1.4 COMPLETENESS

Completeness is a measure of the proportion of data obtained from a task sampling plan that is determined to be valid. It is calculated as the number of valid data points divided by the total number of data points requested. The QA objective for completeness during this project will be 95 percent. Completeness will be routinely determined and compared to the DQO acceptable percentage.

### 3.1.5 COMPARABILITY

Comparability is an expression of the confidence with which one data set can be compared to another. QA procedures in this document will provide for measurements that are consistent and representative of the media and conditions measured. All sampling procedures and analytical methods used for the investigation sampling activities will be consistent to provide comparability of results for samples and split samples.

## 3.2 FIELD AND LABORATORY QUALITY CONTROL SAMPLES

Field and laboratory control samples will used to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for the verification sampling. A summary of the QC samples is presented in the following subsections.

### 3.2.1 BLIND FIELD DUPLICATE

Blind field duplicate samples will be used to evaluate data precision for groundwater. Groundwater blind field duplicates will consist of split samples collected at a single sample location. Blind field duplicates of water will be collected by alternately filling sample containers for both the original and the corresponding duplicate sample at the same location to decrease variability between the duplicates. Due to its natural heterogeneity, soil duplicate samples rarely exhibit precision within EPA-specified limits. As a result, blind field duplicates will not be collected and analyzed for soil.

Duplicates will be submitted “blind” to the laboratory as discrete samples (i.e., given unique sample identifiers to keep the duplicate identity unknown to the laboratory), but will be clearly identified in the field log. Blind field duplicates will be collected at a frequency of one per 20 samples, not including QC samples, but not less than one duplicate per sampling event for groundwater, and will be analyzed for a suite of constituents equivalent to the associated original sample.

### 3.2.2 FIELD TRIP BLANKS

Field trip blanks will consist of de-ionized water sealed in a sample container by the analytical laboratory. The trip blank will accompany groundwater sample containers during transportation to and from the field, and then will be returned to the laboratory with each shipment of groundwater samples for VOC and TPH-G analysis. The trip blanks will remain unopened until submitted to the laboratory for analysis of VOCs and TPH-G to determine possible sample contamination during transport.

### 3.2.3 FIELD RINSATE BLANKS

Field rinsate blanks will consist of de-ionized water passed over decontaminated sampling equipment and transferred to sample containers for analysis at the laboratory. Field rinsate blanks are used to identify potential cross-contamination between the sampling equipment and the sample. Currently, groundwater sample collection will be conducted using disposable and/or dedicated equipment, thereby eliminating potential cross-contamination between samples via sampling equipment. As a result, collection of rinsate blanks is not currently planned. If non-dedicated equipment is used during groundwater sample collection, at least one field equipment blank will be collected for laboratory analysis.

### 3.2.4 LABORATORY METHOD BLANKS

One laboratory method blank will be analyzed for all parameters (except total solids) to assess possible laboratory contamination. Dilution water will be used whenever possible. Method blanks will contain all reagents used for analysis. The generation and analysis of additional method, reagent, and glassware blanks may be necessary to verify that laboratory procedures do not contaminate samples.

### 3.2.5 LABORATORY CONTROL SAMPLE

One laboratory control sample will be analyzed for all parameters except total solids.

### 3.2.6 SURROGATE SPIKES

Samples analyzed for organic constituents will be spiked with appropriate surrogate compounds as defined by the analytical methods.

### 3.2.7 LABORATORY MATRIX SPIKE

A minimum of 1 laboratory matrix spike per 20 samples, not including QC samples, or 1 matrix spike sample per batch of samples if fewer than 20 samples are obtained, will be analyzed for inorganic compounds for each matrix sampled. The matrix spikes will be performed using a project sample. These analyses will be performed to provide information on accuracy and to verify that extraction and concentration levels are acceptable. The laboratory spikes will follow EPA guidelines for matrix and blank spikes. Note that a matrix spike duplicate (MSD) will not be collected because the current federal guidance for Quality Assurance Project Plans developed by the EPA, the Department of Defense, and the Department of Energy indicates that the MSD is not an effective measurement of precision in environmental media and is not a useful data quality indicator (EPA 2005a).

### 3.2.8 LABORATORY DUPLICATE

A minimum of 1 laboratory duplicate per 20 samples, not including QC samples, or 1 laboratory duplicate sample per batch of samples if fewer than 20 samples are obtained, will be analyzed for lead. These analyses will be performed to provide information on the precision of the chemical analyses. The laboratory duplicate will follow the appropriate EPA guidance for the method.

## 3.3 CORRECTIVE ACTIONS

Corrective actions will be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in this SAP
- Equipment or analytical malfunctions.

Corrective action procedures to be implemented based on detection of unacceptable data are developed on a case-by-case basis. Such actions may include one or more of the following:

- Altering procedures in the field
- Using a different batch of sample containers
- Performing an audit of field or laboratory procedures
- Reanalyzing samples (if holding times allow)
- Resampling and analyzing
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies
- Accepting the data without action, acknowledging the level of uncertainty
- Rejecting the data as unusable.

During field operations and sampling activities, the field personnel will be responsible for conducting and reporting required corrective actions. A description of any action taken will be entered in the daily field notebook. The project manager will be consulted immediately if field conditions are such that conformance with this SAP is not possible. The field coordinator will consult with the Landau Associates project manager, who may authorize changes or exceptions to the QA/QC portion of this SAP, as necessary and appropriate.

During laboratory analysis, the laboratory QA officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet DQOs outlined in this SAP, corrective action will follow the guidelines in the noted EPA analytical methods and the EPA guidelines for data validation for organics and inorganics analyses (EPA 1999, 2004). At a minimum, the laboratory will be responsible for monitoring the following:

- Calibration check results must be within performance criteria specified in the EPA method or corrective action must be taken prior to initiation of sample analysis. No analyses may be performed until these criteria are met.
- Before processing any samples, the analyst should demonstrate (through analysis of a reagent blank) that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.
- Method blank results should, in general, be below instrument detection limits. If contaminants are present, then the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank

reanalyzed. If, upon reanalysis, blanks do not meet these requirements, Landau Associates will be notified immediately to discuss whether analyses may proceed.

- Surrogate spike analysis must be within the specified range for recovery limits for each analytical method used or corrective action must be taken and documented. Corrective action includes: 1) reviewing calculations, 2) checking surrogate solutions, 3) checking internal standards, and 4) checking instrument performance. Subsequent action could include recalculating the data and/or reanalyzing the sample if any of the above checks reveal a problem. If the problem is determined to be caused by matrix interference, reanalysis may be waived if so directed following consultation with Landau Associates. If the problem cannot be corrected through reanalysis, the laboratory will notify Landau Associates prior to data submittal so that additional corrective action can be taken, if appropriate.
- If the recovery of a surrogate compound in the method blank is outside the recovery limits, the blank will be reanalyzed along with all samples associated with that blank. If the surrogate recovery is still outside the limits, Landau Associates will be notified immediately to discuss whether analyses may proceed.
- If quantitation limits or matrix spike control limits cannot be met for a sample, Landau Associates will be notified immediately to discuss corrective action required.
- If holding times are exceeded, all positive and undetected results may need to be qualified as estimated concentrations. If holding times are grossly exceeded, Landau Associates may determine the data to be unusable.

If analytical conditions are such that nonconformance with this SAP is indicated, Landau Associates will be notified as soon as possible so that any additional corrective action can be taken. The laboratory project manager will then document the corrective action by a memorandum submitted to Landau Associates. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and any recalculation, reanalysis, or re-extractions will be submitted with the data package in the form of a cover letter.

## 3.4 DATA VERIFICATION AND VALIDATION

All RI data will be verified and validated to determine the results are acceptable and meet the DQOs described in Section 3.1. Prior to submitting a laboratory report, the laboratory will verify that all the data are consistent, correct, and complete, with no errors or omissions.

Validation of the data will be performed by Landau Associates following the guidelines in the appropriate sections of the EPA Contract Laboratory Program *National Functional Guidelines for Organic and Inorganic Data Review* (EPA 1999, 2004) and will include evaluations of the following:

- Chain-of-custody records
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates

- Blank spikes/laboratory control samples
- Laboratory duplicates
- Corrective action records
- Completeness
- Overall assessment of data quality.

In the event that a portion of the data is outside the DQO limits or the EPA guidance (EPA 1999, 2004, 2005b, 2009), or sample collection and/or documentation practices are deficient, corrective action(s) will be initiated. Corrective action, as described in Section 3.3, will be determined by the field coordinator and Landau Associates' QA officer in consultation with the Landau Associates project/task manager and may include any of the following:

- Rejection of the data and resampling
- Qualification of the data
- Modified field and/or laboratory procedures.

Data qualification arising from data validation activities will be described in the data validation technical memorandum, rather than in individual corrective action reports.

# 4.0 DATA MANAGEMENT PROCEDURES

All laboratory analytical results, including QC data, will be submitted electronically to Landau Associates. Electronic format will include comma-separated value (CSV) files that will be downloaded directly to an Excel spreadsheet. Following validation of the data, any qualifiers will be added to the Excel spreadsheets. All survey data will be provided electronically in a format that can be downloaded into an Excel spreadsheet. All field data (groundwater field parameter data and water levels measurements) will be entered into an Excel spreadsheet and verified to determine all entered data are correct and without omissions and errors. Following receipt of all RI data, all survey data, water level measurements, field parameters, and analytical results will be formatted electronically and downloaded to Ecology's Environmental Information Management (EIM) system.

# 5.0 REFERENCES

ASTM. 2009. *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).* D2488-09a. ASTM International.

Ecology. 2006. *Minimum Standards for Construction and Maintenance of Wells* (Chapter 173-160 WAC). Washington State Department of Ecology. November.

Ecology. 2004a. *Collecting and Preparing Soil Samples for VOC Analysis.* Implementation Memorandum #5. Washington State Department of Ecology. June 17.

Ecology. 2004b. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies.* Washington State Department of Ecology. July.

Ecology. 1997. *Analytical Methods for Petroleum Hydrocarbons.* Publication No. 97-602. Washington State Department of Ecology. June.

EPA. 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* Office of Solid Waste and Emergency Management, U.S. Environmental Protection Agency. Washington, D.C. January 13.

EPA. 2005a. *Uniform Federal Policy for Quality Assurance Project Plans – Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual*, Intergovernmental Data Quality Task Force EPA: EPA-505-B-04-900A, DoD: DTIC ADA 427785, Final Version 1. U.S. Environmental Protection Agency. March.

EPA. 2005b. *National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review.* Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency. Washington, D.C. September.

EPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-04-004. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency. Washington, D.C. October.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99/008. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Washington, D.C. October.

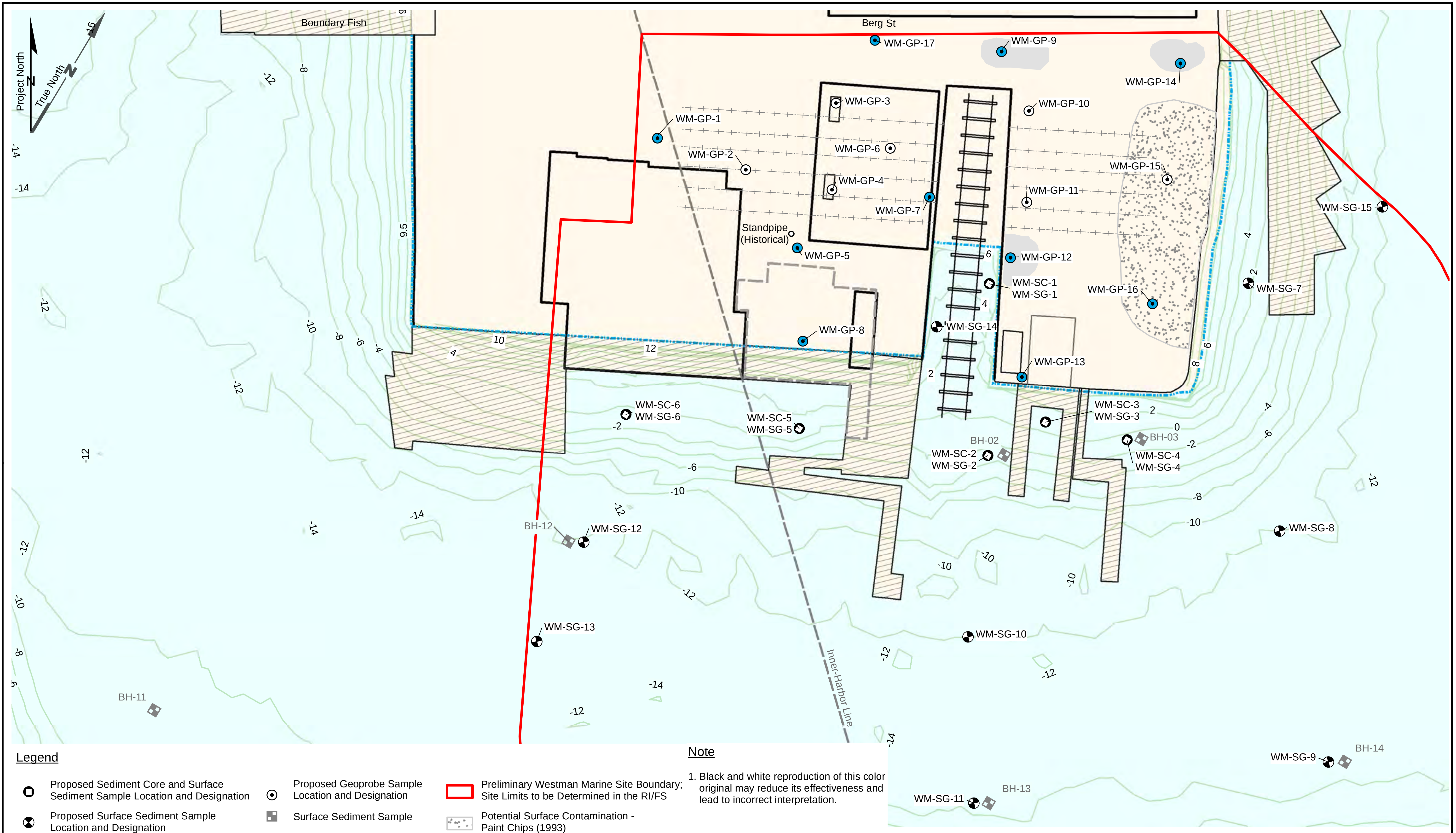
EPA. 1986. *Test Methods for Evaluating Solid Waste*. EPA/SW-846, Third Edition, with 2007 updates. U.S. Environmental Protection Agency.

Data Source: ESRI 2008

Y:\Projects\001035\010.014\RI-FS_Workplan\Sampling & Analysis\Figure_C-1.mxd

Landau Associates

| Westman Marine Site<br>Blaine Harbor<br>Blaine, Washington | **Vicinity Map** | Figure<br>C-1 |
|---|---|---|



## Legend

- ○ Proposed Sediment Core and Surface Sediment Sample Location and Designation
- ◑ Proposed Surface Sediment Sample Location and Designation
- ● Proposed Groundwater Grab Sample Location and Designation
- ⊙ Proposed Geoprobe Sample Location and Designation
- ▨ Surface Sediment Sample
- -+- Historical Track Location (1966)
- — Bathymetric Contours (MLLW)
- 🟥 Preliminary Westman Marine Site Boundary; Site Limits to be Determined in the RI/FS
- ⁘ Potential Surface Contamination - Paint Chips (1993)
- ▭ Potential Surface Contamination - Staining (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

**Proposed Investigation Sample Locations**

Figure
C-2

Landau Associates

Y:\Projects\001035\010\014\RI-FS_Workplan\Appendix_C_2_Proposed.mxd 8/13/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

# TABLE C-1
# SUMMARY OF REMEDIAL INVESTIGATION SOIL AND GROUNDWATER SAMPLE LOCATIONS
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| Location ID | Location Description | Rationale for Sample Collection | Surface Conditions | Soil Sampling Protocol Overview | Soil Analytical Testing | Groundwater Analytical Testing |
|---|---|---|---|---|---|---|
| | | | | | | |
| WM-GP-1 | Northwest corner of the Site; near western boundary of historical sidetracks; in parking lot north of Boundary Fish seafood processing facility. | Evaluate soil and groundwater conditions near historical boatyard activities and northwestern Site boundary. | Asphalt Pavement | Field screening for contamination will be conducted on soil cores from ground surface to 12 ft BGS (or deeper if contamination is suspected in deeper soils).<br>Soil samples will be collected for the full suite of analyses from the upper 4 ft of soil in 1-ft intervals. Samples will be homogenized using equal portions of soil from throughout the depth interval; samples for VOCs and TPH-G will be discrete samples from the most likely contaminated soil within the interval and will NOT be homogenized.<br>If pavement is present, the uppermost soil samples will be collected below the pavement and base course material.<br>**0 to 1 ft: Analyze**<br>1 to 2 ft: Archive<br>2 to 3 ft: Archive<br>3 to 4 ft: Archive<br>If field screening indicates potential contamination deeper in the exploration, a sample will be collected and analyzed for the full suite of analyses and a sample will be collected from 1 ft above and 1ft below this potential contamination and archived at the laboratory. | WM-GP-1: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-1: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-2 | Northwestern portion of the Site in parking lot near northeast corner of Boundary Fish seafood processing facility. | Evaluate soil conditions near area of historical boatyard activities. | Asphalt Pavement | | WM-GP-2: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | - |
| WM-GP-3<br>WM-GP-4<br>WP-GP-6 | Locations are distributed within the present shipyard area under the canopy that currently provides cover for operations. WM-GP-3 is near former paint storage; WM-GP-4 is near former fuel storage. | Evaluate soil conditions near area of historical and current boatyard activities. | Asphalt Pavement | | WM-GP-3: TPH-Dx, PAHs, metals<br>WM-GP-4: TPH-Dx, PAHs, metals<br>WM-GP-6: TPH-Dx, PAHs, metals, organotins<br>*(TPH-G and VOCs based on field screening)* | - |
| WM-GP-5 | Southwest of covered boatyard area, near location of historical standpipe shown on Figure 7. | Evaluate soil and groundwater conditions associated with boatyard activities. Investigate for COPCs downgradient of the standpipe identified in historical engineering drawings. | Asphalt Pavement | | WM-GP-5: TPH-Dx, PAHs, metals, organotins<br>*(TPH-G and VOCs based on field screening)* | WM-GP-5: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-7<br>WM-GP-8 | Along western edge of the marine railway, underneath the canopy (WM-GP-7) and in the former shop area (WM-GP-8). | Evaluate soil and groundwater conditions near former and and current boatyard activities. | Asphalt Pavement | | WM-GP-7: TPH-Dx, PAHs, metals<br>WM-GP-8: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-7: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals<br>WM-GP-8: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-9<br>WM-GP-10<br>WM-GP-11<br>WM-GP-12<br>WM-GP-13 | North of the marine railway and along its eastern edge. | Evaluate soil and groundwater conditions near area of historical and current boatyard activities in locations where surface staining may indicate release of COPCs to ground surface, near the solvent recycling shack, and near the stormwater treatment system. | Gravel | | WM-GP-9: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-10: TPH-Dx, PAHs, metals<br>WM-GP-11: TPH-Dx, PAHs, metals<br>WM-GP-12: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-13: TPH-Dx, PAHs, metals<br>*(TPH-G and VOCs based on field screening)* | WM-GP-9: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-12: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-13: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-14<br>WM-GP-15<br>WM-GP-16 | Eastern portion of the Site; in the DIY boat maintenance area where paint chips have been observed in surface soils (WM-GP-15 and WM-GP-16) and and in the northeast corner of the Site where waste containers were once stored (WM-GP-14). | Evaluate soil and groundwater conditions near area of historical and current shipyard activities. Potentially contaminated surface soil observed at these locations. | Gravel | | WM-GP-14: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>WM-GP-15: TPH-Dx, PAHs, metals<br>WM-GP-16: TPH-Dx, PAHs, metals, organotins<br>*(TPH-G and VOCs based on field screening)* | WM-GP-14: TPH-G, TPH-Dx, VOCs, SVOCs, PAHs, dissolved metals<br>WM-GP-16: TPH-G, TPH-Dx, VOCs, PAHs, dissolved metals |
| WM-GP-17 | Northern portion of the Site; presumably away from impacts related to Site activities | Background sample; evaluate fill quality in a location unimpacted by previous Site activites | Asphalt Pavement | | WM-GP-17: TPH-Dx, SVOCs, PAHs, metals, PCBs<br>*(TPH-G and VOCs based on field screening)* | WM-GP-17: TPH-G, TPH-Dx, SVOCs, PAHs, dissolved metals |

# TABLE C-1
## SUMMARY OF REMEDIAL INVESTIGATION SOIL AND GROUNDWATER SAMPLE LOCATIONS
## WESTMAN MARINE SITE – BLAINE, WASHINGTON

Note:

Soil samples collected for TPH-G or VOC analyses will be collected discretely (not a composite) by EPA Method 5035 from unhomogenized soil.

BGS = Below Ground Surface
Metals = Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Zinc
PAHs = Polycyclic Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
SVOCs = Semivolatile Organic Compounds
TPH-Dx = Total Petroleum Hydrocarbons - Diesel and motor-oil range
TPH-G = Total Petroleum Hydrocarbons - Gasoline Range
VOCs = Volatile Organic Compounds

# TABLE C-2
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
# UPLAND INVESTIGATION – BLAINE MARINA INC. SITE
# BLAINE, WASHINGTON

| Matrix / Analysis | Analytical Method | Container | Preservation | Maximum Holding Time (Days) |
|---|---|---|---|---|
| **Soil:** | | | | |
| TPH-D and TPH-O | NWTPH-Dx (a) | 8-oz. jar - glass | Store cool at 4°C | 14 |
| TPH-G | NWTPH-G | 2 x 40-ml vial - glass<br>1 x 2-oz jar - glass | Methanol (2 vials)<br>Store at <6°C | 14 |
| VOCs | EPA 8260C | 4 x 40-ml vial - glass<br>1 x 2-oz jar - glass | Sodium Bisulfate (2 vials)<br>Methanol (2 vials)<br>Store at <6°C | 14 |
| Metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) | EPA 6020 / EPA 7471B for Mercury | 8-oz. jar - glass | Store cool at 4°C | 180<br>(mercury 28 days) |
| SVOCs | EPA 8270D | 8-oz. jar - glass | Store cool at 4°C | 14 |
| PAHs | EPA 8270D SIM | 8-oz. jar - glass | Store cool at 4°C | 14 |
| PCBs | EPA 8082 | 8-oz. jar - glass (b) | Store cool at 4°C | 14 |
| Organotins | EPA 8270D SIM | 4-oz. jar - glass | Store cool at 4°C | 14 |
| **Water:** | | | | |
| TPH-D and TPH-O | NWTPH-Dx (a) | 2 x 500-mL amber glass | Store cool at 4°C | 7 |
| TPH-G | NWTPH-Gx | 2 x 40-ml vials - glass | HCl to pH<2;<br>Store cool at 4°C | 14 |
| VOCs | EPA 8260C | 3 x 40-ml vials - glass | HCl to pH<2;<br>Store cool at 4°C | 14 |
| Dissolved Metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc) | EPA 6020 | 1-L polyethylene | $HN0_3$;<br>Store cool at 4°C | 180<br>(mercury 28 days) |
| SVOCs | EPA 8270/D | 2 x 500-mL amber glass | Store cool at 4°C | 7 |
| PAHs | EPA 8270D SIM | 2 x 500-mL amber glass | Store cool at 4°C | 7 |

# TABLE C-2
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
# UPLAND INVESTIGATION – BLAINE MARINA INC. SITE
# BLAINE, WASHINGTON

Notes:

(a) Laboratory sample preparation / Cleanup method: Acid / Silica gel cleanup.
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
EDB = Ethylene dibromide (gasoline fuel additive)
EDC = Ethylene dichloride (gasoline fuel additive)
EPA = Environmental Protection Agency
MTBE = Methyl tert-butyl ether (gasoline fuel additive)
NWTPH - Northwest Total Petroleum Hydrocarbons (Test Method)
oz = Ounce
PAHS = Polycyclic Aromatic Hydrocarbons
SIM = Selective Ion Monitoring
SVOCs = Semivolatile Organic Compounds
TPH-D = Total Petroleum Hydrocarbons - Diesel Range
TPH-O = Total Petroleum Hydrocarbons - Oil Range
VOCs = Volatile Organic Compounds

# TABLE C-3
# QUANTITATION LIMIT GOALS - SOIL INVESTIGATION
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | Soil Screening Level (Saturated Soil) (mg/kg) | Quantitation Limit Goals (mg/kg) |
|---|---|---|
| ***Total Petroleum Hydrocarbons*** | | |
| Gasoline Range Hydrocarbons (with benzene) | 30 | 5 |
| Gasoline Range Hydrocarbons (without benzene) | 100 | 5 |
| Diesel Range Hydrocarbons | 2,000 | 25 |
| Oil Range Hydrocarbons | 2,000 | 100 |
| ***Metals*** | | |
| Arsenic | 7 | 0.5 |
| Cadmium | 80 | 0.1 |
| Chromium (Total) | 2,000 | 0.5 |
| Copper | 36 | 0.2 |
| Lead | 81 | 0.1 |
| Mercury | 0.07 | 0.025 |
| Zinc | 5 | 1 |
| ***Volatile Organic Compounds*** | | |
| 1,1,1,2-Tetrachloroethane | 38 | 0.005 |
| 1,1,1-Trichloroethane | 400 | 0.005 |
| 1,1,2 - Trichlorotrifluoroethane | 2,400,000 | 0.005 |
| 1,1,2,2-Tetrachloroethane | 0.0015 | 0.005 |
| 1,1,2-Trichloroethane | 0.0058 | 0.005 |
| 1,1-Dichloroethane | 16,000 | 0.005 |
| 1,1-Dichloroethene | 0.005 | 0.005 |
| 1,2,3-Trichloropropane | 0.033 | 0.005 |
| 1,2,4-Trichlorobenzene | 0.01 | 0.01 |
| 1,2-Dibromo-3-chloropropane | 1.3 | 0.02 |
| 1,2-Dibromoethane (EDB) | 0.02 | 0.02 |
| 1,2-Dichlorobenzene | 0.005 | 0.005 |
| 1,2-Dichloroethane (EDC) | 0.012 | 0.005 |
| 1,2-Dichloropropane | 0.005 | 0.005 |
| 1,3,5-Trimethylbenzene | 800 | 0.02 |
| 1,4-Dichlorobenzene | 0.005 | 0.005 |
| 2-Butanone | 48,000 | 0.02 |
| 2-Chlorotoluene | 1,600 | 0.02 |
| 4-Methyl-2-pentanone | 6,400 | 0.02 |
| Acetone | 72,000 | 0.02 |
| Acrolein | 40 | 0.1 |
| Acrylonitrile | 1.9 | 0.02 |
| Benzene | 0.008 | 0.005 |
| Bromodichloromethane | 0.005 | 0.005 |
| Bromoform | 0.058 | 0.005 |
| Bromomethane | 0.29 | 0.005 |
| Carbon disulfide | 8,000 | 0.005 |
| Carbon tetrachloride | 0.005 | 0.005 |
| Chlorobenzene | 0.051 | 0.005 |
| Chloroform | 0.16 | 0.005 |
| cis-1,2-Dichloroethene (DCE) | 160 | 0.005 |
| Dibromochloromethane | 0.005 | 0.005 |
| Dibromomethane | 800 | 0.005 |
| Dichlorodifluoromethane | 16,000 | 0.005 |
| Ethylbenzene | 1 | 0.005 |
| Hexachlorobutadiene | 0.011 | 0.01 |

# TABLE C-3
# QUANTITATION LIMIT GOALS - SOIL INVESTIGATION
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | Soil Screening Level (Saturated Soil) (mg/kg) | Quantitation Limit Goals (mg/kg) |
|---|---|---|
| Isopropylbenzene | 8,000 | 0.02 |
| Methylene chloride | 0.18 | 0.01 |
| n-Propylbenzene | 8,000 | 0.02 |
| o-Xylene | 16,000 | 0.005 |
| Styrene | 16,000 | 0.005 |
| Tetrachloroethene (PCE) | 0.005 | 0.005 |
| Toluene | 6.4 | 0.005 |
| trans-1,2-Dichloroethene | 3.2 | 0.005 |
| Trichloroethene (TCE) | 0.005 | 0.005 |
| Trichlorofluoromethane | 24,000 | 0.005 |
| Vinyl acetate | 80,000 | 0.02 |
| Vinyl chloride | 0.005 | 0.005 |
| Xylenes (total) | 16,000 | 0.02 |
| Naphthalene | 0.12 | 0.001 |
| ***Polycyclic Aromatic Hydrocarbons*** | | |
| Acenaphthene | 0.017 | 0.005 |
| Anthracene | 0.22 | 0.005 |
| Fluoranthene | 0.16 | 0.005 |
| Fluorene | 0.024 | 0.005 |
| Pyrene | 1 | 0.005 |
| 1-Methylnaphthalene | 35 | 0.005 |
| 2-Methylnaphthalene | 320 | 0.005 |
| Naphthalene | 0.12 | 0.005 |
| Benz(a)anthracene | 0.0065 | 0.005 |
| Benzo(a)pyrene | 0.017 | 0.005 |
| Benzo(b)fluoranthene | 0.022 | 0.005 |
| Benzo(k)fluoranthene | 0.022 | 0.005 |
| Chrysene | 0.0072 | 0.005 |
| Dibenzo(a,h)anthracene | 0.018 | 0.005 |
| Indeno(1,2,3-cd)pyrene | 0.035 | 0.005 |
| Total cPAHs TEQ | 0.14 | 0.00076 |
| ***Other Semivolatile Organic Compounds*** | | |
| 1,2,4-Trichlorobenzene | 0.02 | 0.02 |
| 1,2-Dichlorobenzene | 0.02 | 0.02 |
| 1,4-Dichlorobenzene | 0.02 | 0.02 |
| 2,3,4,6-Tetrachlorophenol | 2,400 | 0.02 |
| 2,4,5-Trichlorophenol | 6.8 | 0.1 |
| 2,4,6-Trichlorophenol | 0.1 | 0.1 |
| 2,4-Dichlorophenol | 0.1 | 0.1 |
| 2,4-Dimethylphenol | 0.27 | 0.05 |
| 2,4-Dinitrophenol | 1 | 0.2 |
| 2-Chloronaphthalene | 6,400 | 0.02 |
| 2-Chlorophenol | 0.066 | 0.02 |
| 2-Methylphenol | 4,000 | 0.02 |
| 2-Nitroaniline | 800 | 0.1 |
| 3,3'-Dichlorobenzidine | 0.1 | 0.1 |
| 4-Chloroaniline | 5 | 0 |
| 4-Methylphenol | 400 | 0.02 |
| Aniline | 180 | 0.1 |
| Azobenzene | 9.1 | 0.1 |

# TABLE C-3
# QUANTITATION LIMIT GOALS - SOIL INVESTIGATION
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | Soil Screening Level (Saturated Soil) (mg/kg) | Quantitation Limit Goals (mg/kg) |
|---|---|---|
| Benzoic acid | 320,000 | 0.2 |
| Benzyl alcohol | 8,000 | 0.1 |
| Benzyl butyl phthalate | 0.02 | 0.02 |
| Bis(2-chloro-1-methylethyl) ether | 14 | 0.1 |
| Bis(2-chloroethyl) ether | 0.02 | 0.02 |
| Bis(2-ethylhexyl) phthalate | 0.33 | 0.1 |
| Dibenzofuran | 80 | 0.02 |
| Diethyl phthalate | 0.27 | 0.02 |
| Di-n-butyl phthalate | 0.26 | 0.02 |
| Di-n-octyl phthalate | 83 | 0.02 |
| Hexachlorobenzene | 0.08 | 0.02 |
| Hexachlorobutadiene | 0.02 | 0.02 |
| Hexachlorocyclopentadiene | 220 | 0.1 |
| Hexachloroethane | 0.02 | 0.02 |
| Isophorone | 0.2 | 0.02 |
| m,p-Cresol (2:1 ratio) | 4,000 | 0.02 |
| Nitrobenzene | 0.28 | 0.02 |
| N-Nitroso-di-n-propylamine | 0.02 | 0.02 |
| N-Nitrosodiethanolamine | 0.36 | 0.1 |
| N-Nitrosodimethylamine | 0.1 | 0.1 |
| N-Nitrosodiphenylamine | 0.02 | 0.02 |
| Pentachlorophenol | 0.1 | 0.1 |
| Phenol | 180 | 0.03 |
| 2,4-Dinitrotoluene | 0.1 | 0.1 |
| 2,6-Dinitrotoluene | 80 | 0.1 |
| ***Polychlorinated Biphenyls (PCBs)*** | | |
| Aroclor 1016 | 0.033 | 0.033 |
| Aroclor 1254 | 0.5 | 0.033 |
| Aroclor 1260 | 0.033 | 0.033 |
| Total PCBs | 0.05 | 0.05 |
| ***Organotins*** | | |
| TBT | - | 0.00386 |

Notes:

mg/kg = Milligrams per kilogram

Screening levels are more stringent for saturated than unsaturated soil. As a result, quantitation limit goals are established to the most stringent (lower detection limit) requirement.

# TABLE C-4
# QUANTITATION LIMIT GOALS - GROUNDWATER
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | Groundwater Screening Level (µg/L) | Quantitation Limit Goals (µg/L) |
|---|---|---|
| ***Total Petroleum Hydrocarbons*** | | |
| Gasoline Range Hydrocarbons (with benzene) | 800 | 250 |
| Gasoline Range Hydrocarbons (without benzene) | 1,000 | 250 |
| Diesel Range Hydrocarbons | 500 | 250 |
| Oil Range Hydrocarbons | 500 | 500 |
| ***Metals*** | | |
| Arsenic | 0.5 | 0.5 |
| Cadmium | 8.8 | 0.1 |
| Chromium (Total) | 50 | 0.5 |
| Copper | 2.4 | 0.5 |
| Lead | 8.1 | 0.1 |
| Mercury | 0.15 | 0.001 |
| Zinc | 81 | 4 |
| ***Volatile Organic Compounds*** | | |
| 1,1,1-Trichloroethane | 930,000 | 1 |
| 1,1,2,2-Tetrachloroethane | 4 | 0.5 |
| 1,1,2-Trichloroethane | 16 | 0.5 |
| 1,1-Dichloroethene | 3.2 | 0.5 |
| 1,2,4-Trichlorobenzene | 0.48 | 0.2 |
| 1,2-Dibromoethane (EDB) | 2 | 2 |
| 1,2-Dichlorobenzene | 6.1 | 0.2 |
| 1,2-Dichloroethane (EDC) | 37 | 0.5 |
| 1,2-Dichloropropane | 15 | 0.5 |
| 1,3-Dichlorobenzene | 960 | 0.2 |
| 1,4-Dichlorobenzene | 5 | 0.2 |
| Acrolein | 20 | 20 |
| Acrylonitrile | 5 | 5 |
| Benzene | 23 | 0.5 |
| bis(2-chloroisopropyl)ether | 65,000 | 2 |
| Bromodichloromethane | 0.5 | 0.5 |
| Bromoform | 140 | 0.5 |
| Bromomethane | 970 | 0.5 |
| Carbon tetrachloride | 0.5 | 0.5 |
| Chlorobenzene | 100 | 0.5 |
| Chloroform | 470 | 0.5 |
| Dibromochloromethane | 0.5 | 0.5 |
| Ethylbenzene | 2,100 | 1 |
| Hexachlorobutadiene | 0.2 | 0.2 |
| Methylene chloride | 590 | 2 |
| Tetrachloroethene (PCE) | 0.5 | 0.5 |
| Toluene | 15,000 | 1 |
| trans-1,2-Dichloroethene | 10,000 | 1 |
| Trichloroethene (TCE) | 0.5 | 0.5 |
| Vinyl chloride | 0.5 | 0.5 |
| Naphthalene | 83 | 0.2 |
| ***Polycyclic Aromatic Hydrocarbons*** | | |
| Acenaphthene | 3.3 | 0.01 |
| Anthracene | 9.6 | 0.01 |
| Fluoranthene | 3.3 | 0.01 |
| Fluorene | 3 | 0.01 |
| Pyrene | 15 | 0.01 |

# TABLE C-4
# QUANTITATION LIMIT GOALS - GROUNDWATER
# WESTMAN MARINE SITE – BLAINE, WASHINGTON

| | Groundwater Screening Level (µg/L) | Quantitation Limit Goals (µg/L) |
|---|---|---|
| Naphthalene | 83 | 0.01 |
| Benz(a)anthracene | 0.018 | 0.01 |
| Benzo(a)pyrene | 0.018 | 0.01 |
| Benzo(b)fluoranthene | 0.018 | 0.01 |
| Benzo(k)fluoranthene | 0.018 | 0.01 |
| Chrysene | 0.018 | 0.01 |
| Dibenzo(a,h)anthracene | 0.01 | 0.01 |
| Indeno(1,2,3-cd)pyrene | 0.01 | 0.01 |
| Total cPAHs TEQ | 0.018 | 0.0051 |
| ***Other Semivolatile Organic Compounds*** | | |
| 1,2,4-Trichlorobenzene | 1 | 1 |
| 1,2-Dichlorobenzene | 6.1 | 1 |
| 1,3-Dichlorobenzene | 960 | 1 |
| 1,4-Dichlorobenzene | 5 | 1 |
| 2,4,5-Trichlorophenol | 3,600 | 5 |
| 2,4,6-Trichlorophenol | 3 | 3 |
| 2,4-Dichlorophenol | 190 | 3 |
| 2,4-Dimethylphenol | 550 | 4 |
| 2,4-Dinitrophenol | 3,500 | 20 |
| 2-Chloronaphthalene | 1,000 | 1 |
| 2-Chlorophenol | 97 | 1 |
| 3,3'-Dichlorobenzidine | 5 | 5 |
| Benzyl butyl phthalate | 1 | 1 |
| Bis(2-chloro-1-methylethyl) ether | 37 | 1 |
| Bis(2-chloroethyl) ether | 1 | 1 |
| Bis(2-ethylhexyl) phthalate | 3 | 3 |
| Diethyl phthalate | 740 | 1 |
| Dimethyl phthalate | 1,100,000 | 1 |
| Di-n-butyl phthalate | 140 | 1 |
| Di-n-octyl phthalate | 1 | 1 |
| Hexachlorobenzene | 1 | 1 |
| Hexachlorobutadiene | 3 | 3 |
| Hexachlorocyclopentadiene | 1,100 | 5 |
| Hexachloroethane | 3.3 | 2 |
| Isophorone | 600 | 1 |
| Nitrobenzene | 690 | 1 |
| N-Nitroso-di-n-propylamine | 1 | 1 |
| N-Nitrosodimethylamine | 3 | 3 |
| N-Nitrosodiphenylamine | 6 | 1 |
| Pentachlorophenol | 10 | 10 |
| Phenol | 560,000 | 1 |
| 2,4-Dinitrotoluene | 3.4 | 1 |

Notes:

µg/L = Micrograms per liter

APPENDIX D

# Marine Sediment Sampling and Analysis Plan

# Marine Sediment Sampling and Analysis Plan
# Westman Marine Site
# Blaine, Washington

August 21, 2013

Prepared for

**Port of Bellingham**
**Bellingham, Washington**

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA  98020
(425) 778-0907

# TABLE OF CONTENTS

Page

1.0 INTRODUCTION AND BACKGROUND 1-1
  1.1 SITE DESCRIPTION 1-1
  1.2 SITE HISTORY AND OPERATIONS 1-1
  1.3 EXISTING SEDIMENT QUALITY DATA 1-2
  1.4 SEDIMENT QUALITY DATA GAPS 1-3

2.0 OBJECTIVE AND DESIGN OF SEDIMENT INVESTIGATION 2-1
  2.1 OBJECTIVE 2-1
  2.2 OVERALL SAMPLING DESIGN 2-1

3.0 FIELD INVESTIGATION METHODOLOGY 3-1
  3.1 INVESTIGATION PHASING 3-1
  3.2 STATION POSITIONING METHODS 3-1
  3.3 SURFACE SEDIMENT SAMPLE COLLECTION 3-2
  3.4 SUBSURFACE SEDIMENT SAMPLE COLLECTION 3-3
    3.4.1 Core Processing 3-3
  3.5 DECONTAMINATION 3-4
  3.6 SAMPLE DOCUMENTATION AND HANDLING 3-5
    3.6.1 Sample Identification 3-6
    3.6.2 Sample Container Labels 3-6
    3.6.3 Sample Containers, Preservation, and Storage 3-6
    3.6.4 Sample Custody 3-6
  3.7 MANAGEMENT OF RESIDUAL WASTES 3-7

4.0 SEDIMENT TESTING 4-1

5.0 QUALITY ASSURANCE AND QUALITY CONTROL 5-1
  5.1 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL FOR CHEMICAL AND PHYSICAL ANALYSES 5-1
  5.2 FIELD AND LABORATORY QUALITY CONTROL SAMPLES FOR CHEMICAL ANALYSES 5-1
    5.2.1 Blind Field Duplicate 5-1
    5.2.2 Laboratory Matrix Spike 5-2
    5.2.3 Laboratory Matrix Spike Duplicate 5-2
    5.2.4 Laboratory Duplicates 5-2
    5.2.5 Laboratory Method Blanks 5-2
    5.2.6 Laboratory Control Sample 5-2
    5.2.7 Surrogate Spikes 5-2
  5.3 DATA QUALITY EVALUATION 5-2
  5.4 REPORTING 5-3
    5.4.1 Laboratory Reports 5-3
  5.5 DATA MANAGEMENT PROCEDURES 5-4

6.0 HEALTH AND SAFETY 6-1

7.0 REFERENCES 7-1

## FIGURES

| Figure | Title |
|---|---|
| D-1 | Vicinity Map |
| D-2 | Proposed Sediment Investigation Sampling Locations |

## TABLES

| Table | Title |
|---|---|
| D-1 | Proposed Sediment Sample Locations and Designations |
| D-2 | Analytical Methods, Sample Containers, and Holding Times |
| D-3 | Quantitation Limit Goals |
| D-4 | Quality Control Procedures for Organic Analyses |
| D-5 | Quality Control Procedures for Metals Analyses |
| D-6 | Quality Control Procedures for Conventional Analyses |

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| cm | Centimeter |
| CSL | Cleanup Screening Level |
| DGPS | Differential Global Positioning Device |
| DMMP | Dredged Material Management Program |
| DNR | Washington State Department of Natural Resources |
| Ecology | Washington State Department of Ecology |
| EIM | Environmental Information Management |
| EPA | U.S. Environmental Protection Agency |
| HASP | Health and Safety Plan |
| MLLW | Mean Lower Low Water |
| NAD83 | North American Datum of 1983 |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| Port | Port of Bellingham |
| PSDDA | Puget Sound Dredge Disposal Analysis program |
| PSEP | Puget Sound Estuary Program |
| QA | Quality Assurance |
| QC | Quality Control |
| RI | Remedial Investigation |
| SAP | Sampling and Analysis Plan |
| SAPA | Sampling and Analysis Plan Appendix |
| Site | Westman Marine Site |
| SMS | Sediment Management Standard |
| SQS | Sediment Quality Standard |
| SVOC | Semivolatile Organic Compound |
| TBT | Tributyltin |
| TEC | The Environmental Company |
| TOC | Total Organic Carbon |
| WAC | Washington Administrative Code |

This page intentionally left blank.

# 1.0 INTRODUCTION AND BACKGROUND

This sampling and analysis plan (SAP) describes the sample collection, handling, and laboratory analysis procedures for marine sediment characterization being conducted as part of the remedial investigation (RI) for the Westman Marine Site (Site) in Blaine, Washington (Figure D-1). This SAP is an appendix to the Westman Marine Site RI Work Plan, one of the required deliverables under the Agreed Order (No. DE 9001), between the Port of Bellingham (Port) and the Washington State Department of Ecology (Ecology). The primary objective of this plan is to provide sampling, sample handling, and analytical testing methodologies consistent with accepted procedures so that the data collected will be adequate for use in characterizing Site sediment conditions. This SAP is consistent with the requirements of Washington Administrative Code (WAC) 173-340-820, the Sediment Management Standards (SMS; WAC 173-204; Ecology 1995), and the Sediment Sampling and Analysis Plan Appendix (SAPA; Ecology 2008). It provides field, sampling, and analytical procedures to be used during the RI.

## 1.1 SITE DESCRIPTION

The Site is located in Blaine, Washington within Blaine Harbor. Blaine Harbor is at the north end of Drayton Harbor, in the Willamette Meridian northwest quarter of Section 1, Township 40 North, Range 1 West. The Site encompasses property that is owned by the Port and the Washington Department of Natural Resources (DNR). The Site is a part of a larger area referred to as the Blaine Harbor Industrial Area that supports the local marine industry. The Port-owned portion of the property is upland of the inner harbor line, and the DNR-owned portion of the property is on the shoreward side of the inner harbor line.

Westman Marine leased approximately 1.5 acres of upland property at 218 McMillan Avenue from the Port from 1989 until January 2011. Westman Marine and previous tenants have conducted boatyard activities at this location that may have resulted in the release of hazardous substances to soil, groundwater and/or marine sediment. The extent of these releases and the media that have been affected will be determined in the RI and will define the Site boundary.

## 1.2 SITE HISTORY 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 also aerial photographs taken between 1949 and 2011, which are provided in Appendix A of the RI Work Plan.

Blaine Harbor was originally created in the late 1930s by dredging 2 acres of tideflats to create a small boat harbor. An access road was constructed and adjacent tidelands were filled to create uplands and provide shore support for the area. In the late 1940s, 4 additional acres were dredged, additional tidelands were filled, and a breakwater, bulkheads, floats, and ramps were constructed. The upland area created at the Site generally consists of hydraulic fill with timber bulkheads along the shoreline. In some areas, riprap was used instead of, or in conjunction with, the bulkheads to establish the shoreline. An additional 15-acre area of tideflats was dredged and an extension of the breakwater was completed in the mid-1950s (TEC 2001). The harbor and industrial area 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 and the footprint of the upland industrial area has remained largely unchanged since the late 1940's. In 2001, the Port completed an expansion project at Blaine Harbor that included dredging approximately 15 acres of tideflat, enlarging the moorage basin, and adding more than 300 slips.

Business activity has historically been focused in the area along the western end of Blaine Harbor referred to herein as the Blaine Harbor Industrial Area, which comprises all of the upland area shown on Figure D-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 D-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).

## 1.3 EXISTING SEDIMENT QUALITY DATA

Landau Associates conducted a sediment quality investigation in Blaine Harbor on behalf of the Port in 2001 (Landau Associates 2002). The purpose of the investigation was to evaluate compliance with the Washington State Sediment Management Standards (SMS) for surface sediment within Blaine Harbor that may have been affected by harbor activities. The investigation evaluated sediment quality throughout much of Blaine Harbor, including the vicinity of the Westman Marine leasehold. The following discussion is focused on the samples collected in the vicinity of the Westman Marine uplands that are considered relevant to Site sediment quality.

Surface sediment samples BH-02, BH-03, and BH-12 through BH-14, were collected in close proximity to the upland portion of the Site during the 2001 sediment quality investigation. The locations of these samples are shown on Figure D-2. Samples were analyzed for metals, PCBs, PAHs, SVOCs, organotins, and conventional sediment parameters. The analytical results are summarized in Table 1 of the RI. The analytical results were compared to the SMS Sediment Quality Standards (SQS) for those constituents for which SQS criteria area available. SQS criteria are not available for organotins, so the Puget Sound Dredge Disposal Analysis program (PSDDA) screening level of 73 micrograms per kilogram (μg/kg) for bulk tributyltin (TBT) as the TBT ion was used for screening purposes. PSDDA, now administered by the Dredged Material Management Program (DMMP), also promulgated TBT criteria comparable to the SQS based on analysis of sediment pore water, but pore water samples were not collected for the 2001 investigation. As indicated in the table, samples collected from locations BH-02, BH-03, BH-12, BH-13, and BH-14 exceeded the sediment screening level for bulk TBT.

The detected concentration of copper [estimated at 521 milligrams per kilogram (mg/kg)] in the surface sediment sample collected from BH-02, the sample location closest to the marine railway and travel lift piers, exceeded the Sediment Quality Standard (SQS) and the Cleanup Screening Level (CSL; 390 mg/kg) established in the Sediment Management Standards (WAC 173-204).

To support this investigation, The Environmental Company (TEC) prepared an uplands source assessment report (TEC 2001). Based on this report and the results of the investigation, SMS and TBT screening level exceedances were attributed to marine vessel repair activities that have been performed at the Site since the 1950s. TBT and copper are common constituents of marine bottom paints and were thought to have been released to sediments from sand blasting and hull painting activities. TBT and copper concentrations were highest in sediment near the marine railway well.

## 1.4 SEDIMENT QUALITY DATA GAPS

The current environmental condition of marine sediment the Site is not clear. Based on the preliminary understanding of Site conditions and potential contaminant sources as described in the RI Work Plan, the potential pathways for contaminant migration to marine sediment at the Site include the transport of contaminants in soil to marine sediment via stormwater runoff, the transport of contaminants in groundwater to adjacent marine sediment, and the 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.

As noted above, surface sediment samples collected from locations BH-02, BH-03, BH-12, BH-13, and BH-14 exceeded the sediment screening level used for bulk TBT, and the surface sediment sample collected from location BH-02 exceeded the screening level for copper. These surface sediment samples were collected 12 years ago, and current surface sediment quality is unknown. The primary sediment quality data gap identified for marine sediment at the Site is the nature and extent of sediment contamination.

## 2.0 OBJECTIVE AND DESIGN OF SEDIMENT INVESTIGATION

This section describes the objective of the sediment investigation and the sampling approach for achieving the objective.

### 2.1 OBJECTIVE

The objective of the sediment investigation is to determine if previous Site activities have impacted sediment quality to an extent that may pose a threat to human health or adversely affect biological resources.

### 2.2 OVERALL SAMPLING DESIGN

As discussed in Section 1.4, there is a potential for contaminants to have migrated from the uplands portion of the Site to sediment via stormwater runoff, groundwater transport, or by the direct release of contaminants to sediment from boat maintenance activities. Based on these considerations, the proposed sediment investigation is designed to determine the lateral and vertical extent of contamination in marine sediment. The proposed sediment investigation will include both sediment surface samples and sediment core samples. For the reasons explained in Section 3.1, the sediment investigation will be phased to collect surface sediment samples first, followed by sediment core samples.

The investigation will be conducted in aquatic areas near the shoreline and up to approximately 200 ft from the shoreline. Fifteen marine sediment sampling locations are proposed for the RI: six core locations and nine surface sediment locations. Surface sediment samples will be collected at each core location. Each sediment sample collected will undergo analysis for SMS chemicals listed in WAC 173-204-400, as described in Section 4.0. Proposed marine sediment sampling locations are shown on Figure D-2.

# 3.0 FIELD INVESTIGATION METHODOLOGY

This section presents the field sampling methods to be used by Landau Associates and its subcontractors for the sediment investigation and collection of a marine surface water sample. In general, field and sample processing methods will follow WAC 173-340-820, WAC 173-204-600, SAPA (Ecology 2008), and Puget Sound Estuary Program (PSEP) guidelines for marine sediments and surface waters (PSEP 1997a,b,c, 1998).

## 3.1 INVESTIGATION PHASING

The sediment investigation will be phased to evaluate whether a good statistical correlation can be developed between TBT porewater and bulk concentrations. TBT porewater screening levels are considered more representative of impacts to aquatic organisms than bulk criteria, so TBT porewater-based criteria are preferred over bulk TBT criteria. However, a large volume of sediment, three to four sediment cores, is required to obtain sufficient porewater for TBT porewater analysis, so testing sediment cores for TBT porewater significantly increases the RI sediment characterization costs. As a result, it is more cost-effective to develop a bulk TBT screening level based on the TBT porewater criteria using bulk/porewater data from surface sediment testing (where large volumes of sediment are easier to obtain), and then limiting sediment core testing to bulk TBT analysis. Based on correlations developed for similar sites, a linear regression analysis may provide an acceptable correlation between bulk and porewater TBT concentrations.

In order to evaluate whether TBT bulk concentrations correlate well to TBT porewater concentrations, the sediment investigation will be phased to conduct the marine surface sediment investigation first. Marine sediment surface samples will be analyzed for both porewater and bulk organotins and the results will be evaluated to determine whether an acceptable correlation exists between bulk and porewater TBT concentrations. The Port will prepare a technical memorandum for Ecology's review and concurrence, along with a recommendation for proceeding with the second phase of the marine sediment investigation. If an acceptable bulk/porewater correlation exists, marine sediment core samples will be analyzed only for bulk organotins. If an acceptable correlation does not exist, sufficient sediment cores will be collected to test core samples for TBT porewater, which will likely require three to four cores from each sampling location.

## 3.2 STATION POSITIONING METHODS

The objective of the station positioning is to accurately establish and record the positions of all sampling locations within ±2 meters (6.56 feet). The northings and eastings of the proposed sediment sampling station locations in State Plane Coordinates are provided in Table D-1. Station locations will be surveyed in the field using a Trimble NT300D differential global positioning system (DGPS) or equivalent DGPS with the use of a known survey control point. Sampling station coordinates will be reported relative to the North American Datum of 1983 (NAD83). Planned sampling location coordinates will be entered into the sampling vessel's onboard GPS unit. Riprap located along the shoreline may influence the selection of the final sampling locations and could result in difficulty with sample recovery. Sediment sampling locations may require modification in the field if riprap is encountered.

Vertical position control at each location will be evaluated by using a lead line (or weighted tape) to measure from the water surface to the sediment surface. The elevation of the mudline at each location will be calculated by measuring depth of water at each location and subtracting it from the tide elevation. Mudline elevations will be recorded based on the mean lower low water (MLLW) datum.

## 3.3 SURFACE SEDIMENT SAMPLE COLLECTION

Surface sediment samples for chemical testing will be collected using a powered (pneumatic) grab sampler. A hydraulic winch system will be used to deploy the sampler at a rate not exceeding 1 meter/second to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, the jaws will be activated and then the sampler will be brought to the deck of the vessel at a rate not exceeding 1 meter/second to minimize any washing and disturbance of the sediment within the sampler. The date, time, mudline elevation, sample depth, and location of sample acquisition will be recorded on the sample collection form.

Once onboard, the sampler will be secured, any overlying water will be carefully siphoned off, and the sample will be inspected to determine acceptability. Criteria used to determine acceptability are those detailed in PSEP (1997a) guidelines. These criteria include but are not limited to:

- Minimal or no excessive water leakage from the jaws of the sampler
- No excessive turbidity in the water overlying the sample
- The sampler is not overfilled with sediment
- The sediment surface appears to be intact with minimal disturbance
- The penetration depth is sufficient (10 cm; dependent on grain size).

If the sample meets acceptability criteria, the sediment will be characterized on the field sample collection form. This characterization will include color, odor, sheen, grain size, a soil description consistent with the Visual Manual Method (ASTM 2009), and field-screening results (e.g., photoionization detector readings). If after multiple sampling attempts, a surface sample does not meet acceptability criteria (e.g., overpenetration), the sample will still be collected but the sampler will document the reasons for not meeting criteria on the sample collection form.

Once the sample has been characterized, the sediment will then be homogenized and sub-sampled for chemical analysis. Sediment will be collected from the bioactive zone (top 10 cm of the sediment) from an area large enough to ensure adequate sample volume and excluding portions that are touching the power-grab sampler. This collected sediment will exclude large, unrepresentative material (e.g., shells, woody debris). Sediment to be analyzed for total sulfides will be collected directly from the grab sampler, prior to collection of sediment for homogenization. Sediment will be homogenized to obtain a smooth consistency (based on color and texture) in decontaminated stainless steel bowls, using a decontaminated stainless steel spoon. After sufficient homogenization, sediment will be placed into laboratory-supplied containers, placed on ice, and stored in coolers at approximately 4°C until transported to the laboratory.

## 3.4 SUBSURFACE SEDIMENT SAMPLE COLLECTION

Subsurface sediment samples (core samples) will be collected by means of vibracore sediment coring methods. Prior to deployment of the vibracorer, water depth will be measured using a weighted sounding line. This water depth, along with known tide elevation, will be used to calculate the mudline at each location. A hydraulic winch system will be used to deploy the vibracorer to approximately 1 ft above the mudline. The vibracorer will be activated and driven to the target depth of 7 ft below the mudline.

The vibracorer will be returned to the deck of the vessel and the core tube will be removed. Collected cores will be allowed to settle until the overlying water is almost clear. Once the sediment has settled, the recovery length will be measured. Cores that have over 75 percent recovery length will be saved and numerically decompacted during processing (discussed in Section 3.31). Cores that have under 75 percent recovery length will be returned to the collection site and a new core will be collected in the nearby (within 5 ft) vicinity. If refusal is encountered prior to full penetration, the vibracore will be repositioned and a new core will be attempted. If refusal is met during the third such attempt, this core will be collected and noted in the field log. Cores will be drained of overlying water, capped, and labeled with the sample number, date, and surface direction. Cores will be stored on ice overnight in a secure location, or will be transported to the laboratory for storage each night.

### 3.4.1 CORE PROCESSING

Core processing will be accomplished at the laboratory, after sample collection is complete. Care will be taken to avoid spills and plastic sheeting will cover all laboratory surfaces during processing. Cores will be cut open lengthwise using sheet metal sheers, leaving the caps on the core to maintain core-tube integrity. The outer sediment surface will be removed with a decontaminated stainless steel spoon. The core will be split in half lengthwise, using a decontaminated stainless steel spatula.

Sediment will be characterized on core exploration logs. This characterization will include stratification, color, odor, grain size, and a soil description consistent with the Visual Manual Method (ASTM 2009). This description will also include any visual or olfactory indications of contamination, biological activity (e.g., shells, worms, etc.), debris, or other distinguishing features and the depth at which these occur.

Sediment cores will be subdivided into 1.5-ft elevation intervals to provide adequate sample volume for the planned analyses. The first core sample will start at an elevation 1 ft below the mudline because the surface sediment sample will be considered representative of the upper 1 ft of sediment. All interval measurements will be adjusted according to the percent retention (length of sediment sample retrieved/penetration depth of core tube) of the sediment collected within each individual core tube. For example, if 6 ft of sediment were retrieved from a core with a penetration depth of 8 ft, the retention ratio would be 0.75 or 75 percent. The resulting intervals to be sampled would then be adjusted for 75 percent sediment retention. For example, 75 percent of 1 ft is 0.75 ft, therefore each 0.75 ft of recovered core represents 1 ft of elevation change.

Sediment will be collected from each interval, excluding sediment portions that are in contact with core tube walls. Sediment will be homogenized to obtain a smooth consistency (based on color and texture) in decontaminated stainless steel bowls, using a decontaminated stainless steel spoon. Sediment to be analyzed for total sulfides will be collected directly from the core, prior to collection of sediment for homogenization. After sufficient homogenization, sediment will be placed into laboratory-supplied containers, placed on ice, and stored in coolers at approximately 4°C.

The number of sediment samples to be analyzed will be determined based on the lithology observed during core processing. All core samples to the interpreted depth of native sediment will be initially analyzed and the remaining core samples archived. If the deepest initially tested sample exceeds one or more of the sediment PSLs, the underlying archived sample (from at least 6-inches below the native sediment interface) will be tested for the constituents that exceed the PSLs, and testing will continue progressively downward until no PSL exceedances are detected, or the lowest collected sample is tested.

## 3.5 DECONTAMINATION

All field sampling equipment, including the pneumatic power grab sampler, vibracore heads, stainless steel bowls and spoons, and sample core tubes will be decontaminated in the following manner:

- Rinsed with clean site water

- Scrubbed with Alconox
- Rinsed with clean site water.

Equipment used during core processing at the laboratory will be rinsed with clean tap water, scrubbed with Alconox, and rinsed with de-ionized water.

## 3.6 SAMPLE DOCUMENTATION AND HANDLING

A complete record of field activities will be maintained. Documentation necessary to meet quality assurance (QA) objectives for this project include: field notes and sampling forms, sample container labels, and sample chain-of-custody forms. All original documentation will be kept in the Landau Associates project files. The documentation and other project records will be safeguarded to prevent loss, damage, or alteration.

If an error is made on a document, corrections will be made by drawing a single line through the error and entering the correct information. The erroneous information will not be obliterated. Corrections will be initialed and dated, and, if necessary, a footnote explaining the correction will be added. Errors will be corrected by the person who made the entry, whenever possible. Documentation will include:

- Recordkeeping by field personnel of primary field activities
- Recordkeeping of all samples collected for analysis
- Use of sample labels and chain-of-custody tracking forms for all samples collected for analysis.

Field report forms will provide descriptions of all sampling activities, sampling personnel, weather conditions, and a record of all modifications to the procedures and plans identified in this SAP. The field report forms are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period.

After sample collection, the following information will be recorded on the field log sheet:

- Sample identification
- Date, time, of sample collection
- Name of person collecting the sample
- Sample location coordinates
- Depth of water at the location
- Surface water elevation at the time of sample collection
- Sampler penetration depth
- Physical observations including presence of debris (e.g., wood debris), color, presence of sheen (or other visible contamination), apparent grain size, and odor.

### 3.6.1 SAMPLE IDENTIFICATION

All sediment samples will be assigned an individual identification. The samples will be identified in a manner that identifies the name of the Site [i.e., Westman Marine (WM)]; identifies the sample type location [i.e., surface sediment grab (SG) or subsurface sediment core (SC)]; and identifies the location of the sample (i.e., station number). Subsurface sediment core samples will also identify the depth below mud line from which the sample was collected. The following are three examples of potential sample identifications used at the Site.

- The subsurface sediment sample collected at subsurface sediment station 1, from a depth of 1 to 1.5 ft below mud line will be identified as ***WM-SC-1(1-1.5)***.
- The co-located surface sediment sample collected at subsurface sediment station 1 will be identified as ***WM-SG-1)***.
- The surface sediment sample collected at surface sediment grab station 7 will be identified as ***WM-SG-7***.

### 3.6.2 SAMPLE CONTAINER LABELS

Sample labels will be made of waterproof material and will be self-adhering. An indelible pen will be used to fill out each label. Each sample label will contain the project number, sample identification, preservation technique (if applicable), analyses, date and time of collection, and initial of the person(s) preparing the sample.

### 3.6.3 SAMPLE CONTAINERS, PRESERVATION, AND STORAGE

Samples submitted to the laboratory for chemical analysis will be placed in the appropriate sample container provided by the laboratory. The samples will be preserved by cooling to a temperature of 4°C or frozen as required by the analytical method. Maximum holding and extraction times until analysis will be strictly adhered to by field personnel and the analytical laboratory. Analytical methods, sample containers, and holding times for each chemical analysis to be performed during the surface sediment quality investigation are provided in Table D-2.

All samples archived at the laboratory will be properly packed in coolers and maintained at 4ºC. Original chain-of-custody forms and analysis request forms will accompany the samples to the laboratory.

### 3.6.4 SAMPLE CUSTODY

The primary objective of sample custody is to create an accurate, written record that can be used to trace the possession and handling of samples so that their quality and integrity can be maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the chain-of-custody record, which is initially completed by the sampler and is, thereafter, signed by those individuals who accept custody of the sample.

## 3.7 MANAGEMENT OF RESIDUAL WASTES

Excess sediment generated during sediment sampling will be returned to the water at the station from where it was collected. Decontamination water, if generated, will be placed in drums for offsite disposal.

# 4.0 SEDIMENT TESTING

Each sediment sample (both surface sediment and sediment cores) will undergo analysis for SMS chemicals listed in WAC 173-204-400, including metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), SVOCs, PCBs, and conventional parameters (grain size, total organic carbon, total volatile solids, total solids, ammonia, and total sulfides). Target reporting limits are presented in Table D-3.

Surface sediment samples collected during the first phase of the investigation will also be analyzed for both porewater and bulk organotins to provide the data needed to develop a correlation between porewater and bulk organotin concentrations, as discussed in Section 2.2.

Sediment core samples will be analyzed for either bulk or porewater organotins, depending on the outcome of the quality of the correlation between bulk and porewater TBT concentrations, as previously discussed. The laboratory analyses for this investigation will be consistent with the PSEP guidelines (PSEP 1997a,b,c) and protocols required by SMS (Ecology 1995) and described in the SAPA (Ecology 2008), as applicable.

# 5.0 QUALITY ASSURANCE AND QUALITY CONTROL

This section describes both field and laboratory QA/QC procedures and provides a description of the data quality review that will be performed on the analytical results. Implementation of these procedures in conjunction with the sample collection and handling procedures described in Section 3.0 should provide a reasonable degree of confidence in the project data.

## 5.1 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL FOR CHEMICAL AND PHYSICAL ANALYSES

QA/QC for chemical testing of sediment samples includes laboratory instrument QA/QC and analytical method QA/QC. Instrument QA/QC monitors the performance of the instrument and method QA/QC monitors the performance of sample preparation procedures. The analytical laboratory will be responsible for instrument and method QA/QC. QA/QC procedures to be performed by the laboratory are summarized in Table D-4 for analyses of organic compounds, Table D-5 for analyses of metals, and Table D-6 for analyses of conventional parameters. The frequency that each procedure should be implemented and the control limits for the procedures are also summarized in Tables D-4, D-5, and D-6. When an instrument or method control limit is exceeded, the laboratory will contact Landau Associates' quality control officer immediately. The laboratory will be responsible for correcting the problem and will reanalyze the samples within the sample hold time if sample reanalysis is appropriate.

## 5.2 FIELD AND LABORATORY QUALITY CONTROL SAMPLES FOR CHEMICAL ANALYSES

Field and laboratory control samples that will be used for quality control purposes during the sediment investigation are described in the following subsections.

### 5.2.1 BLIND FIELD DUPLICATE

One blind field duplicate will be collected during each phase of the sediment investigation. The blind field duplicate will consist of a split sample collected at a single sample location. The sample will be homogenized, split into duplicate sample containers, and submitted blind to the laboratory as two discrete samples. The blind field duplicate samples will be used to evaluate data precision. The blind field duplicates will be analyzed for the same SMS constituents as the sediment samples.

### 5.2.2 LABORATORY MATRIX SPIKE

A minimum of one laboratory matrix spike will be included with each analysis. These analyses will be conducted to provide information on accuracy and to verify that extraction and concentration levels are acceptable. The laboratory spikes will follow EPA guidance for matrix and blank spikes.

### 5.2.3 LABORATORY MATRIX SPIKE DUPLICATE

A minimum of one laboratory matrix spike duplicate will be included with each organic analysis. These analyses will be conducted to provide information on the precision of chemical analyses. The laboratory spikes will follow EPA guidance for matrix and blank spike duplicates.

### 5.2.4 LABORATORY DUPLICATES

A minimum of one laboratory duplicate per 20 samples, not including laboratory QC samples, or one laboratory duplicate sample per batch of samples if fewer than 20 samples are obtained, will be included with each analysis. Laboratory triplicates will be analyzed for TOC and total solids. These analyses will be conducted to provide information on the precision of chemical analyses. The laboratory duplicate will follow EPA guidance in the method.

### 5.2.5 LABORATORY METHOD BLANKS

One laboratory method blank will be analyzed for all parameters (except total solids) to assess possible laboratory contamination. Dilution water will be used whenever possible. Method blanks will contain all reagents used for analysis. The generation and analysis of additional method, reagent, and glassware blanks may be necessary to verify that laboratory procedures do not contaminate samples.

### 5.2.6 LABORATORY CONTROL SAMPLE

One laboratory control sample will be analyzed for all parameters except total solids.

### 5.2.7 SURROGATE SPIKES

Samples analyzed for organic constituents will be spiked with appropriate surrogate compounds as defined by the analytical methods.

## 5.3 DATA QUALITY EVALUATION

An internal data quality evaluation will be conducted on all sample data collected as part of the surface sediment investigation to determine acceptability of data results. Data quality evaluation will be conducted in accordance with the appropriate sections of the EPA Contract Laboratory Program *National*

*Functional Guidelines for Organic and Inorganic Data Review* (EPA 1999, 2004) and the *Data Validation Guidance Manual for Selected Sediment Variables* (PTI 1989) and will include evaluations of the following:

- Chain-of-custody records
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes/laboratory control samples
- Laboratory duplicates
- Corrective action records
- Completeness
- Overall assessment of data quality.

Data qualification arising from data validation activities will be described in the data validation report, rather than in individual corrective action reports.

Care will be taken by the laboratory to not use method detection limits and to use practical quantitation limits in accordance with the SAPA (Ecology 2008).

## 5.4 REPORTING

This section describes requirements for laboratory reports. The Agreed Order establishes reporting requirements for the RI.

### 5.4.1 LABORATORY REPORTS

A written report will be prepared by the analytical laboratory documenting all the activities associated with sample analyses. As a minimum, the following will be included in the report:

- Results of the laboratory analyses and QA/QC results
- All protocols used during analyses
- Chain-of-custody procedures, including explanation of any deviation from those identified herein
- Any protocol deviations from this SAP
- Location and availability of the data
- Batch identification for each analysis method
- Digestion/extraction/analysis dates for each QA/QC parameter corresponding to each batch definition (i.e., all QA/QC data will be batch-specific)

- A case narrative.

As appropriate, this SAP may be referenced in describing protocols.

## 5.5 DATA MANAGEMENT PROCEDURES

All laboratory analytical results, including QC data, will be submitted to Landau Associates. Following validation of the data, any qualifiers will be added to the Excel spreadsheets. All field data will be entered into an Excel spreadsheet and verified to determine all entered data are correct and without omissions and errors. Following receipt of all data, analytical results will be formatted electronically and downloaded to Ecology's Environmental Information Management (EIM) system.

# 6.0 HEALTH AND SAFETY

General health and safety provisions to protect workers from potential hazards during field activities described in this SAP are provided in the accompanying Health and Safety Plan (HASP; Appendix B of the RI Work Plan). The HASP applies to the employees of Landau Associates and its subcontractors while conducting all field activities at the site.

A copy of the HASP will be with the field crew during field activities. All individuals performing fieldwork must read, understand, and comply with the HASP before undertaking field activities.

# 7.0 REFERENCES

ASTM. 2009. D 2488-09a. *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. ASTM International.

DMMP. 2012. Public Review Draft: *Bioassay Endpoint Refinements: Bivalve Larval and Neanthes Growth Bioassays*. Dredged Material Management Program (DMMP)/Sediment Management Standards (SMS) Clarification Paper. Prepared by David Kendall (U.S. Army Corps of Engineers) and Russ McMillan (Washington State Department of Ecology) for the DMMP agencies and SMS Program, and Bill Gardiner, Brian Hester, and Jack D. Word (NewFields, LLC). April 27.

Ecology. 2008. *Sediment Sampling and Analysis Plan Appendix*. Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Publication No. 03-09-043. Washington State Department of Ecology. Last updated February.

Ecology. 2007. *Model Toxics Control Act (MTCA) Cleanup Regulation Chapter 173-340 WAC*. Publication No. 94-06. Washington State Department of Ecology. Last updated October 12.

Ecology. 1995. *Sediment Management Standards. Chapter 173-204 WAC*. Washington State Department of Ecology. Last updated December 29.

EPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-04-004. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency. Washington, D.C. October.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99-008. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Washington, D.C. October.

Krone, C.A., D.W. Brown, D.G. Burrows, R.G. Bogar, S.L. Chan, and U. Varanasi. 1989. "A Method for the Analysis of Butyltin Species and the Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound." *Marine Environmental Research*. 27:1-18.

Landau Associates. 2002. Report: *Sediment Quality Investigation, Blaine Harbor, Blaine, Washington*. Prepared for Port of Bellingham. April 2.

Plumb, R.H. 1981. *Procedures for Handling and Chemical Analysis of Sediment and Water Samples*. Technical Report EPA/CE-81-1. U.S. Army Corps of Engineers. Vicksburg, Mississippi.

PSEP. 1998. *Puget Sound Estuary Program: Recommended Guidelines for Station Positioning in Puget Sound*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority. Olympia, Washington.

PSEP. 1997a. *Puget Sound Estuary Program: Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority. Olympia, Washington.

PSEP. 1997b. *Puget Sound Estuary Program: Recommended Guidelines for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority. Olympia, Washington.

PSEP. 1997c. *Puget Sound Estuary Program: Recommended Protocols for Measuring Metals in Puget Sound Sediment and Tissue Samples*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority. Olympia, Washington.

PSEP. 1995. *Puget Sound Estuary Program: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority. Olympia, Washington. Revised July.

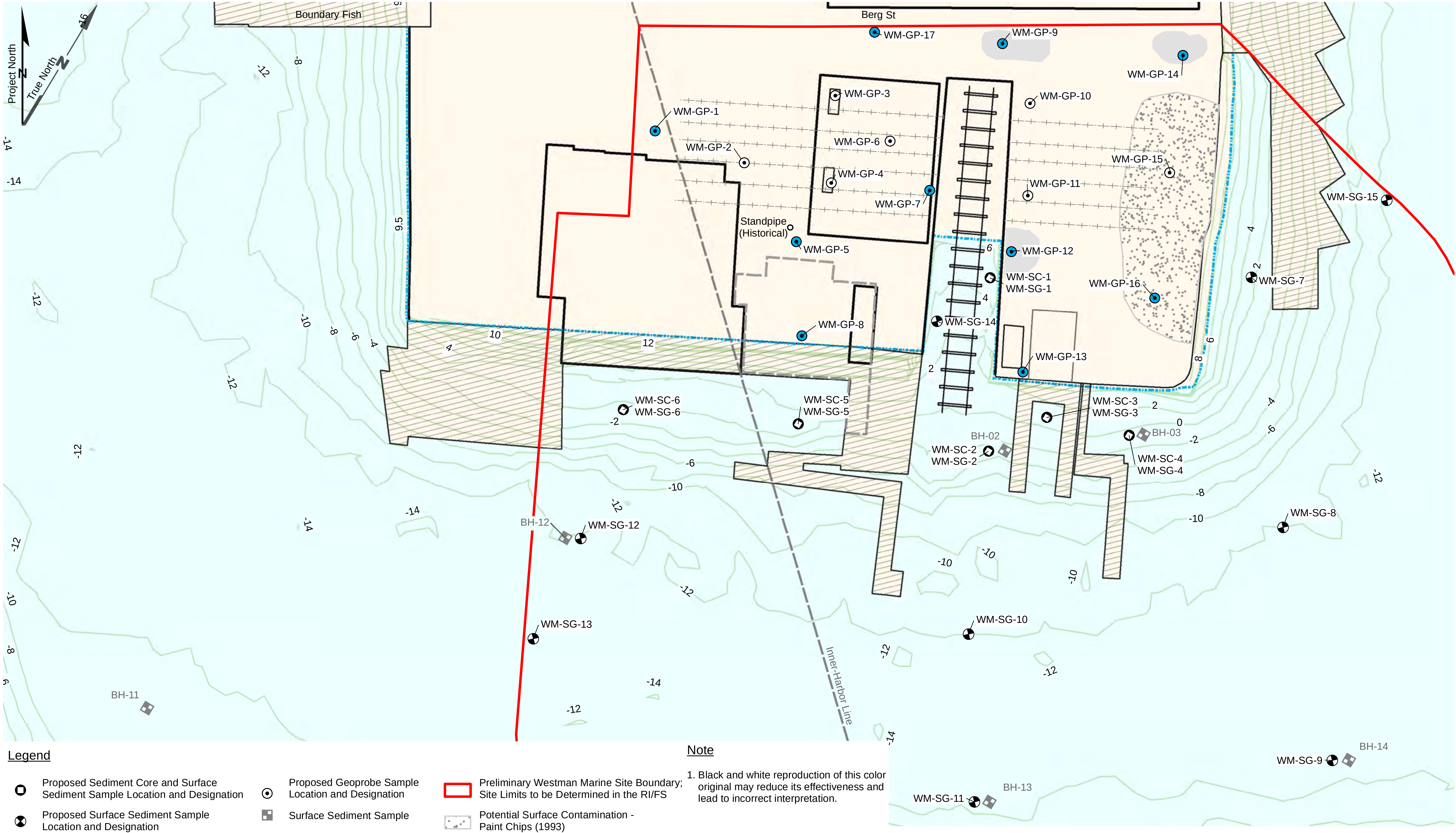
TEC. 2001. *Uplands Source Assessment Report in Support of Sediment Characterization Study for Blaine Harbor, Blaine, Washington*. The Environmental Co., Inc. Prepared for Landau Associates. June 7.

Data Source: ESRI 2008

Y:\Projects\001035\010.014\RI-FS_Workplan\Sampling & Analysis\Figure_D-1.mxd

LANDAU ASSOCIATES

| Westman Marine Site<br>Blaine Harbor<br>Blaine, Washington | **Vicinity Map** | Figure<br>D-1 |
|---|---|---|



## Legend

| | | | | | |
|---|---|---|---|---|---|
| ○ | Proposed Sediment Core and Surface Sediment Sample Location and Designation | ⊙ | Proposed Geoprobe Sample Location and Designation | 🟥 | Preliminary Westman Marine Site Boundary; Site Limits to be Determined in the RI/FS |
| ⊗ | Proposed Surface Sediment Sample Location and Designation | ▨ | Surface Sediment Sample | ⁘ | Potential Surface Contamination - Paint Chips (1993) |
| ● | Proposed Groundwater Grab Sample Location and Designation | -+-+- | Historical Track Location (1966) | ▒ | Potential Surface Contamination - Staining (1993) |
| | | — | Bathymetric Contours (MLLW) | ▨ | 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.

Y:\Projects\001035\010.014\RI-FS_Workplan\Appendix_D-2_Proposed.mxd 8/13/2013 NAD 1983 StatePlane Washington North FIPS 4601 Feet

LANDAU ASSOCIATES

Westman Marine
Blaine Harbor
Blaine, Washington

**Proposed Investigation Sample Locations**

Figure
D-2

# TABLE D-1
# PROPOSED SEDIMENT SAMPLE LOCATIONS AND DESIGNATIONS
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Sample Location Name | Sample Type | Coordinates (Feet) (a) Northing | Coordinates (Feet) (a) Easting |
|---|---|---|---|
| WM-SC-1/WM-SG-1 | Sediment Core and Surface Grab | 732419 | 1177332 |
| WM-SC-2/WM-SG-2 | Sediment Core and Surface Grab | 732338 | 1177379 |
| WM-SC-3/WM-SG-3 | Sediment Core and Surface Grab | 732370 | 1177396 |
| WM-SC-4/WM-SG-4 | Sediment Core and Surface Grab | 732385 | 1177439 |
| WM-SC-5/WM-SG-5 | Sediment Core and Surface Grab | 732298 | 1177283 |
| WM-SC-6/WM-SG-6 | Sediment Core and Surface Grab | 732256 | 1177199 |
| WM-SG-7 | Surface Sediment Grab | 732491 | 1177452 |
| WM-SG-8 | Surface Sediment Grab | 732385 | 1177536 |
| WM-SG-9 | Surface Sediment Grab | 732291 | 1177623 |
| WM-SG-10 | Surface Sediment Grab | 732248 | 1177420 |
| WM-SG-11 | Surface Sediment Grab | 732172 | 1177470 |
| WM-SG-12 | Surface Sediment Grab | 732185 | 1177215 |
| WM-SG-13 | Surface Sediment Grab | 732125 | 1177221 |
| WM-SG-14 | Surface Sediment Grab | 732384 | 1177319 |
| WM-SG-15 | Surface Sediment Grab | 732565 | 1177493 |

(a) Washington State Plane North Zone; North American Datum of 1983 (NAD83).

# TABLE D-2
# SAMPLE SIZE, CONTAINERS, AND ANALYTICAL METHODS
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Sample Type | Recommended Method | Container | Preservation | Maximum Holding Time |
|---|---|---|---|---|
| Metals | 6010B/6020 or 7471A/245.5 | 8 oz - WMG with teflon-lined lid | Cool, 4° C | 6 months, 28 days for mercury |
| Semivolatiles | 8270C/1625C | 8 oz - WMG with teflon-lined lid | Cool. 4° C | 14 days (a), 1 year (b) |
| PCBs | 8082 | 8 oz - WMG with teflon-lined lid | Cool, 4° C | 14 days (a), 1 year (b) |
| TOC | 9060 | 4 oz - WMG with teflon-lined lid | Cool, 4° C | 28 days, 6 months (b) |
| Total Solids | PSEP | 4 oz - WMG with septa lid | Cool, 4° C | 14 days, 6 months (b) |
| Grain Size | Plumb 1981 | 1-16 oz WMG | Cool, 4°C | 6 months |
| Organotins (bulk) | Krone et al. 1989 | 4 oz - WMG with teflon-lined lid | Cool, 4°C | 14 days, 1 year |
| Organotins (Porewater) | Krone et al. 1989 | 2, 32-oz Glass | Cool, 4°C; Zero Head Space | 7 Days until Pore Water Extraction; 7 Days until Organotin Extraction; 40 Days after Extraction |
| Total sulfides | Plumb 1981/9030B | 40 mL vial | Cool, 4°C | 7 days |

PCBs = Polychlorinated Biphenyls
TOC= Total Organic Carbon
WMG = Wide Mouth Glass
oz = ounces
° C = degrees Celsius

(a) Holding time shown is from sample collection to extraction; holding time from extraction to analysis is 40 days.
(b) Holding time shown is from sample collection to extraction if sample is frozen.

# TABLE D-3
# QUANTITATION LIMIT GOALS
# WESTMAN MARINE
# BLAINE, WASHINGTON

| | | WAC 173-204 Dry Weight Equivalents of SMS Criteria (1) | | |
|---|---|---|---|---|
| | | Dry Weight SQS Equivalent | Dry Weight CSL Equivalent | Quantitation Limit Goals (a) |
| ***Metals*** | | **mg/kg-dry wt** | | |
| | Arsenic | 57 | 93 | 19 |
| | Cadmium | 5.1 | 6.7 | 1.7 |
| | Chromium (Total) | 260 | 270 | 87 |
| | Copper | 390 | 390 | 130 |
| | Lead | 450 | 530 | 150 |
| | Mercury | 0.41 | 0.59 | 0.14 |
| | Silver | 6.1 | 6.1 | 2 |
| | Zinc | 410 | 960 | 137 |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | **µg/kg dry wt** | | |
| | Acenaphthene | 500 | 500 | 167 |
| | Acenaphthylene | 1,300 | 1,300 | 433 |
| | Anthracene | 960 | 960 | 320 |
| | Benzo(g,h,i)perylene | 670 | 720 | 223 |
| | Fluoranthene | 1,700 | 2,500 | 567 |
| | Fluorene | 540 | 540 | 180 |
| | Phenanthrene | 1,500 | 1,500 | 500 |
| | Pyrene | 2,600 | 3,300 | 867 |
| | 2-Methylnaphthalene | 670 | 670 | 223 |
| | Naphthalene | 2,100 | 2,100 | 700 |
| | Benz(a)anthracene | 1,300 | 1,600 | 433 |
| | Benzo(a)pyrene | 1,600 | 1,600 | 533 |
| | Chrysene | 1,400 | 2,800 | 467 |
| | Dibenzo(a,h)anthracene | 230 | 230 | 77 |
| | Indeno(1,2,3-cd)pyrene | 600 | 690 | 200 |
| | Benzofluoranthenes (total) | 3,200 | 3,600 | 1067 |
| ***Other Semivolatile Organics*** | | | | |
| ***Chlorinated Benzenes*** | | **µg/kg dry wt** | | |
| | 1,2,4-Trichlorobenzene | 31 | 51 | 31 |
| | 1,2-Dichlorobenzene | 35 | 50 | 35 |
| | 1,4-Dichlorobenzene | 110 | 110 | 37 |
| | Hexachlorobenzene | 22 | 70 | 22 |
| ***Other Semivolatile Organics*** | | **µg/kg dry wt** | | |
| | 2,4-Dimethylphenol | 29 | 29 | 29 |
| | 2-Methylphenol | 63 | 63 | 63 |
| | 4-Methylphenol | 670 | 670 | 223 |
| | Benzoic acid | 650 | 650 | 217 |
| | Benzyl alcohol | 57 | 72 | 57 |
| | Pentachlorophenol | 360 | 690 | 120 |
| | Phenol | 420 | 1,200 | 140 |

# TABLE D-3
# QUANTITATION LIMIT GOALS
# WESTMAN MARINE
# BLAINE, WASHINGTON

| | | WAC 173-204 Dry Weight Equivalents of SMS Criteria (1) | | |
|---|---|---|---|---|
| | | Dry Weight SQS Equivalent | Dry Weight CSL Equivalent | Quantitation Limit Goals (a) |
| ***Phthalate Esters*** | | **µg/kg dry wt** | | |
| | Diethyl phthalate | 200 | 1,200 | 67 |
| | Dimethyl phthalate | 71 | 160 | 24 |
| | Di-n-butyl phthalate | 1,400 | 5,100 | 467 |
| | Di-n-octyl phthalate | 6,200 | 6,200 | 2067 |
| | Benzyl butyl phthalate | 63 | 900 | 21 |
| | Bis(2-ethylhexyl) phthalate | 1,300 | 3,100 | 433 |
| ***Other Carbon Normalized*** | | **µg/kg dry wt** | | |
| | Hexachlorobutadiene | 11 | 120 | 11 |
| | Dibenzofuran | 540 | 540 | 180 |
| | N-Nitrosodiphenylamine | 28 | 40 | 28 |
| ***Polychlorinated Biphenyls (PCBs)*** | | **µg/kg dry wt** | | |
| | Total PCBs | 130 | 1,000 | 6 |
| ***Organotins (Bulk)*** | | **-** | **-** | - |
| | TBT as TBT ion | - | - | 1-5 |
| | TBT as Tin ion | - | 30 | 1-5 |
| ***Organotins (Porewater)*** | | **-** | **-** | |
| | TBT as TBT ion | - | - | 1-5 |
| | TBT as Tin ion | - | - | 1-5 |

**Numerical Criteria Notes:**

(a) Reporting limit goals are based on current laboratory data and may be modified during the investigation process as methodology is refined. Laboratory reporting will be based on the lowest standard on the calibration curve. Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limits.

**Process Notes:**

(1) The SMS numeric criteria as promulgated are based on protection of benthic toxicity. If site-specific bioassay data indicate no adverse affects to benthic organisms, the sediment can be considered to “pass” the applicable sediment quality standards (SQS) of WAC 173-204-320 through 340 even though it may exceed these chemical criteria (WAC 173-204-310(2)). It can then be concluded that the protection of benthic toxicity pathway is protective and does not require further evaluation.

**Abbreviations:**

CSL = Cleanup screening level
HPAH = High molecular weight polycyclic aromatic hydrocarbon
LPAH = Low molecular weight polycyclic aromatic hydrocarbon
MCUL = Maximum cleanup level
OC = Organic carbon
SMS = Sediment Management Standards
SQS = Sediment Quality Standards
TBT = Tributyltin
WAC = Washington Administrative Code
wt = Weight

# TABLE D-4
# QUALITY CONTROL PROCEDURES FOR ORGANIC ANALYSES
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Quality Control Procedure | Frequency | Control Limit | Corrective Action |
|---|---|---|---|
| **Instrument Quality Assurance/Quality Control** | | | |
| Initial Calibration | See reference method(s) in Table D-2 | See reference method(s) in Table D-2 | Laboratory to recalibrate and reanalyze affected samples |
| Continuing Calibration | See reference method(s) in Table D-2 | See reference method(s) in Table D-2 | Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements |
| **Method Quality Assurance/Quality Control** | | | |
| Holding Times | Not applicable | See Table D-2 | Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance |
| Detection Limits | Annually | See Table D-2 | Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table D-4) and contact the QA/QC coordinator and/or project manager immediately |
| Method Blanks | One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents | Analyte concentration < PQL | Laboratory to eliminate or greatly reduce laboratory contamination due to glassware, reagents, or analytical system; reanalyze affected samples |
| Analytical (Laboratory) Replicates and Matrix Spike Duplicates | 1 duplicate analysis with every sample batch or every 20 samples, whichever is more frequent. Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes. | Compound- and matrix-specific RPD of ≤35% applied when the analyte concentration is greater than PQL | Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted |
| Matrix Spikes | One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS | Compound- and matrix-specific | Matrix interferences should be assessed and explained in the case narrative accompanying the data package |
| Surrogate Spikes | Added to every organics sample as specified in analytical protocol | Compound-specific | Follow corrective actions specified in SW-846 (EPA 1996). |
| Laboratory Control Samples (LCS), Certified or Standard Reference Material | One per analytical batch or every 20 samples, whichever is more frequent | Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method of Table D-2 or performance-based intralaboratory control limits, whichever is lower | Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples |

# TABLE D-4
# QUALITY CONTROL PROCEDURES FOR ORGANIC ANALYSES
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Quality Control Procedure | Frequency | Control Limit | Corrective Action |
|---|---|---|---|
| **Field Quality Assurance/Quality Control** | | | |
| Field Replicates | At project manager's discretion | Not applicable | Not applicable |
| Field Blanks | At project manager's discretion | Analyte concentration ≤ PQL | Compare to method blank results to rule out laboratory contamination; modify sample collection and equipment decontamination procedures |

Notes:
EPA = U.S. Environmental Protection Agency
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference

# TABLE D-5
# QUALITY CONTROL PROCEDURES FOR METALS ANALYSES
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Quality Control Procedure | Frequency | Control Limit | Corrective Action |
|---|---|---|---|
| **Instrument Quality Assurance/Quality Control** | | | |
| Initial Calibration | Daily | Correlation coefficient ≥ 0.995 | Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples |
| Initial Calibration Verification | Immediately after initial calibration | 90 - 110% recovery or performance-based intralaboratory control limits, whichever is lower | Laboratory to resolve discrepancy prior to sample analysis |
| Continuing Calibration Verification | After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample | 90 -110% recovery | Laboratory to recalibrate and reanalyze affected samples |
| Initial and Continuing Calibration Blanks | Immediately after initial calibration, then 10% of samples or every 2 hours, whichever is more frequent, and after the last sample | Analyte concentration < PQL | Laboratory to recalibrate and reanalyze affected samples |
| ICP Interelement Interference Check Samples | At the beginning and end of each analytical sequence or twice per 8-hour shift, whichever is more frequent | 80 - 120% of the true value | Laboratory to correct problem, recalibrate, and reanalyze affected samples |
| **Method Quality Assurance/Quality Control** | | | |
| Holding Times | Not applicable | See Table D-2 | Qualify data or collect fresh samples |
| Detection Limits | Not applicable | See Table D-3 | Laboratory must initiate corrective actions and contact the QA/QC coordinator and/or the project manager immediately |
| Method Blanks | With every sample batch or every 20 samples, whichever is more frequent | | Laboratory to redigest and reanalyze samples with analyte concentrations < 10 times the highest method blank |
| Analytical (Laboratory) Replicates and Matrix Spike Duplicates | 1 duplicate analysis with every sample batch or every 20 samples, whichever is more frequent. Use analytical replicates when samples are expected to contain target analytes. Use matrix spike replicates when samples are not expected to contain target analytes. | RPD ≤ 20 % applied when the analyte concentration is greater than PQL | Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted |
| Matrix Spikes | With every sample batch or every 20 samples, whichever is more frequent | 75 - 125% recovery applied when the sample concentration is <4 times the spiked concentration for a particular analyte | Laboratory may be able to correct or minimize problem; or qualify and accept data |
| Laboratory Control Samples, Certified or Standard Reference Material | Overall frequency of 5% of field samples | 80 - 20% recovery, or performance-based intralaboratory control limits, whichever is lower | Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples |

# TABLE D-5
# QUALITY CONTROL PROCEDURES FOR METALS ANALYSES
# WESTMAN MARINE
# BLAINE, WASHINGTON

| Quality Control Procedure | Frequency | Control Limit | Corrective Action |
|---|---|---|---|
| **Field Quality Assurance/Quality Control** | | | |
| Field Replicates | At project manager's discretion | Not applicable | Not applicable |
| Field Blanks | At project manager's discretion | Analyte concentration ≤ PQL | Compare to method blank results to rule out laboratory contamination; modify sample collection and equipment decontamination procedures |

Notes:
CLP = Contract Laboratory Program (EPA)
EPA = U.S. Environmental Protection Agency
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference

responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples. Instrument and method QA/QC results reported in the final data package should

# TABLE D-6
# QUALITY CONTROL PROCEDURES FOR CONVENTIONAL ANALYSES
# WESTMAN MARINE
# BLAINE, WASHINGTON

| | Suggested Control Limit | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analyte** | **Initial Calibration (a)** | **Continuing Calibration (a)** | **Calibration Blanks (a)** | **Laboratory Control Samples** | **Matrix Spikes (a,b)** | **Laboratory Triplicates (a,b)** | **Method Blank (a,b)** |
| Grain size | N/A | N/A | N/A | N/A | N/A | 20% RSD | N/A |
| Total organic carbon | Correlation coefficient ≥0.995 | 90 - 110% recovery | Analyte concentration ≤ PQL | 80 -120% recovery | 75 -125% recovery | 20% RSD | Analyte concentration ≤ PQL |
| Total solids | N/A | N/A | N/A | N/A | N/A | 20% RSD | Analyte concentration ≤ PQL |

Notes:

| | |
|---|---|
| N/A = | Not applicable |
| RSD = | Relative Standard Deviation |
| PQL = | Practical quantitation limit |
| EPA = | U.S. Environmental Protection Agency |
| PSEP = | Puget Sound Estuary Program |
| QA/QC = | Quality assurance and quality control |

(a) EPA and PSEP control limits are not available for conventional analytes. The control limits provided above are suggested limits only. They are based on EPA control limits for metals analyses (see Table D-5), and an attempt has been made to take into consideration the expected analytical accuracy using PSEP methodology. Corrective action to be taken when control limits are exceeded is left to the Project Manager's discretion. The corrective action indicated for metals in Table E-5 may be applied to conventional analytes.

(b) When applicable, the QA/QC procedures indicated in this table should be completed at the same frequency as for metals analyses (see Table D-5).