DEPARTMENT OF
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State of Washington

Cleanup Action Plan (CAP)

March Point Landfill Site
Anacortes, Washington

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For more information contact:

Toxics Cleanup Program
P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360-407-7170

Washington State Department of Ecology — www.ecology.wa.gov

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300
- Central Regional Office, Union Gap 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

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Cleanup Action Plan (CAP)

March Point Landfill Site
Anacortes, Washington

Toxics Cleanup Program

Washington State Department of Ecology

Olympia, Washington

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List of Acronyms

ARAR	Applicable Relevant and Appropriate Requirements
bgs	below ground surface
CAP	Cleanup Action Plan
CLs	Cleanup Levels
cPAHs	Carcinogenic Polycyclic Aromatic Hydrocarbons
CSL	Cleanup Screening Level
CSM	Conceptual site model
CWA	Clean Water Act
CY	Cubic Yards
DCAP	Draft Cleanup Action Plan
DCA	Disproportionate Cost Analysis
Ecology	Washington Department of Ecology
HDPE	High-Density Polyethylene
IHSs	Indicator Hazardous Substances
MLLW	Mean Lower Low Water
MTCA	Model Toxics Control Act Cleanup Regulation
NWP	Nationwide Permit
PCBs	Polychlorinated Biphenyls
PCLs	Preliminary Cleanup Levels
PQL	Practical quantification limit
RCW	Revised Code of Washington
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROW	Right-of-Way
SEPA	State Environmental Policy Act
SF	Square Feet
SMS	Sediment Management Standards
SQS	Sediment Quality Standards
SVOCs	Semi-Volatile Organic Compounds
µg/kg	micrograms per kilogram
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code

Executive Summary

This document presents the Cleanup Action Plan (CAP) for upland properties at the March Point (a.k.a. Whitmarsh Landfill) Landfill Site (the Site) at the base of a bluff in the tidelands area of Padilla Bay in Anacortes, Washington. This CAP has been prepared pursuant to an Agreed Order meeting the requirements of the Model Toxics Control Act (MTCA) administered by the Washington State Department of Ecology (Ecology) under Chapter 173-340 of the Washington Administrative Code (WAC). This CAP was prepared as a collaborative effort by the Washington State Department of Ecology (Ecology) and the potentially liable parties (PLP Group) responsible for cleanup of the various portions of the site: Shell Oil Company, Skagit County, Texaco, Inc., and the Washington State Department of Natural Resources. It provides a general description of the proposed site-wide cleanup action and sets forth functional requirements that the cleanup must meet to achieve the cleanup action objectives for the site.

The former Whitmarsh Landfill was an informal public dump in the 1950s, and was operated by Skagit County as a landfill from 1961 until its closure in 1973. At the time of closure, the former Whitmarsh Landfill was graded and covered with 2-3 feet of soil. Due to the landfill's proximity and potential impacts to Padilla Bay and Bay Lagoon, it has been identified by Ecology as a high priority cleanup site under the Puget Sound Initiative. Until approximately 2010, the northern two-thirds of the landfill was occupied by a cedar log mill, which had operated in this location since the late 1980s under a lease with Washington State DNR. The former mill area currently contains building foundation concrete slabs, partially dismantled buildings, and an intact shop building.

In 2014 and 2015, approximately 44,000 cubic yards of wood waste debris was hauled off site and recycled as compost material; an estimated 13,000 cubic yards of wood waste debris mixed with rock remains on site. The majority of this material is stockpiled in two piles southeast of the log mill foundations. The rest of the residual wood waste is located near the former mill building foundation. The remaining wood waste and rock debris is not considered significant factor for future landfill gas generation.

The remedial investigation showed the following exceedances of the preliminary cleanup levels:

- Soil: total and dissolved metals, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons in the gasoline range and oil ranges, benzene, semivolatile organic compounds (SVOCs), and pesticides.
- Groundwater: total and dissolved metals, PCBs, benzene, SVOCs, pesticides.
- Seeps: total and dissolved metals, benzene, the SVOC 1-methylnaphthalene, PCBs, the pesticide 4,4'-DDE.
- Surface water: total and dissolved metals, benzene, SVOCs, and the pesticide 4,4' DDD.

A sediment investigation and watershed study was performed at the Site from 2008 through 2011. Sediment samples were collected from the inner lagoon, the swale located south of the landfill, and a portion of the outer lagoon during four rounds of sediment sampling. It was concluded based on the results of the sediment investigation that the seep discharges from the landfill do not have a negative effect on the sediment biota (RI/FS Section 7.1.3; Appendix B). Therefore, no impacts on sediments in the inner lagoon or Padilla Bay associated with the landfill were identified (RI/FS Section 5.2).

In addition, landfill gas (LFG) monitoring in 2011 and 2012 revealed elevated methane concentrations within the wood waste which was placed over the original soil cover. Of the ten gas probe wells, only two were installed only in the refuse layer below the soil cover. The remainder were installed in the wood waste and below the soil cover in the refuse. The highest concentrations of methane generally coincided with the thickest accumulations of wood waste.

A conceptual site model was developed that suggests areas exist along the landfill boundary where groundwater within the solid waste is seeping, or has the potential to seep, into surface water. These areas are predominantly in the eastern part of the swale south of the Site and the northeastern landfill boundary within the inner lagoon. The primary potential source area for constituents of concern (COCs) is the footprint of the former Whitmarsh Landfill that includes the small area of solid waste outside the main gate at the Site. Stormwater infiltrates through the landfill cover and into the solid waste, and generates leachate that seeps out of the landfill adjacent to the BNSF Railway Company tracks.

The conceptual site model showed the exposure pathways and receptors for human health receptors are as follows:

- Direct human exposure to solid waste through construction activities.
- Seasonal infiltration of surface water into the solid waste, causing discharge of groundwater through seeps, where it could eventually affect marine biota.
- Migration of shallow groundwater though the Bay Mud into the underlying Lower Aquifer and subsequent discharge to surface waters or marine sediment where it could affect marine biota.
- Potential exposure of solid waste through erosion and direct release to surface waters/marine sediment of the inner lagoon where it could affect marine biota.
- Volatilization, dust emission, and inhalation of chemicals and methane gas generated from solid waste.

Constituents that were detected in at least one sample at a concentration that exceeded their preliminary cleanup level were chosen as final COCs for the site, and final cleanup levels were determined for the COCs. There are three points of compliance for the final cleanup levels:

- A conditional point of compliance for groundwater migrating from the former landfill;

- A point of compliance for surface water seeps (seeps) if any exist after completion of the cleanup action; and
- A point of compliance for LFG just outside the landfill footprint to the northwest, and west of the landfill across South March Point Road.

The cleanup action plan has been developed pursuant to the Model Toxics Control Act (MTCA) under the terms of the current Agreed Order. The CAP and a Consent Decree are planned to be negotiated with the PLP Group and issued for public comment at the same time. Ecology will be responsible for issuing the final approval for the cleanup action, after the public comment period closes and following consultation with other state and local regulators. Although the cleanup action will be exempt from some state and local permits in accordance with the Agreed Order, several permits/approvals/processes will be required from local, state, and federal agencies.

Key components of the remedy for the site are:

- Engineering controls and institutional controls;
- Landfill cover (vertical/lateral) including demolition and stormwater control;
- Leachate (or groundwater), treatment and/or containment as necessary;
- LFG collection and venting, and

Seven remedial alternatives were developed for this project:

- Alternative 1 – No Action
- Alternative 2 – Restoration of Existing Soil Cover
- Alternative 3 – Geosynthetic Clay Laminated Liner (GCLL) Cap
- Alternative 4 – High Density Polyethylene (HDPE) Cap
- Alternative 5 – HDPE Cap Anchored Into Bay Mud
- Alternative 6 – Polyvinyl Chloride Cap
- Alternative 7 – Landfill Removal

The alternatives were evaluated using seven evaluation criteria: protectiveness; permanence; long term effectiveness; short term risk; technical and administrative implementability; public concerns; and cost. In addition, the restoration time frame for each alternative was taken into account and a disproportionate cost analysis was performed for the alternatives.

Based on this evaluation, Alternative 3, GCLL Cap, is the MTCA preferred remedy for the site. Alternative 3 meets the threshold requirements and other MTCA/Minimum Functional Standards requirements, and is the remedy that is permanent to the maximum extent practicable as determined by the disproportionate cost analysis.

Alternative 3 includes:

- Demolition of the structures on site;
- Moving solid waste (45,000 cubic yards) from the edges of the landfill inward, to allow construction of a permanent cap without expanding the footprint of the landfill.
- Grading the waste to a mound to promote stormwater runoff.
- Installing a passive LFG collection system, and placing an engineered cap over the landfill with standard GCLL.
- Installing modified bentonite clay GCLL with polymer GCLL extending to the Bay Mud, and constructing a perimeter access road around the landfill. The engineered cap would minimize or eliminate infiltration of groundwater into the landfill, and the GCLL would minimize discharge of groundwater from the landfill to surface waters.
- Treating wastewater (1.3 million gallon) generated during the construction work.
- Installing an LFG collection system, which would vent LFG to the atmosphere, as well as groundwater collection/treatment as needed to prevent off-site migration.
- Installing stormwater control measures and constructing a surface drainage system on and around the landfill.
- Installation of a perimeter road for access to wells and the LFG vent system.
- Installation of stubouts for future use of public water and electricity.
- Providing institutional and engineering controls.
- Performing long-term monitoring of groundwater (quality and levels for hydraulic control purpose), seepage, LFG, and the landfill closure facility.
- Performing habitat restoration at the shoreline including temporary irrigation piping and ancillary equipment.

The estimated capital and long term (operation and maintenance) costs for the proposed cleanup action are $9.7 million and $2.8 million, respectively. Institutional controls will be implemented when the cleanup action is complete. Those include installation of a permanent chain link fence around the perimeter of the landfill to limit site access.

Consistent with Chapter 70.105D Revised Code of Washington, as implemented by Chapter 173-340 Washington Administrative Code (MTCA Cleanup Regulation), Ecology has determined that the selected site cleanup action described in Section 4 of this CAP is protective of human health and the environment, will attain federal and state applicable or relevant and appropriate requirements, complies with cleanup standards, and provides for compliance monitoring. The selected cleanup action satisfies the preference expressed in Washington Administrative Code 173-340-360 for the use of permanent solutions to the maximum extent practicable, and provides for a reasonable restoration time frame.

Compliance monitoring will include construction performance monitoring to ensure the work is performed in compliance with the project requirements. Post-construction performance monitoring of groundwater, seeps, LFG, and stormwater will be conducted after construction of the landfill cap is complete to determine whether or not the cap is performing as expected, and to evaluate whether leachate is continuing to seep from the landfill into Padilla Bay, and to determine whether lateral migration of groundwater into the solid waste or lateral migration of LFG away from the landfill is occurring. Ecology will review the selected cleanup action described in this CAP every five years to ensure protection of human health and the environment.

1.0 Introduction

This document presents the Cleanup Action Plan (CAP) for upland properties at the March Point (a.k.a. Whitmarsh) Landfill Site (the Site) located at 9663 South March Point Road in Anacortes, Washington (Figure 1). This CAP was prepared as a collaborative effort by the Washington State Department of Ecology (Ecology) and the potentially liable parties (PLP Group) to Agreed Order DE-08TCPHQ-5999 (the Agreed Order): Shell Oil Company, Skagit County, Texaco, Inc., and the Washington State Department of Natural Resources (DNR). It has been prepared pursuant to the requirements of the Model Toxics Control Act (MTCA), RCW 70.105D, and it's implementing regulations in Chapter 173-340 of the Washington Administrative Code (WAC). This CAP provides a general description of the proposed site-wide cleanup action and sets forth functional requirements that the cleanup must meet to achieve the cleanup action objectives for the site.

1.1 Purpose

As described in WAC 173-340-380, the purpose of this CAP is to:

- Describe the site, including a summary of its history and extent of contamination;
- Identify site-specific cleanup levels and points of compliance (POCs) for each hazardous substance and medium of concern;
- Identify applicable state and federal laws for the proposed cleanup action;
- Summarize the other cleanup action alternatives evaluated in the remedial investigation/feasibility study (RI/FS);
- Identify and describe the selected cleanup action alternative for the site;
- Discuss environmental covenants and site use restrictions;
- Discuss compliance monitoring requirements; and
- Present the schedule for implementing the CAP.

1.2 Regulatory framework

This CAP was prepared as a collaborative effort by Ecology and the PLP Group. Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) prepared this CAP on behalf of the PLP Group for the Site. The Site is listed on Ecology's Hazardous Sites List as Facility Site ID 2662. This Site is one of 10 sites on Padilla Bay and nearby Fidalgo Bay that are being investigated and cleaned up as part of the Puget Sound Initiative.

This CAP summarizes the results of the RI/FS report and the selection of the proposed cleanup remedy, including the nature and extent of contamination. It also presents a conceptual site model of exposure pathways for constituents of concern (COCs) at the site, presents the cleanup levels and remedial action objectives (RAOs), outlines important project considerations governing and guiding the permanent cleanup action under MTCA (WAC 173-340) and the applicable landfill closure requirements under the applicable or relevant and appropriate requirements (ARARs) (WAC 173-304). The CAP also provides additional details concerning the cleanup remedy, including post-implementation compliance monitoring. This CAP was prepared in response to and in accordance with Section VII.A of the Agreed Order.

2.0 Summary of Site Conditions

2.1 Site description

The Site (approximately 14 acres of upland and filled tidelands) is located north of South March Point Road at the base of a bluff in the tidelands area of Padilla Bay in Anacortes, Washington (Figure 1). The landfill was a public dump in the 1950s, and was operated by Skagit County as a landfill from 1961 until its closure in 1973. At the time of closure, the former Whitmarsh Landfill was graded and covered with 2-3 feet of soil. Padilla Bay is a National Marine Estuarine Sanctuary that supports sustenance fishing by the Swinomish Indian Tribal Community. Due to the site's proximity and potential impacts to Padilla Bay and Bay Lagoon, it has been identified by Ecology as a high priority cleanup site under the Puget Sound Initiative.

The Site is bounded by South March Point Road to the south, the BNSF Railway Company (BNSF) railroad causeway and Padilla Bay to the north and northeast, and the Swinomish Indian Reservation to the east and southeast (Figure 1). State Highway 20 runs generally east-west about 800 feet southeast of the site, beyond South March Point Road. The landfill is buttressed with heavy rock riprap along its saltwater edge to the northeast, which includes the BNSF right-of-way. The embankment under the railroad serves as a dike separating the Bay Lagoon from Padilla Bay. A short trestle (approximately 110 feet wide) in the railroad embankment allows for salt water exchange between the inner and outer lagoon. The area southeast of the landfill is owned by the Swinomish Indian Tribal Community and has been developed as light industrial/commercial area.

The elevation of the former Whitmarsh Landfill generally ranges from 6 to 25 feet above mean lower low water (MLLW). The landfill surface is relatively flat across the top, with higher elevations on the north end. The landfill slopes down to tidelands on the northeast and east sides, and to drainage channels along the north and south sides. The tidelands on the northeast and east sides consist of the inner lagoon and outer lagoon, with an estuarine stream running along the eastern boundary continuing out toward Padilla Bay.

Padilla Bay is part of an ancient delta of the Skagit River that was abandoned by the river and currently has no substantial freshwater stream input. Water depths in Padilla Bay are shallow, with the bottom generally at an elevation of less than 12 feet below MLLW. Tidal fluctuation within Padilla Bay averages 8 feet and can vary from 3 feet to +12 feet MLLW.

2.2 Site history

This section presents a brief history of landfill operation and ownership. Figure 2 depicts changes in parcel boundary and landfill extent through time.

2.2.1 Ownership of properties at the Site

According to the Skagit County Assessor's Office, the Site area included five tax parcel numbers (P19676, P19684, P19707, P19713, and P19761) prior to the remedial investigation. However, the remedial investigation did not find contamination triggering cleanup action on tax parcel P19707; therefore, the parcel is no longer considered part of the site. Figure 3 shows parcel numbers and boundaries for the site. Ownership of the four parcels is as follows.

- The Snow Mountain Land Company, LLC (Snow Mountain) owns parcels P19713 and P19676. The State of Washington owns the aquatic lands waterward of the 1890 meander line (est.) abutting P19713 and P1967 to the railroad right-of-way.
- The Charles Moon Credit Trust owns parcel P19684.
- Ralph Hillestead, deceased, owns parcel P19761.

2.2.2 Landfill history

Prior to the 1950s, the property consisted of undeveloped tidelands lying between the main Mount Vernon-Anacortes highway and the BNSF rail line.

Landfilling began in the 1950s, when the site was used by the public as a convenient, unregulated dump site. In 1961, Skagit County applied for and received a lease from the state to operate the property as a landfill. The County operated the landfill as a "burn dump" and burned waste regularly until 1969 (Skagit County Health Department, 1990). In 1969 or 1970, the County converted the facility to a sanitary landfill. From 1969 through 1973, the landfill was the primary solid waste disposal facility in Skagit County (Skagit County Health Department, 1990). Skagit County Public Works records of waste accepted from 1970 onward indicate that waste originated from the cities of Anacortes, Burlington, La Conner, Mount Vernon, and Sedro-Woolley; rural Skagit County; Whidbey Island; and the Shell Oil Company and Texaco, Inc. refineries, among many others (GeoEngineers, 2007).

Historical documents from the early 1970s indicate that a dike was intended to be built along the southeastern margin of the landfill, apparently to better contain waste within the landfill. Aerial photographs from this same time period show a linear feature that resembles a dike extending along the current southeastern margin of the landfill, which indicates that a dike may have been constructed along the current southeastern margin of the landfill.

Limited records are available regarding the composition and quantity of any potentially hazardous substances dumped at the landfill. According to the Skagit County Health Department (Ecology, 1986), industrial wastes from Allied Chemical and Northwest Petrochemical were dumped at the landfill. Independently, other industrial wastes, including drummed wastes, are also alleged to have been dumped at the landfill. In 1973, Skagit County opened the Inman Landfill and the Whitmarsh Landfill ceased operation. Closure appears to have consisted of grading the solid waste and covering it with 2 to 3 feet of soil.

2.2.3 Recent property use and Site operations through 2015

Until approximately 2010, the northern two-thirds of the former Whitmarsh Landfill was occupied by a cedar log mill operated by Snow Mountain under a lease with Washington DNR; The former mill building foundations and the remaining former mill buildings are shown on Figures 3 and 4. The log mill had operated in this location since the late 1980s. The former mill area currently contains building foundation concrete slabs, partially dismantled buildings, and an intact shop building.

In 2014 and 2015, Washington State DNR conducted a wood waste removal project to address a 2- to 10-foot-thick layer of wood waste (mainly sawdust) left behind after removal of the log mill and associated equipment. The wood waste generally consisted of cedar bark, wood chips, and sawdust. Amec Foster Wheeler oversaw and monitored the removal of the wood waste by a Washington State DNR-selected contractor. Approximately 44,000 cubic yards of wood waste debris was hauled off site and recycled as compost material; an estimated 13,000 cubic yards of wood waste debris mixed with rock remains on site. The rock content of this debris is estimated at approximately 50 percent, and the majority of this material is stockpiled in two piles southeast of the log mill foundations as shown on Figure 4 (Amec Foster Wheeler, 2015). The rest of the residual wood waste is located near the former mill building foundation.

After this wood waste was removed, at the City of Anacortes' request, two 3- to 4-foot high berms were constructed on the east and west sides of the landfill to limit potential stormwater runoff. These berms were hydroseeded after construction. After construction of the berms, the surface of the landfill was re-surveyed, and the current topography is shown in Figure 4. The southern third of the former Whitmarsh Landfill is unoccupied and covered with light forest, blackberry brambles, and grass.

2.2.4 Zoning and future land use

The Site lies within the Anacortes city limits, and is currently zoned as "HM" or Heavy Manufacturing. Amec Foster Wheeler contacted the City's Department of Community & Economic Development, and the department confirmed that there are no plans to change the zoning for the foreseeable future (City of Anacortes, 2014).

2.3 Summary of environmental conditions

The environmental conditions for the soil, groundwater, seeps, surface water, sediments and landfill gas were discussed at length in the RI/FS Report (AMEC, 2017). Because there were no exceedances of the sediment cleanup standards associated with releases from the former Whitmarsh Landfill, but only releases from a secondary unrelated non-landfill source, the reader is directed to Section 5.2 and Appendix B of the RI/FS Report for a complete discussion of the sediment results.

2.3.1 Soil sample results

A total of 40 soil samples were collected at depths ranging from 1 to 37 feet below ground surface during monitoring well installation and the landfill test pit investigation. These include 38 primary soil samples, one field duplicate soil sample, and one sample of material collected from inside a drum recovered from test pit G30. Soil samples from monitoring well and test pit locations were submitted for laboratory analysis according to the decision criteria established in the work plans. Table 1 summarizes all upland samples collected and presents the analysis scheme.

Soil analytical results exceeding the preliminary cleanup levels (PCLs) are shown on Figure 5 and are summarized in Table 2. The complete soil analytical tables are included in Appendix L of the RI/FS Report (AMEC, 2017). Soil results that exceeded the PCLs are discussed in more detail in Section 2.3.1.1 and 2.3.1.2.

2.3.1.1 Monitoring well soil sample results

Analytical results for monitoring well soil samples that exceed PCLs are presented in Table 2. Borings MW-01 and MW-04 located on the south side of South March Point Road were determined to be hydraulically upgradient from the landfill and most likely representative of background soil conditions. Boring MW-03 was advanced through the landfill solid waste, and the well was screened within the solid waste. Wells MW-08 and MW-10 were also screened in the solid waste material, but the soil samples from these two wells were collected from the underlying, confining Bay Mud unit. Monitoring well boring logs are provided in Appendix F of the RI/FS Report (AMEC, 2017).

All monitoring well soil samples had detections of at least one metal at a concentration above the applicable PCL. One sample (from MW-03) exceeded the PCL for polychlorinated biphenyls (PCBs) (Aroclor 1254). Additional PCBs congeners (at MW-03 only) and volatile organic compounds (VOCs) were detected in other monitoring well soil samples, but none was found exceeding PCLs. No total petroleum hydrocarbons (TPH) or semivolatile organic compounds (SVOCs) were detected in any of the monitoring wells above their respective PCLs.

2.3.1.2 Test pit soil sample results

All test pit soil samples contained at least one metal at concentrations greater than PCLs (Figure 5 and Table 2). In addition, analytical results from test pit soil samples revealed the following PCL exceedances:

- Samples from three locations (G5, G32, and G35) exceeded the PCL for TPH in the gasoline range and one sample (G29) exceeded the PCL for TPH in the oil range. Benzene exceeded the PCL at G3 and G32.
- Samples from five locations (G1, G5, G29, G32, and G35) had at least one SVOCs above their respective PCLs.

- No VOCs other than benzene exceeded the respective PCLs in any test pit sample.
- Concentrations of the PCB mixture Aroclor 1254 exceeded its PCL in samples from five locations (G3, G4, G5, G6, and G32).
- Pesticides were detected at concentrations above their respective PCLs in one or more test pit soil samples: aldrin (G5), delta-BHC (G3 and G6), dieldrin (G3 and G5), 4-4’-DDD (G29), and 4,4’-DDE (G35).

The toxicity equivalents for dioxins and furans (expressed as the toxicity-equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD]) in the composite samples from G41, G42, and G43 ranged from 0.13 to 2.58 picograms per gram (pg/g), which is less than the MTCA Method B cleanup level of 12.8 pg/g for 2,3,7,8-TCDD per Ecology’s CLARC database. Complete analytical results for dioxins and furans in these samples are presented in Table L-2 in Appendix L of the RI/FS Report (AMEC, 2017).

2.3.2 Groundwater/Seep sample results

Complete analytical data for groundwater and seep samples are presented in Appendix L of the RI/FS Report (AMEC, 2017). Individual results that exceeded PCLs are presented in Table 3 and are shown on Figures 6 and 7.

2.3.2.1 Groundwater sample results

Groundwater samples were collected from monitoring wells during multiple rounds of sampling conducted from October 2009 through March 2013. Groundwater samples were collected from monitoring wells MW-02, MW-03, and MW-04 during the Phase I investigations in October and December 2008 and April and July 2009. Phase II groundwater sampling also included samples from monitoring wells MW-05, MW-06, MW-07, MW-08, MW-09, MW-10, and MW-11 in April, July, and October 2010 (Table 3). Groundwater samples were collected from MW-08 and MW-09 in March 2013 for analysis of dioxins and furans.

Samples from all monitoring wells contained several total and dissolved metals at concentrations exceeding PCLs (Table 3 and Figure 6), typically including arsenic, iron, and manganese. Concentrations of metals (i.e., arsenic and manganese) are also present in groundwater samples from MW-2 and suggests certain metals concentrations in the shallow perched groundwater within the landfill solid waste may be attributable to background contributions. SVOCs and VOCs were detected during both Phase I and Phase II sampling events. Four SVOCs—bis(2-ethylhexyl) phthalate, chrysene, 1-methylnaphthalene, and 2,4-dimethylphenol— exceeded applicable PCLs in one or more groundwater samples. Samples from wells MW-3, MW-10, and MW-11 detected pesticides (4,4’ DDD, 4,4’ DDE, and alpha-BHC) at concentrations exceeding applicable PCLs. One VOC, benzene, was detected in groundwater samples at concentrations that exceeded the applicable PCL in samples from MW-10 and MW-11. Three PCB congener mixtures (Aroclor 1232, Aroclor 1242, and Aroclor 1248) were detected in groundwater samples at concentrations that exceeded the applicable PCL: Aroclor 1232 and 1242 in MW-03 and

Aroclor 1248 in MW-06 and MW-08. No TPH was detected at concentrations greater than the PCL in any groundwater sample analyzed.

The groundwater samples collected in March 2013 from MW-08 and MW-09 did not have detections of dioxins/furans at or above the laboratory reporting limit, as shown in Table L-4 of Appendix L in the RI/FS Report (AMEC, 2017).

2.3.2.2 Seep sample results

Seep samples were collected from locations SP-01, SP-02, and SP-03 during seven sampling events from October 2008 through October 2010. Samples collected during the first four sampling events as part of the Phase I RI were analyzed for the full suite of analyses (Table 3). Samples collected during the three later sampling events during the Phase II RI were analyzed for a reduced suite of analytes plus TPH in the diesel range.

Analytical results shown in Table 3 and on Figure 7 revealed the following PCL exceedances:

- All of the seep samples had detected exceedances of total and dissolved metals (aluminum, arsenic, iron, and manganese, and one detection each for selenium and silver) during one or more sampling events. It is noted, however, that concentrations of metals collected at the upstream surface water sample location SW-01 are similar to or higher than concentrations in the seep samples, suggesting concentrations of some of the metals in the seep samples are consistent with background concentrations (RI/FS Section 7.1.3).
- Concentrations of one SVOC, 1-methylnaphthalene, exceeded the PCL in samples collected from SP-03 during the first four sampling events. No other SVOC was detected above its respective PCL in any other seep sample. SVOCs were not analyzed for during the final three sampling events.
- Benzene was detected at concentrations above its PCL in samples collected from SP-01 during the four Phase I sampling events. No other VOC exceeded its PCL.
- Concentrations of total PCBs exceeded the PCL in the samples collected at SP-03 during four sampling events. Concentrations of Aroclor 1232, 1242, and 1248 also exceeded the respective PCL in samples collected during one or more sampling events at SP-03. PCBs were not detected at concentrations greater than the PCL during the July and October 2010 sampling events at SP-03. Aroclor 1232 also exceeded the PCL in one sample collected at SP-02 in April 2009.
- One pesticide, 4,4’-DDE, exceeded its PCL in a single sample collected at SP-01 in July 2010. No other pesticides exceeded applicable PCLs. The analytical result is estimated due to variability between the two chromatographic columns used in the analysis.
- TPH in the diesel range and several other SVOCs and VOCs were detected in seep samples collected during Phase I and Phase II, but no additional analytes exceeded the applicable PCL.

2.3.3 Surface water samples

Surface water samples were collected during all seven Phase I and Phase II sampling events from locations SW-01, SW-03, SW-04, SW-05, and SW-06. Samples were collected from SW-07 only during the December 2008 and April 2009 sampling events. SW-02 was not sampled during any of the sampling events because the location was dry.

Surface water samples were analyzed for the full suite of analyses during the Phase I sampling events and for a reduced suite of analyses during the Phase II sampling events, as shown in Table 4.

Analytical results shown in Table 4 and on Figure 8 revealed the following PCL exceedances:

- Samples from all surface water sampling locations contained concentrations of several total and dissolved metals greater than the PCLs during one or more sampling events, although arsenic was the most commonly detected metal.
- The pesticide 4,4' DDD was detected in one sample collected at SW-06 in December 2008 exceeding the PCL. However, 4,4' DDD was not detected during any other sampling events at this location. No other pesticide exceeded its applicable PCL.
- Three SVOCs exceeded PCLs at one location during one sampling event: butyl benzyl phthalate at SW-05 in October 2008, bis(2-ethylhexyl) phthalate at SW-01 in December 2008, and chrysene at SW-01 in July 2009.
- The concentration of benzene exceeded its PCL in samples from SW-07 in December 2008 and April 2009.

Selected other SVOCs and VOCs were detected during Phase I sampling events, but no other detected concentrations exceeded the associated PCL.

2.3.4 Sediment results

A sediment investigation and watershed study was performed at the Site from 2008 through 2011. Sediment samples were collected from the inner lagoon, the swale located south of the landfill, and a portion of the outer lagoon during four rounds of sediment sampling. It was concluded based on the results of the sediment investigation that the seep discharges from the landfill do not have a negative effect on the sediment biota (RI/FS Section 7.1.3; Appendix B). Therefore, no impacts on sediments in the inner lagoon or Padilla Bay associated with the landfill were identified (RI/FS Section 5.2).

2.3.5 Landfill gas monitoring results

The landfill gas (LFG) monitoring data collected in 2011 and 2012 are summarized in Table 5. Methane concentrations measured in April 2012 are plotted on Figure 9. The highest LFG readings coincided with the thickest accumulations of wood waste in the center of the site at

LFGP-04, with a maximum methane concentration of approximately 70 percent and a maximum carbon dioxide concentration of approximately 32 percent.

Elevated LFG concentrations may have correlated to the thickness of wood waste placed above the original soil cover across the site. This correlation would be consistent with the expected pattern of LFG generation. The LFG at the site was more likely generated by the wood waste rather than landfill solid waste, because the wood waste was only 4 to 20 years old, and the solid waste had been graded and covered with 2-3 feet of soil (RI/FS, Section 2.2.2) for at least 40 years. In addition, much of the solid waste deposited prior to 1969 was burned and therefore had a lower organic content than wood. However, it should be noted that LFG data do not differentiate between sources. LFG data represent the combined gas production of all on-site organic material.

The bulk of the wood waste was removed from the landfill in 2014 (Section 2.2.3). Copies of the methane monitoring memoranda are included in Appendix H of the RI/FS Report (AMEC, 2017).

2.4 Conceptual site model

This section describes the current conceptual site model (Figure 10) that was developed based on the Phase I and Phase II RIs, as well as available historical data and the exposure pathways and receptors at the site.

2.4.1 Geology

The regional geology was discussed in Section 3.1 of the RI/FS Work Plan (AMEC, 2008). The geology in the vicinity of the site was shaped by a complex history of accretion, mountain orogeny, igneous intrusions, and deposition of terrestrial and marine sediments (Savoca et. al., 2009). The area has been repeatedly overridden by advancing and retreating continental glaciers, including the most recent stage of glaciations (the Vashon Stade of the Frasier glaciation) about 17,000 years ago. During the last glaciation, the Skagit River valley was excavated by submarine meltwater. Upon deglaciation, this area was filled by fluvial, estuarine, and deltaic deposits during the Holocene. These Holocene deposits represent most of the lowland surficial deposits observed in the vicinity of the site.

Based on the RI field investigations, the stratigraphy at the site is interpreted as shown on Figures 11 and 12. Most of the site, excluding the southwestern-most part, was covered by wood waste. The wood waste was generated during operation of the log mill at the site. The maximum observed thickness of wood waste (10 feet) was found in boring MW-10, located in the central part of the sawmill operations. From there, the thickness of wood waste decreased to the northwest and southeast. Wood waste is not present above the solid waste in the northwestern and southeastern parts of the site.

Underlying the wood waste was a 1-foot to 3-foot layer of cover soil, generally consisting of silty sand overlying the solid waste. This silty sandy cover soil was present in many of the test pits and borings, though in some cases the cover material has settled into the solid waste. The solid waste varies from approximately 8 to 16 feet in thickness (Figures 11 and 12). The approximate volume of solid waste is estimated to be approximately 300,000 cubic yards. The solid waste consists of burnt and unburnt municipal solid wastes. Neither large numbers of drums nor other sources of hazardous or dangerous waste were identified within the landfill during the Phase I and Phase II investigation. Crushed drums were identified in only three out of a total of eleven test pits, located where anomalies were detected during the geophysical survey.

Along the southeastern portion of the site is a buried “dike-like” feature consisting in some areas of low-permeability organic silt; in other areas the dike appeared to be constructed of poorly- and well-graded sand that was apparently constructed in the 1970s to contain the solid waste. The hydraulic conductivity of organic silt material is low (4.43 x 10^{-6} cm/s) and appears to restrict discharge of groundwater as seeps along this portion of the landfill (Figure 11).

Stratigraphy beneath the wood waste, cover soil, and landfill solid waste consists of the following units (from shallowest to deepest):

- **Silt to Peat Unit**: This unit was found only at MW-04 and consists of silt with various amounts of peat. The unit is up to 16 feet thick and is likely an onshore continuation of the Bay Mud observed in test pits below the landfill solid waste.
- **Poorly Graded Gravel Unit** (potential old roadbed material): This unit was observed in the bottom of test pits G21 and G23, and potentially within the fill in boring PZ-02. This unit consists of poorly graded gravels with fine to coarse sand. Based on the location where this unit is encountered, the linear features observed in historical aerial photographs, and the anomaly identified during the geophysical study, this unit is interpreted as an old roadbed.
- **Padilla Bay Mud Unit**: This unit was found below the landfill solid waste in several test pits (G3, G7, G11, G18, G19, and G38), and in all borings except PZ-02 and MW-07. This tide flat deposit consists of silt with various amounts of clay or a lean clay and organics (peat-like material). The thickness of this unit, where fully penetrated, ranges from inches (MW-06) to 9.5 feet (MW-05).
- **Poorly Graded to Well Graded Sand Unit** (Recessional Outwash/Lower Aquifer): This unit is found in borings MW-01, MW-02, MW-04, MW-05, MW-06, MW-07, MW-08, MW-10, PZ-02, and PZ-03; and test pits G-18, G-19, and G-38. This unit consists of poorly- to well-graded sand with little or no fines. This unit is up to 31 feet thick (as evident in MW-01). This unit is mapped as Qago (Alluvial and Recessional Outwash Aquifer), and is dated to the Holocene or Pleistocene Epoch based on Schuster (2000).
- **Lean Clay Unit (till)**: This unit is found in MW-01, MW-02, and MW-04. This unit is very stiff, lean clay with occasional fine sand laminations and is not fully penetrated in

any boring where encountered. This unit is mapped as Qgt (Till Confining Unit), and is a glacial till unit dated to the Pleistocene Epoch based on Schuster (2000).

Lithologic data from monitoring wells (Figures 11 and 12) suggest that the landfill material is underlain by native Bay Mud in thicknesses up to approximately 9.5 feet over most of the site. Based on the local topography and the lithological information from test pits G21 and G23 as well as boring PZ-02, it appears that the solid waste is underlain by an old roadbed and associated fill material along the eastern edge. This potential roadbed material is found stratigraphically higher than the Bay Mud (and Lower Aquifer unit) encountered elsewhere at the site.

It is assumed that the Bay Mud unit is continuous beneath the landfill. The Bay Mud is underlain by a glacial outwash sand unit (Lower Aquifer). The Bay Mud likely acts like an aquitard, separating shallow groundwater in the landfill material from lower water-bearing zones. This is supported by hydrograph data (Figure 13), which indicates that the Lower Aquifer is tidally influenced, while most shallow groundwater within the solid waste landfill material above the aquitard is not tidally influenced.

2.4.2 Groundwater elevations and flow directions

The hydrogeological investigations have identified two main groundwater systems at the site (Figures 11 and 12):

- Shallow, perched groundwater/leachate within the solid waste inside the footprint of the former Whitmarsh Landfill; and
- A Lower Aquifer within recessional outwash sands (Qago unit).

The Bay Mud functions as an aquitard between the solid waste and the Lower Aquifer. It appears that the upgradient, shallow groundwater zone between MW-02 and MW-04 is hydraulically disconnected from shallow groundwater within the landfill footprint and is more likely connected to the Lower Aquifer. Groundwater elevations measured in upgradient, off-site monitoring wells MW-02 and MW-04 are significantly higher than wells observed within the landfill footprint (Figure 11). The swale along South March Point Road (shown on cross section A-A’ in Figure 11) should act as a discharge zone for upgradient groundwater and the groundwater in the waste, if there were hydraulic connectivity between these two water-bearing zones. However, surface flow in the swale appears to be limited to seasonal precipitation, and occasional influx of tidally-influenced surface water from the inner lagoon. At high tide, water in the swale has been observed to extend just south of monitoring well MW-02, suggesting that groundwater at MW-04 and as far north as MW-02 might be disconnected from groundwater within the landfill. Based on these findings, it appears that the upgradient, shallow groundwater zone between MW-02 and MW-04 is hydraulically disconnected from the shallow perched groundwater within the solid waste landfill footprint and is more likely connected to the Lower Aquifer.

It appears, based on the potentiometric maps (Figures 16 through 19 of the RI/FS Report [AMEC, 2017]) and current local topography (Figure 4), that a groundwater ridge is present southeast of the sawmill building that extends to the southeast corner of the site. Monitoring well MW-03 is located within the solid waste footprint. However, based on the potentiometric maps, the well location is on the upgradient end of the landfill. Groundwater in the solid waste east of the groundwater ridge flows toward the inner lagoon and the seeps seen at SP-01, SP-02, and SP-03. Groundwater in the solid waste west of the groundwater ridge flows toward the swale bordering the southwest side of the landfill. The swale may receive discharge both from upgradient groundwater on the west (outside the landfill) and southwest side of South March Point Road and from groundwater beneath and within the landfill, though direct discharge of groundwater from the solid waste was not observed. Surface water is present in the swale during the winter and spring, and dries out during the summer, with the exception of high tides reaching up the swale. Surface water within the swale ultimately flows into the inner lagoon south of the landfill boundary.

No seeps were observed along the southern landfill shoreline of the inner lagoon. The southern landfill shoreline is the approximate location of a linear dike-like feature observed along the eastern extent of the landfill area in historical aerial photographs from 1972 (Figure 2). Soils encountered at MW-05, G16, G17.5, and G18 showed properties consistent with material that could potentially have been used for a dike. The hydraulic conductivity of the dike-like material collected from G17.5 was 4.43×10^{-6} centimeters per second [cm/s], which is three orders of magnitude less than published hydraulic conductivity values (ranging from 1.3 to 8.8×10^{-3} cm/s) for solid waste material (Penmethsa, 2007). It should be noted that the actual permeability of solid waste varies depending on component material, age, and the amount of compaction (Reddy et al., 2009). It is likely that the solid waste at the landfill has a higher permeability than the dike-like feature. Thus, the dike-like feature could act as a hydraulic barrier at the site, diverting groundwater flow to the southern or southwestern edge of the site, which explains the absence of seeps along this part of the landfill.

Seeps observed at the northern end of the landfill enter the inner lagoon and are encountered in approximately the same location as seeps referred to in historical reports. In addition, surface water observed at location SW-07 was similar in color and odor to seep water encountered at location SP-01 during the December 2008 sampling event. These observations may suggest that a dike does not extend north to this part of the landfill boundary. Historic aerial photographs also indicate that this northern boundary was created as landfill material was being deposited and later armored with large concrete debris (visible today) when landfill operations ended.

2.4.3 Subsurface migration of contaminants

The conceptual site model (Figure 10) suggests that limited areas exist along the landfill boundary where groundwater within the solid waste is seeping, or has the potential to seep, into surface water. These areas are predominantly in the eastern part of the swale south of the site and the northeastern landfill boundary within the inner lagoon. Further, the landfill solid waste extends northwesterly at least to the locations of G38, G39, and G40.

Soil samples collected from within the landfill footprint indicate that selected metals, PCBs (Aroclor 1254) and pesticides exceeded the PCLs in soil samples across the site. TPH in the gasoline and oil ranges and benzene were identified exceeding the PCLs at only a few locations. Arsenic, barium, copper, and nickel were detected in soil samples outside the landfill footprint at concentrations that exceed the PCL. Concentrations of arsenic in soil samples collected within the solid waste were within the range of concentrations in soil samples outside the landfill footprint. Ecology has not established a background value for barium in the Puget Sound Basin (Ecology, 1994). See Section 2.3.1 for a detailed discussion of PCL exceedances in soil.

Groundwater samples collected from monitoring wells at the site also indicate that several metals (both total and dissolved) exceeded their PCLs, especially arsenic and the redox-sensitive metals iron and manganese. The pesticides, 4,4'-DDD and/or 4,4'-DDE, as well as PCBs and SVOCs, were noted above their respective PCLs in only a few groundwater samples. See Section 2.3.2 for a detailed discussion of PCL exceedances in groundwater. As with groundwater, seep water samples indicate that several metals (both total and dissolved) exceeded their PCLs, especially the redox-sensitive metals iron and manganese. It is noted, however, that concentrations of metals collected at the upstream surface water location SW-01 are similar to or higher than concentrations in the seep samples, suggesting concentrations of metals in the seep samples may represent background concentrations (RI/FS Section 7.1.3). 4,4'-DDE was noted in one seep sample and individual PCB Aroclors were noted above the respective PCLs in several seep water samples. See Section 2.3.2 for a detailed discussion of PCL exceedances in seep water.

Most of the elevated 4,4'-DDE and PCB concentrations were observed during the winter and spring months. These findings potentially indicate that small amounts of groundwater from within the landfill may possibly seep into the inner lagoon during the wet season. Based on the sediment bioassays conducted as part of the RI, the seep discharges do not have a negative effect on the sediment biota (Appendix B of the RI/FS Report (AMEC, 2017).

Similar concentrations of metals were noted in samples collected at the upgradient surface water sample location SW-01 and in samples collected at downstream sample locations, which may suggest that the downgradient surface water samples represent contributions from an off-site source. Surface water samples contained higher concentrations of total metals than dissolved metals, suggesting that entrained sediment in the water samples may have affected these results (as shown by high concentrations of dissolved aluminum, a very abundant element present in many minerals).

Iron and manganese are also common mineral components and since metals samples are preserved at a pH of less than 2, sediment introduced into the bottle can dissolve, causing higher apparent dissolved metals concentrations. Site conditions strongly suggest that elevated concentrations of iron and manganese observed in groundwater have resulted from redox conditions caused by the decomposition of organic matter at the site. The low concentrations of dissolved oxygen (<1.0 milligrams per liter) and the negative oxidation reduction potential readings in some of the samples from the monitoring wells indicate anoxic conditions. The anoxic conditions, the high organic content of nearby sediments, and the concentrations of iron and manganese in the groundwater indicate that naturally-occurring, bacterially mediated degradation of organic matter and reduction of manganese oxides and iron oxides/hydroxides is producing the high levels of dissolved iron and manganese that are detected in the groundwater samples.

2.4.4 Landfill gas migration

LFG at the landfill was monitored from 2010 through 2012. Selected monitoring data are presented in Table 5 and are shown on Figure 9. The sampling and monitoring results show that the highest concentrations of methane generally coincided with the thickest accumulations of wood waste. One of the requirements in WAC-173-304-460 is that no explosive levels of methane are allowed beyond the property line.

The highest concentrations of LFG and methane were detected in LFGP-04, with a maximum methane concentration of approximately 70 percent and a maximum carbon dioxide concentration of approximately 32 percent. This probe was installed in the area with one of the thickest accumulations of wood waste. There may have been a correlation between wood waste thickness and LFG percent; however, the LFG data do not differentiate between sources. It is not known whether there is a correlation between LFG percent and solid waste characteristics such as organic content, or whether wood waste thickness correlates to lower release rates of LFG generated by solid waste. From the 1950s through 1969 or 1970, the landfill operated as a "burn dump" with open incineration of solid waste. Accumulation of unburned solid waste occurred only over a four-year span ending in 1973. This solid waste has had over 40 years to degrade, so the quantities of methane generated is anticipated to be significantly reduced in the future.

The removal of the wood waste conducted in late 2014 minimizes a potential source of LFG and lessens the likelihood of differential settlement of the consolidated solid waste. Settlement can contribute to slope failures and ponding, which may tear the cover material.

2.4.5 Potential source areas

The primary potential source area for COCs is the footprint of the former Whitmarsh Landfill that includes the small area of solid waste outside the main gate at the site. The landfill was closed in 1973 and the solid waste covered by 2 to 3 feet of silty sand. Stormwater infiltrates through the landfill cover and into the solid waste, and generates leachate that appears to pond up on underlying Bay Mud and seep out of the landfill along the northwest corner of the lagoon adjacent to the BNSF tracks.

2.4.6 Transport mechanism and water input

Figure 13 is a hydrograph showing variations in groundwater water level elevation over time along with tidal water level fluctuations. This hydrograph shows that:

- Groundwater levels within the solid waste are generally higher than tidally influenced surface water levels in the inner lagoon.
- Groundwater levels within the solid waste are generally higher than the water levels in the Lower Aquifer monitoring wells MW-05 and MW-07, and the majority of vertical hydraulic gradients measured were negative, indicating downward directed flow from the solid waste to the Lower Aquifer (Table 6).
- Groundwater levels within the solid waste are mainly influenced by seasonal precipitation, with higher elevations seen in the spring and corresponding decreases in water levels through the summer and early fall.
- Groundwater levels within the solid waste display no tidal influence, except where the Bay Mud thins (Figure 13).

At the northwest corner of the former landfill, there is an area where there is no swale on the west side of the landfill to either route surface water away or potentially intercept shallow groundwater that might flow laterally into the solid waste. While the majority of water infiltrating the solid waste is likely due to vertical infiltration, there may be a small area of the landfill at the northwest edge where lateral infiltration may be occurring.

2.4.7 Potential exposure pathways and receptors

This section details the exposure pathways and receptors for both human health and terrestrial ecological receptors.

2.4.7.1 Human health exposure pathways and receptors

Access to the site is restricted by fencing and a locked gate at the northern end of the site. Currently most of the solid waste is covered by the silty sand cover and the wood waste. As shown in Figure 10, potential and complete exposure pathways at the site under the current conditions are:

- Direct human exposure to solid waste through construction activities such as utility work, especially at the north end of the landfill where solid waste was observed outside of the locked gate near South March Point Road. Currently the public can be exposed to leachate seeping out of the landfill along the shallow swale between the landfill and the BNSF railroad embankment.
- Seasonal infiltration of surface water into the solid waste, causing groundwater mounding and subsequent discharge of groundwater through seeps, where it could eventually affect marine biota. Both the groundwater in the solid waste and the seep water have high

concentrations of redox-sensitive metals such as iron and manganese (see Section 2.3.2). Groundwater, which can be found in the solid waste, is anoxic in some areas. Under anoxic conditions, redox-sensitive metals (iron and manganese, etc.) are soluble and can be transported along groundwater flow paths. The presence of contaminants in the seep water samples suggest that contaminated groundwater from the site is discharging from the seeps into Padilla Bay which is also supported by the presence of orange-staining associated with oxidation of dissolved iron in the leachate as the leachate is exposed to the atmosphere.

- Migration of shallow groundwater through the Bay Mud into the underlying Lower Aquifer, especially where it is thin or absent, and subsequent discharge to surface waters or marine sediment where it could affect marine biota.
- Potential exposure of solid waste through erosion and direct release to surface waters/marine sediment of the inner lagoon where it could affect marine biota.
- Volatilization, dust emission, and inhalation of chemicals and methane gas generated from solid waste.

2.4.7.2 Terrestrial ecological exposure pathways and receptors

As stated in WAC 173-340-7491(1)(b), an exemption from a terrestrial ecological evaluation (TEE) is appropriate when "all soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination." Exclusion from a TEE requires an institutional control under WAC 173-340-440. If the preferred remedial alternative isolates the solid waste and soil from the environment and establishes institutional controls meeting the requirements of WAC 173-340-440, an exclusion from the requirement for a TEE can be requested from Ecology.

If the preferred remedial alternative does not isolate the solid waste from the environment (for instance, if burrowing animals can breach the cover liner) then a TEE will need to be completed in order to show whether or not the preferred remedial alternative poses a risk to the burrowing animals or if additional engineering steps are necessary to isolate the solid waste from the environment. In either case, institutional controls meeting the requirements of WAC 173-340-440 must be implemented.

3.0 Cleanup requirements

The MTCA cleanup regulations provide that a cleanup action must comply with site-specific cleanup standards (WAC 173-340-700), which include cleanup levels (CLs) for hazardous substances, points of compliance, and applicable or relevant and appropriate requirements (ARARs) based on federal and state laws (WAC 173-340-710). The Site CLs, points of compliance, and ARARs for the selected cleanup remedy are briefly summarized in the following sections.

3.1 Human health and environmental concerns

After the selected site cleanup action is constructed, there should be no human health concerns, no terrestrial ecological concerns, nor any other environmental concerns associated with the landfill. The cap is designed to prevent exposure to the solid waste through engineering controls, with a cover design including a layer of crushed rock to discourage burrowing animals. Furthermore, the cap should cut off shallow groundwater and prevent it from migrating and discharging as seeps. An environmental covenant with institutional controls and fencing will secure access to the site and its associated control systems.

3.2 Indicator hazardous substances

Under MTCA, *"indicator hazardous substances"* means the subset of hazardous, toxic, and/or deleterious substances present at a site that are monitored and analyzed during any phase of remedial action for the purpose of characterizing the site or establishing cleanup requirements for that site. Consistent with WAC 173-340-703, when defining cleanup requirements at a site that is contaminated with a relatively large number of constituents of potential concern (COPCs), Ecology may eliminate from consideration those hazardous substances that contribute only a small percentage of the overall threat to human health and the environment. The remaining COPCs can then serve as indicator hazardous substances for purposes of defining site cleanup requirements.

As outlined in Table 8, the list of indicator hazardous substances in groundwater and seeps identified at the site includes:

- Metals: arsenic, copper, iron, lead, manganese, mercury, selenium and silver;
- SVOCs: 1-methylnaphthalene, 2,4-dimethylphenol, benzo(a)anthracene, and chrysene;
- VOCs: benzene; and
- Total PCBs and the DDT breakdown products 4-4' DDD and 4-4' DDE.

Bis(2-Ethylhexyl)phthalate was detected in a single seep sample; because this compound is a common laboratory contaminant and plasticizer, it will not be included as an indicator of hazardous substance.

3.3 Final constituents of concern and cleanup levels

This section identifies the final list of COCs and presents final cleanup levels for the site.

3.3.1 Final constituents of concern

Analytical results for detected analytes from all samples were compared to the PCLs presented in Section 4.2 of the RI/FS Report (AMEC, 2017). Constituents that were detected in at least one sample at a concentration that exceeded the PCL were chosen as COCs for the site. The COCs for soil, groundwater/seeps, and surface water are presented in Tables 7, 8, and 9, respectively.

3.3.2 Final cleanup levels

Final cleanup levels are determined only for the final COCs for the site, identified as described in Section 3.3.1. Final cleanup levels for some hazardous substances have been adjusted downward in accordance with WAC 173-340-705(4) (multiple hazardous substances or pathways). Cleanup levels were adjusted downward if the total combined excess cancer risk potential (calculated in accordance with MTCA methods) for the carcinogenic substances exceeded one in 100,000 (1 x 10^5), or if the hazard index calculated in accordance with MTCA methods exceeded 1. The hazard index is calculated by summing hazard quotients for individual COCs. The cleanup levels applicable to the COC must be adjusted to meet these two total risk criteria.

Table 10 presents the final cleanup levels for soil, groundwater/seeps, and surface water. Documentation of total risk calculations is provided in Appendix J of the RI/FS Report (AMEC, 2017).

3.4 Points of compliance

Under MTCA, the POC is the point or location on a site where the cleanup levels must be attained. The POC for soil, based on WAC 173-340-740(6), is throughout the site. MTCA recognizes that for those cleanup actions that involve containment of hazardous substances, the soil cleanup levels will typically not be met throughout the site (WAC 173-340-740(6)(f)). However, MTCA also recognizes that such cleanup actions may still comply with cleanup standards.

For these cases, and for the March Point Landfill site, containment of hazardous substances in soil is required. However, instead of the soil concentrations complying with a numerical standard, the determination of the adequacy of soil cleanup is based on the ability of the remedial action to comply with groundwater cleanup standards for the site, to meet performance standards designed to minimize human or environmental exposure, and, if applicable, to provide treatment of affected soil. Performance standards to minimize human and environmental exposure to affected soil include institutional controls that limit activities that interfere with the protectiveness of the cleanup action, as well as compliance monitoring and periodic reviews to ensure the long-term integrity of the containment system (WAC 173-340-740(6)(f)(i)-(vi)).

The following sections describe POCs for LFG and for water that may migrate from the Site. There are two differing POCs for water at the Site:

- A conditional point of compliance (CPOC) for groundwater migrating from the former landfill; and
- A POC for surface water seeps (seeps) if any exist after completion of the cleanup action.

Sections 3.4.1 through 3.4.3 describe these different kinds of POCs.

3.4.1 Groundwater conditional points of compliance

The selected remedial alternative involves a low-permeability cap to limit stormwater infiltration that is tied into the low-permeability Bay Mud to reduce lateral flow of groundwater beyond the existing landfill footprint (see Section 5). As such, once remedial measures are implemented, movement of groundwater within the solid waste will be mainly restricted to downward vertical migration through the Bay Mud underlying the solid waste. Because groundwater cleanup levels are based upon protection of marine surface water and not protection of groundwater as drinking water, the point of greatest concern is the marine shoreline on the northeast and east sides of the landfill. Therefore the CPOC will be established in a series of wells installed through the solid waste and the Bay Mud near the edge of the landfill. A series of monitoring wells will be installed along the shoreline into the first aquifer underlying the Bay Mud (Lower Aquifer) and monitored for water quality on a periodic basis.

Although we refer to water in the solid waste as "groundwater," WAC 173-304 defines the water as "leachate." However, the solid waste has been covered with a permeable silty sand cover for several decades, and the landfill has no bottom liner except for that provided by the Bay Mud. So while the water in the solid waste is technically leachate, ongoing infiltration of stormwater over many years has leached material from the solid waste so that the water acts like a perched groundwater body within the unconfined solid waste.

During installation of the low-permeability cap, it will be necessary to lower the groundwater, or leachate, as the cap is constructed. This will reduce the amount of leachate within the solid waste. The cap material will be tied into the underlying Bay Mud along the shoreline, which should eliminate the pathway for groundwater to emerge as seeps along the lagoon shoreline. The CPOC wells installed in the first aquifer beneath the solid waste (the Lower Aquifer) will be paired with wells installed into the solid waste. These well pairs will be used to monitor the response of groundwater/leachate within the solid waste in comparison to the water level in the Lower Aquifer.

As shown during the RI, the hydraulic head in the solid waste was higher than the head in the Lower Aquifer, implying vertically downward-directed groundwater flow. Therefore, we expect the leachate level within the solid waste to slowly diminish as the low-permeability cap eliminates infiltration and the leachate level equilibrates with the average groundwater elevation in the underlying aquifer.

Water levels will be measured quarterly for the first two years, and twice a year (wet season/dry season) thereafter from these well pairs to ensure that the water levels in the solid waste are approaching the water levels of wells completed in the Lower Aquifer. In addition, water samples will be collected quarterly for the first two years, and twice a year (wet season/dry season) thereafter from wells completed in the Lower Aquifer and tested as required by WAC 173-304. Compliance samples will not be collected from wells installed in the solid waste, as this water is considered to be leachate, as described above. Leachate from the solid waste will be reduced to prevent contamination of the groundwater in the lower aquifer, where water samples will be collected for compliance purposes.

3.4.2 Surface water (seeps) points of compliance

Lateral movement of groundwater and leachate migrating to the lagoon will be monitored by looking for seeps emerging from the shoreline at low tide. These visual seep inspections will be conducted, whenever possible, at or near low tide (when the hydraulic head difference between the leachate in the solid waste and the water in the Lower Aquifer is at a maximum). Seeps should be most visible at this time. It should be noted that surface water will infiltrate the landfill cover materials up to the low-permeability cap during the previous high tide, and this water will drain from the cover materials at low tide. A distinguishing characteristic of some of the current and historic seeps are the high concentrations of dissolved iron seen in the seep water and the characteristic orange staining of the sediments. The orange staining is due to reducing conditions within the waste, causing iron to dissolve in the leachate. This reduced iron oxidizes when exposed to the atmosphere and precipitates. Seeps without noticeable discoloration would potentially represent tidal seepage rather than leachate seepage; however, sampling will occur if the seep is observed in the same location on a continued basis (i.e., occurring more than once). Location of any seepage will be determined using GPS to allow relocation of seeps in the future. The POC for seeps will be the inner lagoon shoreline, where the cap cover materials meet the inner lagoon sediments or anywhere nearby where seeps are observed on a continued basis.

The seeps will be monitored quarterly within a week of a large rainfall event with precipitation exceeding 1 inch on a single day, or after a "king tide" or a higher than typical tide. If no leachate-related seeps are observed in connection with large rainfall events or king tides during the first year of monitoring, seep monitoring will decrease to semi-annual with one wet season and one dry season event. In addition to visual monitoring, the leachate wells will be equipped with pressure transducers that will record water levels. Data from these transducers can be correlated with precipitation and if there is a leak in the cap, leachate levels will rise in conjunction with the larger rainfall events. If such a pattern is noticed, additional seep monitoring can be scheduled.

3.4.3 Landfill gas point of compliance

The landfill abuts the BNSF railroad tracks, the inner lagoon, South March Point Road, and the adjacent hillside. WAC 173-340-750 (3) states that standard Method B air cleanup levels shall not exceed 10 percent of the lower explosive limit (LEL) for any hazardous substance or mixture of hazardous substances. WAC 173-304-460(2)(b) states that methane shall not exceed the LEL of 5 percent at the boundary of the landfill or off site. Therefore, methane shall not exceed 0.5 percent. We expect the methane to vent passively from the cap and not to migrate laterally away from the landfill. However, LFG has the potential to migrate off site to the west and northwest, between South March Point Road and the BNSF railroad tracks. Plans include the installation of two gas probes within 100 to150 feet outside the landfill footprint, which can be used to detect LFG if evidence suggests LFG may be moving off site.

Field testing will be conducted with a Landtec GEM 500 LFG meter or the equivalent. The meter will extract gasses from the probes and measure the percentages of methane, oxygen, carbon dioxide, or balance (typically considered to represent the percentage of nitrogen in the sample). Laboratory testing of the LFG is not required.

3.5 Applicable or relevant and appropriate requirements

In addition to the cleanup levels presented in Section 3.3, other regulatory requirements must be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be *"at least as stringent as all applicable state and federal laws"* (WAC 173-340-700(6)(a)). Besides establishing minimum requirements for cleanup standards, applicable state and federal laws also may impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710.

The cleanup action at the site will be performed pursuant to MTCA under the terms of the current Agreed Order and/or a future Consent Decree between Ecology and the March Point PLP Group. Accordingly, the anticipated cleanup action meets the permit exemption provisions of MTCA. Ecology will be responsible for issuing the final approval for the cleanup action, following consultation with other state and local regulators.

Although the cleanup action will be exempt from some state and local permits in accordance with the Agreed Order, several permits/approvals/processes will be required from local, state, and federal agencies. A discussion of each of the anticipated permits/approvals/processes is provided below. A Joint Aquatic Resources Permit Application will be used to apply for the

Shoreline Substantial Development Permit, the 401 Water Quality Certification/Modification, and the U.S. Army Corps of Engineers (USACE) Section 10/404 Permit.

3.5.1 Minimum functional standards for solid waste handling (WAC 173-304)

The MTCA regulations, under Section WAC 173-340-710(7)(c), state that cleanup actions completed under MTCA must meet the landfill closure requirements as specified in WAC 173-304. WAC 173 304, the Minimum Functional Standards for Solid Waste Handling, specifies requirements for construction and operation of solid waste landfills in Washington. In addition, Ecology has determined that the closure requirements in WAC 173-303 (Dangerous Waste Regulations) are legal ARARs; therefore, the more stringent closure requirements under those laws shall also apply to cleanup actions conducted.

As described in WAC 173-304-407(3), the March Point Landfill Site shall be closed in a manner that:

1. Minimizes the need for further maintenance.
2. Controls, minimizes, or eliminates threats to human health and the environment from post-closure escape of municipal solid waste constituents, leachate, LFG, and contaminated rainfall or waste decomposition products to the ground, groundwater, surface water, and the atmosphere.
3. Prepares the site for the post-closure period. The continued facility maintenance and monitoring of air, land, and water are necessary for the facility to stabilize and protect human health and the environment.

3.5.2 Model Toxics Control Act requirements

The main law that governs the cleanup of contaminated sites in the state of Washington is MTCA. The MTCA Cleanup Regulation (WAC 173-340) specifies criteria for the evaluation and conduct of a cleanup action, including criteria for developing cleanup standards. MTCA regulations require that cleanup actions must protect human health and the environment, meet environmental standards in other applicable laws, and provide for monitoring to confirm compliance with cleanup levels.

MTCA places certain requirements on cleanup actions involving containment of hazardous substances that must be met for the cleanup action to be considered in compliance with cleanup standards. These requirements include implementing a compliance monitoring program that is designed to assess the long-term integrity of the containment system and applying institutional controls to the affected area (WAC 173-340-440). There are minimum requirements that must be met in order for a remedial alternative to comply with the requirements of MTCA. In order to meet the requirements of MTCA, the selected remedy must be protective of human health and the environment under the specified exposure conditions. WAC 173-340-360(2)(a) specifies four threshold criteria that all cleanup actions must satisfy.

The threshold criteria are:

1. Protect human health and the environment.
2. Comply with cleanup standards (per WAC 173-340-700 through WAC 173-340-760).
3. Comply with applicable local, state, and federal laws (per WAC 173-340-710).
4. Provide for compliance monitoring (per WAC 173-340-410 and WAC 173-340-720 through WAC 173-340-760).

In addition, WAC 173-340-360(2)(b) specifies three other criteria that alternatives must achieve:

1. Use permanent solutions to the maximum extent practicable.
2. Provide for a reasonable restoration time frame.
3. Consider public concerns (WAC 173-340-600).

Because of the various size and history of landfills, Washington State has determined that it is often impracticable to treat or move a closed solid waste landfill and has outlined specific requirements (refer to WAC 173-340-710(7)(c)) that allow a solid waste landfill to be closed in place in a manner that meets the MTCA criteria identified above.

MTCA defines the expectation for containment sites as follows:

> The department recognizes that, for those cleanup actions selected under this chapter that involve containment of hazardous substances, the soil cleanup levels will typically not be met at the points of compliance specified in (b) through (e) of this subsection. In these cases, the cleanup action may be determined to comply with cleanup standards, provided:
>
> (i) The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;
>
> (ii) The cleanup action is protective of human health. The department may require a site-specific human health risk assessment conforming to the requirements of this chapter to demonstrate that the cleanup action is protective of human health;
>
> (iii) The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;
>
> (iv) Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;

> (v) Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system; and
>
> (vi) The types, levels, and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the draft cleanup action plan.

WAC 173-340-740(6)(f).

The specific remedy selected for the March Point Landfill site described in Sections 4 and 5 of this CAP demonstrate that the all elements of containment are met, as defined by sections (i) through (iv) above.

3.5.3 Endangered Species Act Section 7 consultation

The Endangered Species Act (ESA) of 1973, as amended (16 United States Code [USC] § 1531), provides *"... a means whereby the ecosystems upon which endangered species depend may be conserved."* On May 24, 1999, the U.S. National Oceanographic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) formalized the listing of Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) as threatened under the ESA. NOAA Fisheries has designated the coho salmon (*O. kisutch*) as a candidate for listing. The U.S. Fish & Wildlife Service (USFWS) listed bull trout (*Salvelinus confluentus*) in Puget Sound as threatened, effective December 1, 1999. The potential presence of these species in the project area may require consultation with NOAA Fisheries and USFWS regarding the effects of the preferred Alternative on Chinook and coho salmon, and bull trout and associated habitat under Section 7 of the ESA.

3.5.4 United States Army Corps of Engineers Section 10/404 permit

The Rivers and Harbors Act of 1899 (33 USC § 403;33 Code of Federal Regulations [CFR] 321-329) gives the USACE regulatory authority over construction activities in all navigable waters of the United States. Section 10 of the act is intended to protect these waters for purposes of navigation and general public benefit. This regulation is administered through the Section 10 Permit application process.

Section 404 of the Clean Water Act (33 USC 1344) prescribes procedures to be followed before dredged or fill materials can be discharged into national water resources (including wetlands). As such, Section 404 provides regulatory guidelines and permit requirements for dredging and filling activities. Administration of the requirements of Section 404 is vested in the USACE. When both a Section 10 Permit and a Section 404 Permit may be required, they are typically considered and administered together by the USACE under a single permit application.

3.5.5 Ecology Section 401 Water Quality certification/modification

The Federal Water Pollution Control Act, as amended (33 USC §§ 1251-1376) provides for restoring national water resources and maintaining water quality. This act, which is administered by the U.S. Environmental Protection Agency (EPA), is intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific policies, programs, and regulatory procedures support the stated objective.

Section 401 of the act requires that any federal permit involving construction activities that may result in discharges into navigable waters also provide state certification that the discharges will comply with applicable provisions of Sections 301, 302, 303, 306, and 307 of the act. The intent of this certification is to protect water resources from degradation and to ensure compliance with water quality standards. In Washington, EPA has delegated the authority to administer Section 401 requirements and issue certification to Ecology.

3.5.6 Ecology Coastal Zone Management Act consistency determination

Activities and development affecting coastal resources that involve federal activities, federal licenses or permits, and federal assistance programs (funding) require written Coastal Zone Management (CZM) federal consistency determinations by Ecology. Activities and developments performed by or for federal agencies require that a CZM determination be submitted stating that the project is consistent with Washington's CZM Program to the maximum extent practicable. Projects obtaining federal permits or licenses or projects that receive federal funding require a certification that they are consistent with Washington's CZM Program. CZM determinations/certifications are submitted to Ecology for concurrence, concurrence with conditions, or objection. A CZM application will need to be submitted and approved before the preferred alternative is constructed.

3.5.7 State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) (Revised Code of Washington [RCW] 43.21C; WAC 197-11) and the SEPA procedures (WAC 173-802) require state and local government officials to consider environmental values when making decisions. The SEPA process begins when an application for a permit is submitted to an agency, or an agency proposes to take some official action, such as implementing a MTCA CAP. In this case, the lead agency for the SEPA process is Ecology.

Prior to taking any action on a proposal, agencies must follow specific procedures so that appropriate consideration has been given to the environment. The severity of potential environmental impacts associated with a project determines whether an environmental impact statement is required. A SEPA checklist would be required prior to initiating remedial construction activities. Because the site cleanup action will be performed under an Agreed Order/Consent Decree, SEPA and MTCA requirements will be coordinated as necessary. It is expected that a Determination of Non-Significance will be issued for the implementation of the final cleanup action.

3.5.8 Shoreline Management Act

The Shoreline Management Act (RCW 90.58) and its implementing regulations establish requirements for substantial developments occurring within water areas of the state or typically within 200 feet of the shoreline. The City of Anacortes has set forth requirements based on local considerations, such as shoreline use, economic development, public access, circulation, recreation, conservation, and historical and cultural features. Local shoreline management plans are adopted under state regulations, creating an enforceable state law. Because the site cleanup action will be performed under an Agreed Order/Consent Decree, compliance with the substantive requirements of the Shoreline Management Act will be necessary, but a shoreline permit may not be required.

3.5.9 Construction Stormwater General permit

Construction activities that disturb one or more acres of land must comply with the provisions of Washington State construction stormwater regulations (RCW 90.48.260 and WAC 173-226). Although the site cleanup action will likely be performed under an Agreed Order/Consent Decree, Ecology may still require that a construction stormwater general permit be obtained to satisfy substantive and procedural provisions of these regulations. Substantive requirements could be addressed through preparation of a stormwater pollution prevention plan or equivalent MTCA construction quality assurance project plan (CQAPP) prior to activities that would disturb one or more acres of soil. The CQAPP would document planned procedures designed to prevent stormwater pollution by using best management practices as described in Section 5.1 to control erosion of exposed soil and contain soil stockpiles and other materials that could contribute pollutants to stormwater. It is anticipated that a CQAPP will be prepared as part of the remedial design process, and supplemented as appropriate by the remedial contractor. These requirements will be coordinated with any applicable permits for the local grading and erosion control.

3.5.10 State-Owned Aquatic Lands management

Management of the state-owned aquatic lands is governed by the Washington State Constitution Articles XV, XVII, XXVII, Washington State statutes RCW 79.105 through 79.140, and the aquatic land management regulations included in WAC 332-30. The management of state-owned aquatic lands is intended to provide a balance between:

- Encouraging direct public use and access,
- Fostering water-dependent uses,
- Ensuring environmental protection, and
- Utilizing renewable resources.

The power to lease state-owned aquatic lands is vested in the Washington State DNR, which has the authority to make leases upon terms, conditions, and length of time in conformance. Washington State DNR has the responsibility to consider the natural values of land before leasing it and the authority to withhold land from leasing if Washington State DNR determines it has significant natural values. Institutional controls such as deed restrictions and environmental covenants must conform to aquatic lands management laws.

3.5.11 Other potentially applicable regulatory requirements

Other regulations could potentially apply to the selected cleanup action related to the following issues:

- **Air/Particulate Emissions** – Site grading or excavation work that could generate dust would be required to comply with applicable air quality regulations (RCW 70.94; WAC 173-400-040(8); Northwest Clean Air Agency Regulations, §§ 101.1, 102 & 104). Controls would need to be in place during construction (e.g., wetting or covering exposed soils and stockpiles), as necessary, to meet the substantive restrictions of the Northwest Clean Air Agency for off-site transport of airborne particulates.
- **Archaeological and Historical Preservation** – The Archaeological and Historical Preservation Act (54 USC § 312502) would be applicable if any significant archaeological or historical materials were discovered during site grading and excavation activities. Given the area's landforms and environment that are sensitive for cultural resources, archaeological resource analysis should be incorporated into the planning and cleanup efforts to assure that archaeological resources are identified as part of developing investigation strategy (DAHP, 2008).
- **Archaeological Resources Protection Act** – This act (16 USC 470aa; 43 CFR 7) and regulations specify the steps that must be taken to protect archaeological resources and sites that are on public and Native Americans land and to preserve data that is uncovered. Although the marine environment consists of sediments that have been disturbed through continual fill, this regulation will be considered during implementation of the cleanup action through the inclusion of a discovery plan. Appropriate measures will be taken during excavation activities and appropriate tribal members will be contacted in the event that an artifact is encountered.
- **Health and Safety** – Site cleanup-related construction activities would need to be performed in accordance with the requirements of the Washington Industrial Safety and Health Act (RCW 49.17) and the Federal Occupational Safety and Health Act (29 CFR 1910, 1926). These applicable regulations include requirements that workers are to be protected from exposure to contaminants and that excavations are to be properly shored. These requirements are not specifically addressed in the detailed analysis of cleanup action alternatives because they could be met by each of the alternatives.

- **Washington Hydraulics Project Approval** – Hydraulic Project Approval and associated requirements (RCW 75.55.061, WAC 220-110) for construction projects in or nearby state waters have been established for the protection of fish and shellfish. Any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water or saltwater of the state requires a Hydraulic Project Approval from the Washington Department of Fish and Wildlife. These substantive requirements are potentially applicable to the site, which lies below the high water mark and includes restrictions on dates of in-water work (in-water windows) used to protect fish species at critical life history stages.
- **Washington Solid Waste Management Handling Standards Regulations** – The solid waste management requirements (WAC 173-350) are potentially applicable to the off-site disposal of solid wastes and contaminated media that may be generated as part of the cleanup activities. Waste materials will be sent to facilities licensed and permitted to accept the specific waste material and documentation will be obtained of such disposition.
- **Washington State Dangerous Waste Regulations** – The Dangerous Waste Regulations (WAC 173-303) are potentially applicable to the solid waste as it is moved around or determined to be removed for off-site disposal. Solid wastes destined for off-site disposal will undergo designation before disposal. Solid wastes moved during construction activities will undergo designation if suspected of having dangerous waste characteristics to determine if it is dangerous waste.
- **Well Construction** – Regulations (WAC 173-160 and WAC 173-162-020, -030) related to well constructions/licensing establishes minimum standards for any type of well construction. This regulation is potentially applicable to wells constructed for groundwater withdrawal and monitoring. This regulation is also potentially applicable to decommissioning of existing or future wells.
- **Local Permits from City of Anacortes** – Anacortes Municipal Code (Appendix Chapter 33; Section 3306) requires that a grading permit application be submitted to the City for any earth grading/clearing. Construction activities such as haul truck operations may require that traffic be directed by flaggers and signage. Dewatering activities associated with the cleanup may require a wastewater discharge permit to discharge water to the local publicly owned treatment works. The applicability of these substantive requirements will be determined through consultation with the City of Anacortes during the design phase of the final selected cleanup action.

  The City of Anacortes requires a habitat management plan be developed prior to any city development permit for any parcels of property within the city limits that are adjacent to the March Point Heronry. This ordinance is currently being updated. The applicability of these substantive requirements will be determined through consultation with the City of Anacortes during the design phase of the final selected cleanup action.

- **Local Permits from the Adjacent Swinomish Tribal Community** – Preliminary discussions conducted in 2016 with representatives of the Swinomish Tribal Community suggest that no tribal permits will be necessary or regulatory requirements applicable for completion and implementation of the remedial design as no portion of the project is anticipated to occur on the federally recognized Swinomish Reservation. However, as the project continues tribal representatives will be contacted and be given the opportunity to review and comment on future design documents.

4.0 Alternatives considered and basis for remedy selection

This section summarizes the cleanup technologies, alternatives considered, and the disproportionate cost analysis (DCA), and provides the basis for selection of the preferred alternative.

4.1 Cleanup technologies

Key components of the remedy for the site are:

- Engineering controls and institutional controls;
- Landfill cover (vertical/lateral) including demolition and stormwater control;
- Leachate (or groundwater) treatment and/or containment as necessary;
- LFG collection and venting, and

The components identified above meet both the MTCA requirements for cleanup and the closure and post-closure requirements of a landfill site.

4.1.1 Engineering and Institutional Controls

Institutional controls provide limitations on access or use of the property in order to reduce the potential for applicable receptors to be exposed to COCs from the site. The technologies that were retained include capping of contaminated media, perimeter fencing using poly-coated chain link fence, signage on the fence, and deed restriction.

4.1.2 Landfill Cover

The landfill cover was evaluated based primarily on a vertical infiltration of precipitation component and on a minor horizontal component caused by intrusion of water into the waste within the tidal fluctuation zone. The landfill cover technologies considered and retained were:

- Imported silty sand to augment the original silty sand cover material.
- Low-permeability clay.
- Geosynthetic clay liner, a manufactured product that consists of low-permeability clay sandwiched between two layers of geotextile. The same material is also available as a geosynthetic clay laminated liner (GCLL), with a laminate of high-density polyethylene (HDPE) bonded to the geotextile. Also included was a polymer-enhanced GCLL for the horizontal component, within the intertidal zone that would maintain its low permeability in saline environment.
- Geomembrane made of polyvinyl chloride (PVC) or HDPE.

In conjunction with the landfill cover, the other elements for landfill cover included demolition of any remaining structures/foundations that would interfere with the site grading, and grading and installation of sufficient drainage channels and swales to promote stormwater runoff into the bay.

4.1.3 Leachate/LFG

The technologies that were considered for the leachate include removal, pretreatment, and discharge into the sanitary sewer, and partial containment. The possibility of leachate treatment and discharge into the bay was not evaluated due to the likely cost associated with the expected level of treatment to meet discharge standards.

The technology considered and retained for LFG was removal through passive venting via vent pipes in the newly constructed landfill cap. The active removal and flaring of the LFG was not retained due to the low emissions expected based on the age of the landfill and the nature of the waste, rendering LFG generation to a low level.

4.1.4 Soil Removal (Excavation) and Off-Site Disposal

This technology would remove the source of the contamination from the site and thus address the concerns in the long term. This technology was retained as an option to remove the entire waste from the site and dispose of it at an approved off-site landfill.

4.2 Feasibility study alternatives

A total of seven remedial alternatives were developed for this project from the retained cleanup technologies. The alternatives and their basic elements are described here.

4.2.1 Alternative 1 – No action

This alternative serves as the baseline against which the other alternatives are compared. In this alternative, some site regrading would be performed to promote stormwater runoff from the landfill and implement institutional controls. No long-term monitoring or maintenance would be associated with this alternative.

4.2.2 Alternative 2 – Restoration of existing soil cover

Alternative 2 involves restoration and re-use of the existing landfill cover soil, as well as the following elements:

- Demolition and regrading of the existing soil cover material, along with additional imported soil as needed, to a gently sloping mound covering all exposed solid waste across the landfill footprint;
- Installation of a passive LFG collection system;

- Installation of a groundwater monitoring well network;
- Construction of a perimeter access road and drainage ditches;
- Placement of an additional 6-inch layer of seeded topsoil over the restored cover material;
- Implementation of institutional controls; and
- Long-term seep, groundwater, and LFG monitoring.

4.2.3 Alternative 3 – GCLL cap

Alternative 3 involves constructing an engineered landfill with a low-permeability cap, in general compliance with WAC 173-304, with the following elements:

- Excavation of solid waste at the edges of the landfill and placement within the landfill.
- Demolition and regrading of the waste to minimize infiltration and promote stormwater runoff.
- Constructing an engineered cap using GCLL over the landfill to minimize infiltration. The portion of the GCLL along the shoreline will be modified bentonite clay GCLL with polymer.
- Installation of a passive LFG collection system.
- Installation of a groundwater monitoring well network.
- Construction of a perimeter access road and drainage ditches.
- Implementation of institutional controls.
- Long-term seep, groundwater, and LFG monitoring.

4.2.4 Alternative 4 – HDPE cap

Alternative 4 would involve constructing an engineered low-permeability cap, in general compliance with WAC 173-304, with the following elements:

- Constructing an earthen berm along Padilla Bay to allow shoreline activities without concerns about the tidal cycles;
- Demolition and regrading of the waste to promote stormwater runoff;
- Constructing an engineered cap using HDPE over the landfill;
- Installation of a passive LFG collection system;
- Installation of a groundwater monitoring well network;
- Construction of a perimeter access road and drainage ditches;
- Placement of an additional 6-inch layer of seeded topsoil over the restored cover material;
- Implementation of institutional controls; and
- Long-term seep, groundwater, and LFG monitoring.

4.2.5 Alternative 5 – HDPE cap anchored into bay mud

All of the elements and approach to the project for Alternative 5 are the same as Alternative 4, except that the HDPE geomembrane would be anchored into the Bay Mud within the earthen berm instead of using a layer of modified bentonite clay GCLL with polymer GCLL on the landfill side of the berm.

4.2.6 Alternative 6 – PVC cap

Alternative 6 is the same as Alternative 4, except PVC would be used as the geomembrane instead of HDPE. All construction elements, the landfill configuration, and the long-term monitoring program would be the same.

4.2.7 Alternative 7 – Landfill removal

Alternative 7 entails complete removal of all the waste and leachate, and restoration of the Bay Mud with 1 foot of sand cover.

4.3 MTCA disproportionate cost analysis

MTCA requires that when selecting from cleanup action alternatives that fulfill the threshold requirements, the selected action shall use permanent solutions to the maximum extent practicable per WAC 173-340-360(2)(b)(i) and (3). "Permanent solution" or "permanent cleanup action" means a cleanup action in which cleanup standards of WAC 173-340-700 through 173-340-760 can be met without further action being required at the site being cleaned up or any other site involved with the cleanup action, other than the approved disposal of any residues from the treatment of hazardous substances as defined in WAC 173-340-200. "Practicable" means capable of being designed, constructed and implemented in a reliable and effective manner, including consideration of cost. When considering cost under this analysis, an alternative shall not be considered practicable if the incremental costs of the alternative are disproportionate to the incremental degree of benefits provided by the alternative over other lower-cost alternatives.

MTCA specifies that the permanence of the qualifying alternatives be evaluated by balancing the costs and benefits of each of the alternatives with a DCA in accordance with WAC 173-340-360(3)(f), using seven evaluation criteria:

- Protectiveness;
- Permanence;
- Long term effectiveness;
- Short term risk;
- Technical and administrative implementability;
- Public concerns; and
- Cost.

Table 11 shows the comparison of remedial alternatives with their ratings for the seven evaluation criteria, and Table 12 shows the cost benefit ratios and DCA for the seven remedial alternatives. The comparison of benefits relative to costs may be quantitative, but is often qualitative and requires the use of best professional judgment. When possible for this project, quantitative factors such as mass of contaminant removed or percentage of area of impacts remaining were compared to costs for the alternatives evaluated, but many of the benefits associated with the criteria described below were necessarily evaluated qualitatively. As specified in WAC 173-340-360(3)(e)(ii)(C), Ecology has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action.

In order to favor the benefits represented by particular criteria associated with the primary goals of the remedial action, this RI/FS report uses a weighting system generally accepted by Ecology (see https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=219). Protectiveness, permanence, and long-term effectiveness, which are associated with environmentally-based benefits, are more highly weighted than short-term risk, implementability, and public concerns, which are associated with non-environmental factors. Cost does not have a weighting factor, but is used to determine whether costs are disproportionate to benefits if the incremental costs of the more permanent alternative exceed the incremental degree of benefits achieved by the other lower-cost alternative (WAC 173-340-360(e)(i)). Where two or more alternatives are equal in benefits, Ecology selects the less costly alternative (WAC 173-340-360(e)(ii)C)). Figure 14 presents the comparative benefit of each alternative to the cost benefit ratio of each alternative. Figure 15 compares the cost of each alternative with the cost benefit ratio for each alternative.

The alternatives were evaluated with respect to the seven evaluation criteria identified above, as well as restoration time frame. Sections 4.3.1 through 4.3.8 summarize these evaluations and the assigned weight factors for the DCA.

4.3.1 Protectiveness: Weighting factor = 30%

Alternatives 2 through 7 would be more protective of the environment than Alternative 1. Alternatives 3, 4, 5, and 6 all would offer a similar degree of protectiveness (better than Alternatives 1 and 2) due to the presence of modified bentonite clay GCLL with polymer or geomembrane along the eastern boundary of the landfill. They would meet the objective of reducing or eliminating the seeps in the form of concentrated flow and would substantially reduce hydraulic connectivity between the perched groundwater within the solid waste and the bay. Alternative 7 would be the most protective alternative, since all solid waste would be removed from the site.

4.3.2 Permanence: Weighting factor = 20%

Alternatives 2 through 7 would be more permanent than Alternative 1. Alternative 2 would offer more permanence than Alternative 1, but not as much as the other alternatives, since Alternative 2 does not include a geosynthetic layer that would limit infiltration. Alternative 6 would provide improved permanence than Alternatives 1 and 2, but would be slightly less permanent than the other capping alternatives due to potential for loss of plasticizers from the PVC geomembrane. Alternatives 3, 4, and 5 would be more permanent. Alternative 7 would be the most permanent, since the solid waste would be completely removed from the site and disposed of in a lined, engineered landfill.

4.3.3 Long-term effectiveness: Weighting factor = 20%

Alternative 1 would not be effective in the long term to meet the RAOs. Alternative 7 would be the most effective alternative, since the solid waste would no longer be located near a body of water. As a result, Alternative 7 is assigned a raw score of 10. Alternatives 3, 4, and 5 would be significantly more effective than Alternative 2, since the hydraulic connectivity with the bay would be virtually eliminated. Alternative 6 would be the least effective alternative of the alternatives involving engineered caps, because of its higher likelihood of damage to the PVC geomembrane due to loss of plasticizers and increased potential for cracking and leaks.

4.3.4 Short-term risk: Weighting factor = 10%

Alternative 7 presents the highest short-term risk due to excavation of all of the landfilled solid waste, with the highest possibility for release of pollutants to the bay during construction, both from the solid waste as well as the perched groundwater. Potential off-site spills of solid waste off site due to accidents during transportation of the waste would also present a likely risk that is unique to this alternative. An additional adverse possible risk would be to the railroad embankment and its stability and safety, depending on the extent of waste removal. Alternatives 2 through 6 have less risk (higher benefit) associated with their implementation than Alternative 7 due to substantially less excavation of solid waste; among these, Alternative 2 has the lowest risk since no solid waste relocation would be required and the solid waste would be capped in place. Alternative 2 would require the least amount of imported soil and other materials. It essentially relies on the restoration and reuse of existing cover material with a supplemental topsoil layer.

Except for Alternatives 1 and 2, Alternative 3 presents the least amount of risk among the alternatives due to requiring less waste relocation and perched groundwater handling than Alternatives 4 through 7.

4.3.5 Technical and administrative implementability: Weighting factor = 10%

All alternatives would be implementable from both a technical and administrative standpoint. Alternative 1 presents the least amount of administrative effort. Alternative 7 would present more of a challenge compared to other alternatives due to loss of operating space as the landfill is removed. Alternative 3 scores higher for technical implementability than Alternatives 4, 5, and

6 because the low-permeability GCLL cover does not require welding together of sheets of HDPE or PVC membrane in a dry environment, and due to the use of a berm.

4.3.6 Public concerns: Weighting factor = 10%

Alternatives 1 and 2 would not address current public concerns, since they would not meet the RAOs. Alternatives 3 through 7 would address current public concerns by meeting the RAOs, but the public may express new concerns due to the risk associated with excavation of solid waste, in particular with Alternative 7. Partial excavation along a body of water, as is proposed for Alternatives 3 through 6, has been conducted routinely on other projects and the potential for releases into the environment are short term and manageable (e.g., use of earthen berm for containment). Alternative 2 addresses potential public concerns by lowering the risk of a release to the environment due to solid waste excavation.

4.3.7 Cost

The cost estimates for the alternatives are considered to be within -30 to +50 percent of actual costs of the completed project. The primary use of these estimates is to allow comparison between alternatives during the selection process. Given the similarity of the capping/monitoring components of each alternatives, the actual costs are likely to be proportionally higher or lower for all of the alternatives, but the relative costs are not anticipated to change significantly. The estimated costs for Alternatives 2 through 6 include the cost for first five years of post-construction monitoring and 30 years of operation and maintenance activities. The estimates were prepared in 2015 dollars and have not been adjusted based on annual escalation or the long-term discount rate. The contingency rate applied to each alternative is slightly different and is based on the degree of difficulty and uncertainty, level of detail in the conceptual design, and the engineer’s confidence in the estimated costs.

Alternative 1 is the lowest cost alternative at a total cost of $231,000, and Alternative 7 is the highest cost alternative at an estimated cost of $83 million. Alternatives 2 through 6 are estimated to cost $6.4 million, $12 million, 15.3 million, $15.3 million, and $15.2 million, respectively. The cost difference of $70,000 between Alternatives 4, 5, and 6 is a negligible percentage of the total project value and thus is not considered a distinguishing factor between these three alternatives. Alternative 3 provides an additional cost savings of approximately $3.2 million compared to Alternatives 4, 5, and 6. The estimated 30-year-long operation and maintenance cost for Alternatives 2 through 6 are similar, in the range of $2.7 million.

4.3.8 Restoration time frame

The expected restoration time frame for the different alternatives needs to be based on the factors cited in WAC 173-340-360(4)(b). These factors include:

- Potential risk posed by the site to human health and the environment;

- Practicability of achieving a shorter restoration time frame;
- Current use of the site and surrounding areas that may be affected by releases from the site;
- Potential future use of the site and surrounding areas that may be affected by releases from the site;
- Availability of alternative water supplies;
- Likely effectiveness and reliability of institutional controls;
- Ability to control and monitor migration of hazardous substances from the site;
- Toxicity of hazardous substances left at the site; and
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions.

Alternatives 1 and 2 would both allow precipitation to infiltrate the solid wastes and continue the process of groundwater discharge to the inner lagoon through the seeps. Therefore, neither alternative would have an acceptable restoration time frame.

Alternatives 3 through 6 would allow the landfill to remain intact. The capping and lateral containment should eliminate discharge of groundwater to the inner lagoon. The current use of the site and the future use will remain the same, and access to the site will be restricted through installation of fencing. As currently envisioned for Alternatives 2 through 6, all future uses of the site will need to be restricted to those uses compatible with maintaining the performance of the selected alternative. If these capping alternatives work correctly, groundwater levels within the solid waste should decline due to reduced infiltration as well as through either seepage or removal of groundwater from the solid waste. Monitoring groundwater levels within the solid waste and groundwater quality in the regional aquifer will determine if the capping alternatives are working as planned. The restoration time frame for these alternatives is estimated at approximately ten years. This estimate is based on the extrapolated rate of decline in leachate/groundwater levels in the refuse during the summer months during the RI.

Alternative 7 would remove all refuse from the footprint of the landfill, thereby removing all of the risks to human health and the environment. The estimated restoration time frame of five years is based on the time necessary for re-establishing the lagoon habitat after removal is complete.

4.4 Selection of preferred alternative

Alternative 3 is the MTCA preferred remedy for the site based on the DCA. Alternative 3 meets the threshold requirements and other MTCA/Minimum Functional Standards requirements, and is the remedy that is permanent to the maximum extent practicable as determined by the DCA. Alternative 3 includes:

- Demolition of structures on site;
- Moving solid waste (45,000 cubic yards) from the edges of the landfill inward, to allow construction of a permanent cap without expanding the footprint of the landfill.
- Grading the waste to a mound per the Minimum Functional Standards of WAC-173-304 to promote stormwater runoff.
- Installing a passive LFG collection system, and placing an engineered cap over the landfill with standard GCLL.
- Installing modified bentonite clay GCLL with polymer extending to the Bay Mud, and constructing a perimeter access road around the landfill. The engineered cap would minimize or eliminate infiltration of groundwater into the landfill, and the GCLL would minimize discharge of groundwater from the landfill to surface waters.
- Treating wastewater (1.3 million gallon) generated during the construction work.
- Installing an LFG collection system, which would vent LFG to the atmosphere, as well as groundwater collection/treatment as needed to prevent off-site migration.
- Installing stormwater control measures and constructing a surface drainage system on and around the landfill.
- Providing institutional and engineering controls.
- Performing long-term monitoring of groundwater (quality and levels for hydraulic control purpose), seepage, LFG, and the landfill closure facility.
- Performing habitat restoration at the shoreline.

The use of GCLL for the engineered cap is a major advantage, which would allow for easier, faster, cost effective, and more reliable installation. Among its advantages, GCLL:

- Can be installed in light rain;
- Does not require perfectly clean surfaces or welding/seaming;
- Is less likely to be installed incorrectly than other typical geomembranes (HDPE or PVC);
- Requires less rigorous quality control/quality assurance during installation than geomembrane;
- Entails less use of natural resources than geomembrane, and eliminates the need to import backfill material and construct a berm;
- Exceeds the permeability requirements both in freshwater and saline environments;
- Is less susceptible than geomembrane to damage from post-construction traffic;
- Is easier than geomembrane to maintain and/or repair in case of damage, and
- Is the lowest cost option that meets or exceeds all the ARARs and their requirements as shown in Table 12, while offering the same or better level of protection, effectiveness, and durability as the other viable alternatives.

Construction of the preferred Alternative 3 would be practical and implementable from both technical and administrative standpoints. Construction within the intertidal zone would present some challenges, but these challenges are standard in shoreline rehabilitation and/or restoration projects, and can be readily addressed using well-established engineering and construction practices. This alternative would address concerns raised by the public without introducing new public concerns.

5.0 Selected site cleanup action

The selected remedial alternative for this cleanup action is Alterative 3, as discussed in Section 4.4. This section describes the elements of the remedial alternative and the other pertinent information. Figures 16 through 20 show the proposed remedial plan.

5.1 Description of cleanup action

Prior to any earthwork, the contractor will complete site setup, which will include installation of a sorbent boom along the edge of the landfill in the bay to contain releases that may enter the bay; installation of containment berms, silt fences, and/or straw wattles and other erosion control measures around the perimeter of the landfill; and temporary, perimeter security fencing along the landward sides of the landfill to maintain site security. Based on the current dimensions of the landfill, an estimated 1,500 linear feet of sorbent boom, 2,000 linear feet of silt fence, and 2,600 linear feet of temporary fencing would be needed.

The work along the northern edge of the landfill would be within the BNSF right-of-way (25 feet from the centerline of the tracks). Therefore, it is expected that all of the requirements typically imposed by BNSF for work within the rail right-of-way would apply. These requirements include worker training, insurance, employment of a flagger during applicable construction activities (unless a temporary fence is installed), and possibly shoring, depending on the extent of encroachment to the tracks. The specifics of these items will be determined during the design.

The existing structures on site will be demolished to the approximate limits shown on Figures 16 and 18, which are based on a distance of about 1 foot from the final surface grade of the solid waste. This separation will allow proper grading of the landfill and installation of the cap system without removing all the concrete. The metal debris from the demolition will be shipped off site for recycling. Recycling and/or reuse of the concrete debris from demolition of the slabs and foundations will be evaluated during the design.

The surface vegetation (trees, shrubs, and bushes) on site will be removed and recycled off site for compost. The possibility of chipping the trees and using the chips on the final surface of the landfill will be evaluated during the design. The remainder of the vegetation currently is not being considered for reuse on site due to the likely presence and re-introduction of noxious weeds (e.g. blackberry) to the new landfill cap.

5.1.1 Landfill cap system

The existing soil cover on site is approximately 2 feet thick on average and is primarily sandy (porous) in gradation. The nature and extent of the soil cover on the western portion of the site where most of the saw mill activities took place is not certain. Presence and gradation of the soil cover in this area will be evaluated during the design. The soil cover will be salvaged to the extent possible, while making sure no waste is removed. It is assumed that approximately 50 percent of the soil cover, or 22,000 cubic yards, will be salvaged for reuse. This material is suitable as use for an LFG collection layer, and will be used for this purpose over the final graded surface of the solid waste. If substantial additional cover soil is salvaged, it will be sampled and analyzed for possible use in the capping system. The extent, thickness, and suitability of the existing soil cover material for reuse on site will be further investigated during the design.

The possibility and cost effectiveness of salvaging some of the remaining approximately 6,000 cubic yards of wood waste will be evaluated during the design. Nearly all of the remaining wood waste is mixed with rock at a ratio of approximately 1 to 1. Some 2,000 cubic yards of this material may be salvaged to construct the access road on top of the landfill. Given the soil and wood fiber content, it may be found that the savings will be offset by added long term maintenance such as mowing, or possibly disadvantages such as clogging surface water runoff drainage pathways. For the purpose of this CAP, we conservatively assumed that the material will not be salvaged and will be incorporated into the capped landfill.

5.1.1.1 Excavation

In order to provide the necessary space to allow for construction of the engineered cap without expanding the current footprint of the landfill, the solid waste along the edges of the landfill will be excavated to the full depth of the cap system, extending into the landfill to a horizontal distance needed for the new cap. The solid waste outside the landfill gate within the publicly accessible gravel parking lot will be removed in its entirety and placed under the area covered by the landfill cap. The excavation will be backfilled with imported fill. The bottom of the solid waste is assumed to be at about Elevation 5 feet MLLW, approximately matching the current elevation of the Bay Mud within the inner lagoon, which ranges between Elevations 5 and 8 feet MLLW (Figure 19).

Solid waste along Padilla Bay would be removed to a horizontal distance of 10 to 12 feet into the landfill and sloped up at approximately 20 percent, 5 horizontal to 1 vertical (5H:1V), to about Elevation 15 feet MLLW. Based on the engineer's experience on several other shoreline projects completed along waterways, typical stable slopes within the intertidal zone range from 4H to 5H:1V, depending on the tide and wave actions. It is conservatively assumed the slope of the final grade of the landfill below Elevation 15 feet MLLW, facing Padilla Bay, would be 5H:1V. Along the landward sides of the landfill, excavation will be sloped at approximately 33 percent (3H:1V). The estimated total quantity of solid waste to be excavated and used to create the necessary slopes would be approximately 30,000 cubic yards.

During the waste excavation and handling, a representative will be on site and will inspect the excavated material visually for the presence of potentially regulated waste. Olfactory observations will also be used (e.g., petroleum odor, etc.) to screen for potentially regulated waste. Any such waste that is identified (e.g. car batteries) will be set aside with a "waste pending analysis" label, profiled, and shipped off site to an appropriate recycling or disposal facility.

The project would be constructed during the dry season (July through October), when the level of perched groundwater is typically the lowest, and the low tide generally occurs during daylight hours. The existing perched groundwater within the landfill is typically encountered at Elevation 11.5 feet MLLW during the summer months. Perched groundwater would need to be recovered when excavating portions of the solid waste below the perched groundwater surface. Standard construction dewatering pumps and hoses would be set up to remove the perched groundwater as excavation proceeds.

During the excavation along the shoreline, dewatering pits will be excavated near the shoreline to dewater the waste prior to the start of shoreline excavation. Dewatering is expected to prevent or minimize the discharge of perched groundwater into the bay during earthwork on the shoreline. It is possible that dewatering along the majority of the shoreline that has not exhibited seepage will substantially reduce groundwater levels. The historical aerial photographs show placement of an earthen dike in those areas, which may be the reason for the absence of seeps. The location, extent, and quality of the earthen dike will be evaluated during the design for dewatering. Conservatively, we assume that dewatering will be needed. Water management is discussed in Section 5.1.2.

The excavation along the shoreline will be conducted during the low tide cycles that occur during the day. The shoreline excavation will be conducted in strips perpendicular to the shoreline. The width of the strips will be such that the segment is excavated, graded, and the modified bentonite clay GCLL with polymer is placed during one tide cycle. The excavation at the toe of the landfill will extend at least 6 inches into the Bay Mud to anchor the GCLL. A shallow trench will be excavated into the Bay Mud and the GCLL cover will then be laid into the trench. The Bay Mud will then be re-compacted on top of the GCLL. This approach will effectively tie the polymer-enhanced GCLL into the Bay Mud, thus preventing or minimizing the tidal water or the perched groundwater/leachate from flowing freely under the polymer-enhanced GCLL (Figure 19).

Placement of the cap cover soil layers above the modified bentonite clay GCLL with polymer will follow during the next low tide cycle, following the excavation. The segment width will likely be around 50 feet wide along the approximately 1,500 linear feet of the shoreline. This segments' dimension will result in completing the shoreline excavation and cap construction within 30 working days, or approximately six calendar weeks. Additional work to vegetate the shoreline will follow afterwards. The actual width, timing, and sequencing will be determined in cooperation with the selected contractor.

The excavated solid waste will be placed back onto the landfill and graded to the final grade simultaneously with the excavation activities. A central ridge will be constructed and grades will slope down toward the perimeter of the landfill at a slope of approximately 5 percent (20H:1V). The placement of the waste within the landfill will be conducted in compacted lifts to minimize future settlement and reduce the height of the landfill.

5.1.1.2 Landfill cap

The landfill cap will consist of several layers, as shown on Figure 20. The excavated solid waste will be placed on the landfill in compacted lifts and graded. The compaction of the waste will minimize post-construction settlement of the cap. Based on observations made during previous field activities, the final surface of the graded solid waste will most likely be mainly soil rather than the actual solid waste. The salvaged soil cover will then be placed over the waste across the entire landfill, in a layer of approximately 8 to 12 inches thick, depending on the actual quantity of the cover soil salvaged. This will serve as a cover layer over the solid waste and LFG collection layer, and will provide a relatively smooth surface for placement of the GCLL. The LFG collection and venting piping will be installed within this layer as discussed in Section 5.1.4.

The GCLL is usually provided in 8-feet wide rolls, and will be placed in strips, typically perpendicular to the slope and rolled downhill. Different rolls of GCLL will be overlapped approximately 2 feet. A thin layer of bentonite powder will be placed over the section to be overlapped to serve as sealant. The GCLL rolls or pieces on the downhill direction will be shingled to promote stormwater runoff downhill and reduce the likelihood of water flowing between the overlaps and entering the landfill (Figure 19). GCLL placed below Elevation 16 (MLLW) will be modified bentonite clay GCLL with polymer, which is resistant in a saline environment, and maintains its low permeability. This elevation was established during the FS to account for future sea level rise and possible tsunamis.

The GCLL will be covered with a 6-inch thick layer of sand (porous material) to serve as a protective layer and to provide a drainage media for the stormwater infiltrating the surface of the cap. Approximately 12,000 cubic yards of drainage media will be imported for placement. This layer may be constructed with excess salvaged cover soil, if the material passes chemical characterization and permeability testing. The drainage layer will be covered with a 12-inch thick layer of coarse crushed rock, or approximately 24,000 cubic yards. This layer will serve primarily as a barrier against burrowing animals and plant roots to protect the integrity of the GCLL. This layer will also serve as a drainage layer, but since this material is too coarse to be placed directly on top of the GCLL, the sand layer was added. The possibility of altering material and thicknesses of these two layers will be evaluated further during the design. The final top two layers of the cap will be 12 inches of silty soil cover (24,000 cubic yards) to reduce stormwater infiltration, and 6 inches of topsoil (12,000 cubic yards) to sustain vegetation growth. The possibility of adding a layer of geotextile separating the coarse rock layer from the cover soil above it will be evaluated during the design. A perimeter access road will be constructed on the cap with crushed rock to allow safe vehicular access to the entire landfill. The currently proposed cap system is shown on Figure 20.

The completed cap will be hydroseeded except along the shoreline, where shrubs will be planted and a new habitat will be created. The habitat restoration is discussed in Section 5.1.5.

5.1.2 Water management system

The work will be conducted primarily during the dry summer season. Therefore, the need for stormwater management during the construction will be limited. Furthermore, as was observed during the previous wood waste removal activities, the landfill surface is porous and nearly all stormwater that does not evaporate will infiltrate. However, temporary erosion control measures will be installed and maintained, and a treatment system will be set up that will process both any accumulated stormwater and the perched groundwater/leachate generated from dewatering to a degree that meets the discharge standards for the publicly owned treatment works. The actual discharge standards will not be established by the publicly owned treatment works until the time of the design, when daily and total volumes of discharge will be calculated and the anticipated concentrations of pollutants will be determined. However, we have assumed that the on-site treatment system will have a settling tank to remove the bulk of the suspended solids, a sand filter system to remove the smaller portion of the suspended solids, granular activated carbon vessels to remove excess organic content, and bag filter housings to remove the finer portion of the remaining suspended solids. During the design it may be determined that an aeration tank will be necessary to precipitate total metals in excess of applicable discharge limits. Any sludge or sediment that accumulates in the settling tank will be profiled and disposed of according to state and federal requirements.

Two 20,000-gallon-capacity settlement tanks will be set up on site to store the water and allow the majority of the suspended solids to settle out, and two post-treatment tanks will be set up to hold the treated water for testing and analysis prior to discharge. It is assumed that batch discharges will be required at the start of the project, but that after three consecutive successful test results, continuous discharge and inline sampling will be permitted. Conservatively, it is assumed that one round of sampling will be required per working day for a total of 30 rounds.

Based on the approximately 1,500 linear feet of shoreline and assuming a porosity of 45 percent within the solid waste, it is estimated that approximately 1.3 million gallons of groundwater could be generated. This number roughly correlates to approximately 40,000 gallons of water processing per working day. The treated water would have to be hauled to the nearest discharge point to the City sanitary sewer system. The nearest sanitary sewer line is approximately 0.8 mile from the site. Alternatively, the sewer line could be extended to the site to avoid the transportation cost. The latter would have the benefit of being available for possible future dewatering effort, should it become necessary. A cost-benefit analysis will be performed during the design in cooperation with the City of Anacortes to determine the best option during the design.

The completed landfill cap will be mounded in the center with downward slopes toward the perimeter to drain the stormwater form both the surface of the landfill and the above the GCLL layer through the drainage layer. The drainage layer will daylight to perimeter swales on the landward sides of the landfill and into the bay on the water-ward side. The swales shown on our drawings will include both new and partly or wholly reconstructed existing swales. Additional details concerning the swale design will be provided in the Engineering Design Report. The perimeter swales will remain essentially the same as they currently exist and will drain into the bay. However, all the swales will be reconstructed with a layer of GCLL at the bottom, covered with soil and will likely be grass-lined and have other appropriate measures to prevent erosion, such as baffles and/or weirs.

5.1.3 Hydraulic control

The possibility of a horizontal component of groundwater from upgradient of the landfill contributing to the perched groundwater/leachate accumulation within the solid waste will be investigated during the design. An appropriate field investigation work plan will be developed and submitted for review and approval. Should the investigation reveal that there is a horizontal component, then the design will consider installation of some form of barrier during the reconstruction of the swales. Such a barrier may be extending the GCLL or hanging a geomembrane down to the Bay Mud.

5.1.4 LFG control

The solid waste in this landfill is over 40 years old, on average. Therefore, the majority of the decomposition that causes LFG generation has already occurred. The LFG readings documented during previous field investigations were believed to be, caused primarily by the decomposition of the wood waste from the former saw mill operation. In 2014, between 80 and 90 percent of the wood waste was removed from the site. The remaining organic matter is highly unlikely to generate LFG of sufficient quantity to justify an active removal and flaring system. Therefore, a passive LFG venting system has been included in this preliminary design. The LFG will rise up through the solid waste and collect in the sandy LFG collection layer beneath the GCLL. Our preliminary design includes a perimeter gas collection pipe along an access road on the landfill with vents, and a second line of vents along the ridge of the landfill for a total of 17 passive vents (Figure16). If there is a thicker area of wood waste incorporated under the cap, the need for additional vents will be considered. The piping will be perforated or slotted plastic to collect and convey LFG toward the vents.

The vents will be an inverted U shape (goose neck) to prevent stormwater from entering the pipe (Detail 2, Figure 20). The vent openings will have a screen to prevent animals from entering and nesting inside the pipes. The GCLL openings for protrusion of the vents (or other wells) will be sealed with powdered bentonite and a field-constructed GCLL “boot” as shown in Figure 21. The vents will be used to monitor the LFG, and can be used to set up a vacuum system should the post-construction LFG perimeter probe readings warrant an active LFG removal system to prevent explosive LFG from migrating off site.

5.1.5 Shoreline stabilization and habitat restoration

The existing shoreline will be regraded to a 5H:1V slope and constructed with a multi-layer cap system. The upper 18 inches of the cap will be able to sustain vegetation growth. The vegetation that will be selected will include a variety of native shrubs. Trees will not be planted, due to their tendency to have root systems that could penetrate the cover soils and possibly damage the GCLL. The riparian habitat zone is shown on Figure 19. A total of approximately 1.6 acres of habitat will be created upon completion of the project.

The habitat will need to be irrigated during the summer for the first three dry seasons in order for the revegetation to be successful. The preliminary design included daylighting the GCLL drainage layer onto the surface of the habitat for natural irrigation, but that may not provide sufficient “natural” irrigation. An irrigation system will be designed and installed with plastic piping similar to a household landscape irrigation system. Water supply will be obtained from the water main at the entrance of the landfill. It is possible that the distance from the landfill entrance at the west end of the site (where the water source is available) to the habitat area on the east end of the site will cause too much pressure loss for the existing pressure in the main. This matter will be investigated through the utility company and a booster pump will be installed, if needed. A Vegetation Maintenance Plan is included in Appendix A.

In addition to the three-year establishment period, long-term maintenance, including seasonal mowing and removal of invasive plants like blackberry and tree saplings, will be required.

5.1.6 Construction discovery mitigation

The landfill site is not known to have cultural resources artifacts. However, Josephine Peters of the Swinomish Tribal Historical Preservation Office will be contacted at (360) 488-3860 to consult on activities prior to any excavation work.

During the excavation and earthwork activities, observations will be made for inadvertent discovery of such articles. If any are found or are suspected, the work at that location will stop and the Swinomish Tribal Historical Preservation Office will be contacted. A Cultural Resources/Inadvertent Discovery plan has been prepared and is included as Appendix B.

5.1.7 Cost estimate

The estimated capital and long term (operation and maintenance) costs for the proposed cleanup action are $9.7 million and $2.8 million, respectively (Table 13). The scope of work for the long term monitoring is described in Section 7. This estimate assumes prevailing wage rates will apply, and includes the current sales tax of 8.5 percent, and a contingency of 25 percent. The cost estimate has been prepared in 2017 dollars, but an escalation of 4 percent has been added for construction anticipated to occur in 2019.

5.2 Institutional controls

Institutional controls will be implemented when the cleanup action is complete. Those include installation of a permanent chain link fence around the perimeter of the landfill to limit site access. The fencing will be standard, commercial grade, chain link fence with poly coating, and 6 feet tall. Gates will be installed at the landfill entrance on the west side and at the habitat area on the east side for personnel and or vehicular access, as needed. Signs will be posted on the fence informing the public about the site.

A record survey of the entire site will be completed by a land surveyor registered in the State of Washington. The survey, along with other pertinent information, will be filed with Ecology and Skagit County for an Environmental Covenant and deed restriction, respectively. The Environmental Covenant and deed restriction is required under MTCA because this selected remedy will leave solid waste and contaminated soil on site. DNR will also create an internal land use management record documenting that no future uses are authorized at the site that are incompatible with the remedy.

5.3 Release reduction time frame

Upon completion of the cleanup action, it may take some time for all the elements subject to monitoring to stabilize, and then subsequently be reduced. It is expected that release reduction will begin to occur within five years and will stabilize within approximately ten years after completion of the cleanup action.

5.4 Public participation

The RI/FS was open to public comment, and comments were received from five parties. This Draft CAP is also subject to public comment and will be made available for review by the public. Ecology will post notification of the public comment period and will hold a meeting with the entities who previously submitted comments. Furthermore, if enough interest is expressed, Ecology will hold a public meeting to explain the preliminary design described in this Draft CAP. Representatives from the design team will be present to describe the design and answer any technical questions the public may have.

If comments are received on the Draft CAP, a response to comments will be provided and a resolution that is mutually agreeable to the designer and Ecology will be incorporated into the cleanup action design.

5.5 Pre-design investigation

Upon approval of the CAP, a draft Pre-Design Field Investigation Work Plan will be prepared and submitted for review and comment. The work plan will describe the intent and procedures to determine the elements of the project that require additional information for the design. Those elements are:

- Nature, extent, and quality of the existing soil cover near the landfill entrance
- Testing of existing soil cover for permeability and chemical suitability for potential re-use as an LFG collection layer;
- Nature and extent of the original landfill southeast perimeter earthen berm;
- Presence of a horizontal upgradient groundwater flow into the solid waste;
- Groundwater flow for the purpose of dewatering;
- Perched groundwater levels and chemistry;
- Vertical hydraulic gradient through the Bay Mud beneath the landfill; and
- Confirmation of LFG conditions by testing methane in selected monitoring wells or probes to verify that passive venting is still appropriate for the site.

Additional elements may become necessary to investigate as the project progresses. After completion of the field investigation, a report will be prepared presenting the findings.

6.0 Cleanup action schedule

Consistent with Chapter 70.105D RCW, as implemented by Chapter 173-340 WAC (MTCA Cleanup Regulation), Ecology has determined that the selected site cleanup action described in Section 4 of this CAP is protective of human health and the environment, will attain federal and state ARARs, complies with cleanup standards, and provides for compliance monitoring. The selected cleanup action satisfies the preference expressed in WAC 173-340-360 for the use of permanent solutions to the maximum extent practicable, and provides for a reasonable restoration time frame.

The cleanup action implementation schedule includes completion of this CAP and a SEPA checklist. In parallel with completion of this CAP, a separate Consent Decree was negotiated between the PLP Group and Ecology in consultation with the Washington State Attorney General's office. As the legal document between Ecology and the PLP Group, the Consent Decree lays out the schedule for submitting remedial design and construction documents to Ecology for review and approval. Exhibit C of the Consent Decree contains an outline of the schedule to complete remedial design, construction, and implementation activities. The Consent Decree will be entered in Skagit County Superior Court, and become effective once entered. Because many of the project deliverables are contingent upon completion, review, and approval of the preceding project tasks, the project schedule will be a living document that will require periodic updating.

The preliminary implementation schedule provided below outlines many of the same major elements and key milestones that are included in the Consent Decree:

- Draft Final CAP to Ecology: January 10, 2020.
- Public comment period for Draft Final CAP, SEPA checklist, and Consent Decree: begins February/March 2020.
- Ecology issues Final CAP, SEPA Checklist, and Consent Decree: April 30, 2020.
- Final CAP issued for implementation: May 1, 2020.
- Complete Joint Aquatic Resource Permit Application (JARPA) and prepare Biological Evaluation: March 1 to April 30, 2020.
- Submit JARPA and Biological Evaluation May 15, 2020.
- Complete Pre-design Field Investigation: May 15, 2020 to October 31, 2020.
- Complete remedial design (Engineering Design Report) and submit local permits: November 1, 2020 to September 30, 2021.
- Complete Habitat Management Plan for the March Point Heronry: November 1, 2020 to September 30, 2021.

- Negotiate and obtain environmental covenants for institutional controls: May 1, 2020 to November 15, 2021.
- Receive USACE Section 10/404 Permit: November 1, 2021.
- Construction contractor procurement and construction: February 1, 2022 to October 31, 2022.
- As-Built Report: November 1, 2022 through February 12, 2023.

7.0 Compliance monitoring

7.1 Construction performance monitoring

All aspects of the construction will be inspected by the representatives of the design engineer. These visual inspections will ensure the work is performed in compliance with the project requirements. The critical elements of inspection will include:

- Salvage of the existing soil cover without any solid waste;
- Excavation of all the waste where designated to be removed;
- Segregation of any suspect dangerous waste and proper handling;
- Verification of all imported products;
- Correct grading of the waste, verified by land surveying;
- Installing the cap system in correct manner;
- Perched groundwater/leachate handling, treatment, and discharge;
- Leachate settling tank sludge/sediment designation and disposal; and
- Stormwater management during and post-construction.

The project activities will be documented in daily field reports and photographs. A summary weekly progress report will be prepared and distributed to the interested parties.

In addition to these inspection/verification activities, dewatering effluent will be sampled if this water is discharged to the City of Anacortes sewer system. Samples of water that is pumped from the excavations by the construction dewatering system will be collected on a periodic basis, as required by the City of Anacortes. The treated dewatering effluent sample results will be evaluated for compliance with the City’s water quality standards for discharge to the sanitary sewer.

7.2 Post-construction performance monitoring and contingency action triggers

This section presents the post-construction performance monitoring of groundwater, seeps, LFG, and stormwater monitoring that will be conducted after construction of the landfill cap is complete. The goal of the monitoring is to evaluate if the cap is performing as expected. If ongoing monitoring indicates that the cap is performing as designed, modifications to the performance monitoring program (e.g., reduction in sampling frequency and removal of selected testing parameters) may be requested after discussion with and in agreement by Ecology.

7.2.1 Monitoring wells

As mentioned in Section 3.4, the CPOC will be the Lower Aquifer directly underlying the Bay Mud. The CPOC wells will be screened below the Bay Mud and carefully constructed to ensure an adequate well seal is emplaced. A second leachate monitoring well will be installed adjacent to the CPOC well. Figure 16 shows a plan view of the well spacing around the landfill, and Figure 20 provides the construction details for the new wells. The proposed well locations are adjacent to the maintenance road to facilitate access to these wells.

The monitoring wells in the underlying Lower Aquifer will be constructed with 2-inch diameter Schedule 80 PVC. The leachate monitoring wells will be installed with 4-inch diameter Schedule 80 PVC along with a 20-slot Johnson Vee-Wire screen. As a contingency measure, the larger diameter leachate wells will allow for recovery of leachate if required; the larger open area of the V-wire screen permits easier redevelopment of the well and greater production of leachate, should pumping of these wells become necessary to reduce leachate head.

The monitoring wells will be equipped with self-logging water level transducers to allow for calculation of the mean groundwater level in the Lower Aquifer and to track any variations in the leachate level in the solid waste.

Groundwater elevation data will be downloaded during each event. Table 14 lists the proposed analyte list for quality assurance/quality control samples. All samples will be collected from the mid-screen using dedicated low-flow bladder pumps or no-flow sampling techniques (i.e., Snap Sampler).

The analyte list was developed from WAC 173-304-490(2)(d), with the exception of chemical oxygen demand, total organic carbon (TOC), and total coliform. Dissolved iron is a surrogate for chemical oxygen demand and therefore redundant, and TOC could be attributable to naturally-occurring carbon in an estuarine environment. Similarly, total coliform could be naturally occurring and attributed to wildlife in the area.

Detection of redox sensitive iron or manganese in groundwater samples from CPOC wells or surface water may not be solely attributed to leachate. At this site, anaerobic conditions could be caused by naturally-occurring organic matter within the Bay Mud or in regional groundwater in contact with the Bay Mud. Under anaerobic conditions, iron and manganese can be reduced to their more soluble forms.

Samples of Bay Mud were collected during the sediment investigation performed as part of the RI. All of the samples contained TOC at concentrations ranging from 1.9 to 16.6 percent, with an average concentration of 4.8 percent. In the Model Toxics Control Act regulations (i.e., WAC 173-340-747), the default fraction of organic carbon used in calculating cleanup levels in the three-phase or four-phase models is 0.1 percent. The Bay Mud average TOC level is 48 times higher than the default TOC concentration specified by Ecology. Therefore, sufficient naturally-occurring organic carbon is present to promote anaerobic conditions.

Some of these compounds could be present in surface water due to their widespread presence in the environment. This is especially true for arsenic and PCBs. Arsenic was detected above the new lower cleanup level of 0.14 micrograms per liter in nearly all surface water samples collected during the RI. In addition, surface water data from the Ecology Environmental Information Management System shows that arsenic was detected in all Puget Sound seawater samples at concentrations exceeding the new lower cleanup standard.

The other pesticides and polycyclic aromatic hydrocarbons (4,4'-DDD, 4,4'-DDE, alpha BHC, and benzo[a]anthracene) could be present in low concentrations in surface water, seeps, and groundwater due to their widespread use in agriculture as pesticides and creosote used for preserving wooden timbers. Therefore detections of these COCs in surface water samples upstream or in water known to infiltrate the landfill will be taken into consideration when well samples are found to be above the cleanup levels. The remaining parameters from WAC 173-304-490(2) will be tested in each CPOC well. However, they will not be considered "actionable" parameters that would trigger contingent actions; rather, they will be used as potential evidence of the landfill's effect on the water quality.

Ecology has adopted new lower water quality standards for surface water including the COCs 4,4'-DDD, 4,4'-DDE, alpha BHC, benzo(a)anthracene, total PCBs, and arsenic (Ecology, 2017). The new surface water cleanup levels are well below current attainable practical quantitation limits used by most Ecology-approved commercial analytical laboratories. Therefore, the new cleanup levels will default to the laboratory practical quantitation limits certified by Ecology.

The CPOC well analytical data will be charted in a time series plot, and once sufficient data are collected, the data will be reviewed and the appropriate statistical methods will be used to help determine if there are any trends in the groundwater quality within the Lower Aquifer. The anticipated methods are Mann-Kendall Trend Test or Theil-Sen Line Test, executed in ProUCL (EPA, 2015) or Ecology-approved statistical package. From Ecology guidance for groundwater monitoring at landfills,[1] the recommended false positive rate is *"usually set at 1 or 5 percent"* for a statistically significant increase. These significance levels are consistent with standard statistical practice.

In addition to the trend charts mentioned above, the mean groundwater levels in the CPOC wells and leachate monitoring wells will be calculated using the transducer/logger data corrected using a calculated 25-hour mean water level or a 73-hour mean water level (Serfes, 1991). The mean water level in the leachate wells will be compared to the mean water levels in the paired CPOC

[1] Guidance for Groundwater Monitoring at Landfills and Other Facilities Regulated Under Chapters 173-304, 173-306, 173-350, and 173-351 WAC. December 2012. Accessed on January 17, 2018 at: https://fortress.wa.gov/ecy/publications/documents/1207072.pdf.

wells. It is expected that the difference between the mean water levels in the leachate wells will slowly approach either the top of the Bay Mud or the mean water level in the paired CPOC well. The mean water levels will be tracked using trend charts to confirm and document the performance of the low-permeability cap. Mean water levels will also be statistically evaluated for significant increasing trends, using the same methods as described above.

The groundwater flow hydraulic gradient and direction in the Lower Aquifer will be determined each quarter using the calculated mean groundwater level for a given day from the six CPOC wells. The quarterly groundwater quality data and the water level trends will be summarized in an annual report sent to Ecology and the Skagit County Health Department.

Contingency actions, identified in Section 8, have been identified for conditions prior to the estimated 10-year restoration time frame and for conditions after the estimated 10-year restoration time frame. Prior to 10 years post-construction, groundwater monitoring will provide information to determine if the remedy has failed or unexpected additional hydrologic input is occurring. Therefore, contingency actions will be taken prior to the 10-year restoration time frame under two conditions:

- Regular monitoring indicates a significant change in leachate levels and discharges that indicate hydrologic action that may be due to remedy failure and/or an unknown and significant hydrologic input from off site.
- Visual evidence that suggests cap failure or unintended significant hydrologic input.

Regular groundwater and leachate monitoring will also occur after the 10-year restoration time frame to determine whether the remedy is working as designed. Contingency actions will be taken after the 10-year restoration time frame should these two conditions occur:

- Three consecutive exceedances of the cleanup level for a COC in a given CPOC well is measured; and
- A statistically significant increasing trend in groundwater sample analytical results as demonstrated by trend charts of COC concentrations from the CPOC well is observed.

However, if both of these two conditions occur but there are:

- No statistically significant rises in leachate levels in any individual leachate well; *or*
- No correlation of leachate levels with seasonal precipitation in any individual leachate well; *and*
- No physical changes to the cap or cover materials such as ponding, unstable slopes, or reappearance of seeps are evident, *then*

No contingent actions will be undertaken and leachate levels in the refuse will continue to be monitored. A failure of the low-permeability cap would be reflected by increasing leachate levels that correlate with seasonal precipitation.

Should the water level monitoring or water quality monitoring discussed in this section suggest that the engineered low-permeability cap is not meeting performance standards at any time, contingency actions have been developed as outlined in Section 8.

7.2.2 Leachate seep monitoring

The seeps currently present in the northeast corner of the landfill are expected to be eliminated by the construction of the low-permeability cap. Seep inspectors/samplers will access the shoreline directly from the landfill by using a gate installed in the landfill security fence. The seep monitoring will occur in conjunction with the regularly scheduled groundwater monitoring events. We propose to inspect the shoreline and look for leachate seeps quarterly during the first two years. If there are no seeps observed during the first two years, then the seep monitoring frequency will decrease to twice annually during the dry and wet seasons. If "King Tides" as defined by the EPA, or higher-than-normal high tides are forecast in advance, a seep monitoring event will be scheduled within a week of the high tide to look for seeps along the shoreline. In addition, one monitoring event will be scheduled within two weeks of a storm event of 1 inch or more if observed. During seep monitoring, the cover will also be inspected for possible landslides or channeling of the cover materials.

The lower portion of the landfill cover will be inundated during high tide, and seawater will drain out of the cover materials as the tide recedes. This water will differ from the current seep water because it will not contain dissolved iron (and the associated orange-colored iron oxidation discoloration of the surrounding sediments), and should have a specific conductivity approaching that of seawater. The presence of an orange-colored discharge has been observed/documented in seeps that discharge near the inner lagoon. Seeps further from the inner lagoon did not show any discoloration. If seeps are observed by the inspector/sampler, a sample of water will be collected and the specific conductivity of the seep water will be measured. The specific conductivity of the leachate from the seeps was observed to be much lower than the specific conductivity of the seawater, so specific conductivity can be used to determine if the seeps are derived from leachate or seawater. A photograph of the seep will be taken and the GPS coordinates of the seep will be determined and documented for the annual report.

In addition, if the water seeping from the cover materials is turbid and there are orange-colored iron oxide discolored sediments surround the seep, then a sample of water from the seep will be collected and the specific conductivity, temperature, and pH will be measured. At this time, a sample will be collected for total metals using EPA Method 6010C, SVOCs using EPA Method 8270C, and total PCBs using EPA Method 1668A or 1668C.

If visible seeps with concentrations of indicator hazardous substances exceeding cleanup levels are identified 10 years or more after remedial construction, an assessment will be implemented to evaluate this condition and develop a mitigation plan. If the mitigation plan fails to prevent significant seeps within three additional years, the PLPs will develop a sediment sampling plan to determine potential impacts to sediments and marine life that will inform future mitigation requirements.

7.2.3 LFG monitoring

The completed cap will rely on a passive LFG venting system consisting of a network of perforated HDPE pipes bedded in a permeable sand layer immediately below the GCLL layer. The network of perforated pipes will encircle the landfill and a branch will run along the top of the landfill. Since LFG is lighter than air, it will gather in the piping. Natural low pressure in the atmosphere will draw LFG from the piping and passively vent it to the atmosphere. It is expected that methane concentrations will be low and the landfill will be closed to public access and the vented methane will not pose a risk of explosion.

The solid waste within the former Whitmarsh Landfill is over 40 years old, and most solid waste likely to generate methane has already degraded. While there is some residual wood waste remaining on top of the existing landfill cover, it is estimated that only 6,500 cubic yards of wood waste remain. The exact disposition of the remaining wood waste (spread out, left in place, etc.) will be determined in the Engineering Design Report. In addition, a low-permeability cover will limit stormwater infiltration into the solid waste. As groundwater within the solid waste slowly infiltrates through the Bay Mud, the solid waste will become drier. Because water is required for processes that generate methane and carbon dioxide, the increasingly drier solid waste will produce less LFG over time. The volume or concentration of methane generation by the older solid waste and the residual wood waste is not expected to be large or high enough to warrant active LFG recovery.

However, an LFG monitoring program will be conducted quarterly to determine the extent of LFG generation and the methane percentages across the landfill. A portable LFG meter, such as a Landtec GEM-500, will be used to measure methane, carbon dioxide, carbon monoxide, and balance gases (primarily nitrogen gas). Barometric pressure will also be recorded using a GEM meter. LFG readings will be recorded from all of the passive vents using a barbed fitting on the side of the vent well. The readings should not exceed the LEL for methane within the landfill and at the boundary of the landfill, and 100 parts-per-million by volume as hydrocarbon (expressed as methane) in off-site structures. This is consistent with the requirements of WAC 173-351. In addition, readings should not exceed 10 percent of the LEL for methane in ambient (outdoor) air, per WAC 173-340-750(3)(b)(iii).

In addition to LFG readings collected from the passive vent system, two LFG probes will be installed outside the landfill footprint and north of the site to monitor possible LFG migration away from the landfill. One LFG probe will be installed on the west side of South March Point Road near the neighboring quarry. Another probe will be installed just outside the landfill gate in order to monitor LFG migrating onto the Snow Mountain parcel (Figure 16). A portable LFG meter, such as a Landtec GEM-500, will be connected to the well to record LFG readings. The meter will be connected to the well using a barbed tube fitting installed on a temporary slip cap. The meter will be used to extract a headspace sample from the well. LFG monitoring of these LFG gas probes will be conducted quarterly in accordance with WAC 173-304. LFG concentrations in these probes should be below the LEL for methane. Should methane concentrations meet or exceed the LEL, or if the methane concentrations meet or exceed 10 percent of the LEL in ambient (outdoor) air, a contingency plan has been developed as outlined in Section 8.

7.2.3 Stormwater monitoring

Stormwater monitoring will be coordinated with quarterly groundwater monitoring. The main purpose of stormwater monitoring is to visually survey the condition of the stormwater conveyances that will be installed to route stormwater off the cap and into the inner lagoon. In addition to quarterly inspections, site visits will be conducted during the day within one week of a rainfall event of 1 inch or more, to collect photographic evidence of the cap condition for the first three years after completion of construction. The purpose of these site visits is to document whether heavy rainfall causes erosion damage to the cap or creates preferential pathways under the cap that manifest as seeps. These site visits will include documentation of any active seeps with an orange discoloration or olfactory indication of landfill leachate, as well as documentation of cover soil erosion/movement or channel development.

The conveyances will be installed on top of the cover materials, and along the swale bordering the southwest side of the landfill. The preliminary design of the conveyances indicates that they will consist of a low-permeability liner covered by quarry spalls to both protect the liner and lower the velocity of stormwater flowing through the channel. During the inspections, the conveyances will be inspected for damage, vegetation growth, and ponding. The inspection will include photographing the condition of the conveyances as needed to help with repairs. Inspection reports and actions taken along with photographs of the repair action will be submitted to Ecology with the annual report.

8.0 Post-construction contingency triggers and actions

8.1 Groundwater and leachate contingency triggers and actions

There are three post-construction concerns in relation to groundwater and leachate within the solid waste after construction of the low-permeability cap and cover. The concerns are:

- Re-emergent seeps along the northeast/east side of the landfill into the inner lagoon of Padilla Bay;
- COCs exceeding cleanup levels in CPOC wells; and
- Lateral migration of groundwater into the solid waste.

As shown in Figure 13, there is a clear pattern of seasonal groundwater fluctuation at the landfill currently. Given the relatively flat topography of the landfill, the berms limiting any stormwater runoff, and the sandy cover materials, it is logical that the majority of precipitation infiltrates into the landfill. During the dry summer months, groundwater/leachate levels within the solid waste drop between 1.2 and 2.2 feet, as the groundwater seeps laterally from the edges of the landfill and vertically downward through the Bay Mud. Once construction is complete, it is expected that the leachate levels will have been lowered through pumping and disposal to the City of Anacortes sewer system. Additionally, with the low-permeability GCLL cap extending into the Bay Mud along the inner lagoon, shoreline precipitation infiltration will be substantially reduced or eliminated, and therefore visible seeps are expected to be eliminated within five to ten years. Leachate levels are expected to drop slowly as the leachate level equilibrates with the mean water levels in the underlying Lower aquifer. The transducer/loggers will monitor the behavior of the leachate and groundwater levels. We expect the leachate levels will stabilize 2–3 feet above the Bay Mud. Due to uncertainty concerning lateral infiltration of groundwater, there may be some residual seasonal variation in leachate levels.

Water levels between the leachate and the underlying groundwater will be closely monitored and compared using hydrographs for each well cluster. If the seep monitoring described in Section 7.2.2 documents and confirms that leachate is continuing to seep from the shoreline more than ten years post construction, the following actions will be performed:

- Evaluate the groundwater/leachate elevations collected from the self-logging transducers to look for any sudden increase in water levels that may indicate a potential problem with the low-permeability cap;
- Inspect the condition of the cap and surface water conveyances to see if a there is any surficial damage to the cap; and

- Locate the leak and repair the area near the seep because that means the seep itself is indicative of a problem with the low-permeability cap.

If, after diligent inspection of the GCLL cap near the seep, there is no indication of damage to the cap or stormwater conveyances, it will be assumed that the groundwater/leachate is being recharged by another major source.

Due to the very low cleanup levels for COCs and the possibility that concentrations of COCs in CPOC wells may be from sources other than the landfill, a trigger for determining when contingency measures will be initiated related to exceeding cleanup levels has been developed as discussed in Section 7.2.1. If the groundwater monitoring described in Section 7.2.1 triggers the need for contingency measures, the following actions will be performed:

- Evaluate the groundwater/leachate elevations collected from the self-logging transducers to look for any sudden increase in water levels that may indicate a problem with the low-permeability cap near any particular leachate well;
- Inspect the condition of the cap and surface water conveyances to see if a there is any surficial damage to the cap; and
- Locate the leak and repair the area near the monitoring well or leachate well because that suggests that the well results and associated water level increases are indicative of a problem with the low-permeability cap.

Aside from precipitation/infiltration causing seeps or groundwater exceedances, lateral flow of groundwater into the waste, primarily from the north, is another possible source of groundwater/leachate in the solid waste. If seeps continue and/or leachate levels do not stabilize or start to rise over time, then a contingent remedy will be necessary to control lateral migration of groundwater into the landfill. Such a remedy could consist of recovering leachate from within the waste and disposing of it, or could include cutoff of lateral groundwater inflow to the waste. The simplest contingent remedy involves leachate recovery using suitable pumps or vacuum trucks from wells installed to monitor leachate levels, and disposal of the leachate into the City of Anacortes publically-owned treatment works. If this additional remedy isn’t sufficient to control seeps and/or rising groundwater, then cutoff of lateral groundwater recharge from the north with an impermeable curtain/wall or dewatering wells will be considered.

8.2 LFG contingency triggers and actions

While it is expected that any methane generated under the low-permeability cover will vent passively through the LFG vents, there is a small possibility of lateral migration of LFG away from the landfill where it could create a safety concern. Due to the setting of the landfill surrounded by surface water bodies, lateral subsurface migration of LFG from the waste is not a concern along the shoreline, since there are no residences or structures in these areas and subsurface LFG migration is blocked by the presence of water bodies. LFG is only expected to pose a potential concern along the north and northwest sides of the landfill.

Two LFG probes will be installed with the intent that these probes will remain intact during and after construction of the cleanup measure. As expressed in WAC 173-304-460 and discussed in Section 7.2, LFG measured in these gas probes during routine LFG monitoring shall not exceed the LEL.

If LFG is detected above the LEL in either of the two LFG probes, then additional passive and/or active LFG recovery will be assessed in the areas exhibiting elevated LEL readings. An active system would entail recovering the LFG using explosion-proof motor blowers extracting LFG from the venting system, and venting directly to the atmosphere. Currently LFG generated at the landfill migrates vertically upward through the permeable cap and enters the atmosphere. No additional impacts to air quality are expected since there is nothing controlling such emissions now. However, any City or County permit requirements or required monitoring of the system will be determined at the time such a conversion is deemed necessary.

9.0 Five-year review

Because the cleanup action described in Section 5 will result in hazardous substances remaining at the site at concentrations exceeding cleanup levels (e.g., solid waste beneath the landfill cap), and because environmental covenants are included as part of the remedy, Ecology will review the selected cleanup action described in this CAP every five years to ensure protection of human health and the environment. Consistent with the requirements of WAC 173-340-420, the five-year review shall include reviews of:

- The title of the real property subject to the environmental covenant to verify that the covenant is properly recorded;
- Available monitoring data to verify the effectiveness of completed cleanup actions, including engineered caps and institutional controls, in limiting exposure to hazardous substances remaining at the site;
- New scientific information for individual hazardous substances or mixtures present at the site;
- New applicable state and federal laws for hazardous substances present at the site;
- Current and projected future land and resource uses at the site;
- The availability and practicability of more permanent remedies; and
- The availability of improved analytical techniques to evaluate compliance with cleanup levels.

9.1 Hydraulic control indicators

Hydraulic control (reduction in the development of landfill leachate and lowering of water levels/leachate levels within the solid waste) is an important element in the cleanup remedy and should result in the elimination of landfill seeps into Padilla Bay. Hydraulic control also will be evaluated during the five-year review to ensure that water levels/leachate levels have dropped and that there are no visible landfill leachate seeps emanating from the landfill body.

9.2 Sediment sampling indicators

Sediment sampling is not likely to be necessary as part of the five-year review. Even under existing conditions, the sediment has not been impacted by the landfill per the Sediment Investigation Report. If there are no visible leachate seeps indicating the presence of leachate, then the likelihood that sediment is being affected by landfill leachate is extremely low. However, if visible leachate seeps are noted during landfill inspections, then additional hydraulic control may be necessary to reduce leachate pressure. The five-year review will consider whether and how often leachate seeps were observed during routine landfill inspections and results from any seep sampling analyses. Extended observations of leachate seeps during consecutive quarterly inspections will be an indicator that additional seep sampling and/or sediment sampling should be performed as part of the five-year review to evaluate sediment quality near the landfill.

Ecology will publish a notice of all periodic reviews in the site register and will provide an opportunity for review and comment by the potentially liable persons and the public. If Ecology determines that substantial changes in the cleanup action are necessary to protect human health and the environment at the site, a revised CAP will be prepared and provided for public review and comment in accordance with WAC 173-340-380 and 173-340-600

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Tables

Table 1. Summary of upland remedial investigation samples and analyses, phase 1 samples

Sample ID	Depth (feet bgs)	Date(s) sampled	Geotechnical Testing Methods[1]	Metals[2, 3]	TPH-G[4]	TPH-D[5]	SVOCs[6]	VOCs[7]	PCBs[8]	Pesticides[9]	Dioxins and Furans[10]	Full Water Suite[11]	Reduced Water Suite[12]	2013 Additional Soil and Groundwatersampling[13]
PHASE I SAMPLES														
Soil Samples														
MW-01	11.5	10/7/2008	--	X	X	--	--	X	--	--	--	--	--	--
	20.5		--	X	X	--	--	X	--	--	--	--	--	--
	37		--	X	X	--	--	X	--	--	--	--	--	--
MW-03	11.5	10/9/2008	--	X	X	--	--	X	X	X	--	--	--	--
MW-04	8.5	10/8/2009	--	X	X	--	--	X	--	--	--	--	--	--
	19		--	X	X	--	--	X	--	--	--	--	--	--
G1	1	11/1/2008	--	X	X	X	X	X	X	X	--	--	--	--
	5.h5		--	X	X	X	X	X	X	X	--	--	--	--
G3	1	10/31/2008	--	X	X	X	X	X	X	X	--	--	--	--
	8		--	X	X	X	X	X	X	X	--	--	--	--
	12		--	X	X	X	X	X	X	X	--	--	--	--
G4	1	10/31/2008	--	X	X	X	X	X	X	X	--	--	--	--
	5		--	X	X	X	X	X	X	X	--	--	--	--
G5	1	11/2/2008	--	X	X	X	X	X	X	X	--	--	--	--
	5		--	X	X	X	X	X	X	X	--	--	--	--
	9		--	X	X	X	X	X	X	X	--	--	--	--
G6	6	11/1/2008	--	X	X	X	X	X	X	X	--	--	--	--
G10	8	11/1/2008	--	X	X	X	X	X	X	X	--	--	--	--
G11	11	10/31/2008	--	X	X	X	X	X	X	X	--	--	--	--
Groundwater Samples														
MW-02	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
MW-03	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
MW-04	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
Seep Samples														
SP-01	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SP-02	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SP-03	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
Surface Water Samples														
SW-01	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SW-03	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SW-04	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SW-05	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SW-06	--	multiple[14]	--	--	--	--	--	--	--	--	--	X	--	--
SW-07	--	multiple[15]	--	--	--	--	--	--	--	--	--	X	--	--

Table 1. Summary of upland remedial investigation samples and analyses (continued)

Sample ID	Depth (feet bgs)	Date(s) Sampled	Geotechnical Testing Methods[1]	Metals[2, 3]	TPH-G[4]	TPH-D[5]	SVOCs[6]	VOCs[7]	PCBs[8]	Pesticides[9]	Dioxins and Furans[10]	Full Water Suite[11]	Reduced Water Suite[12]	2013 Additional Soil and Groundwater Sampling[13]
PHASE II SAMPLES														
Soil Samples														
G15	15	3/29/2010	3/29/2010	--	--	--	--	--	--	--	--	--	--	--
G16	7	3/29/2010	X	--	--	--	--	--	--	--	--	--	--	--
	10	3/29/2010	X	--	--	--	--	--	--	--	--	--	--	--
G17.5	7	4/1/2010	X	X	X	X	X	X	X	X	--	--	--	--
G18	8	3/30/2010	X	--	--	--	--	--	--	--	--	--	--	--
G20	12	3/29/2010	X	--	--	--	--	--	--	--	--	--	--	--
G24	16	3/30/2010	X	--	--	--	--	--	--	--	--	--	--	--
G29	9	3/31/2010	X	X	X	X	X	X	X	X	--	--	--	--
G30	7	3/31/2010	--	X	X	X	X	X	X	X	--	--	--	--
	Drum		--	X	X	X	X	--	X	X	--	--	--	--
G32	12	3/31/2010	--	X	X	X	X	X	X	X	--	--	--	--
G35	15	4/1/2010	--	X	X	X	X	X	X	X	--	--	--	--
G37	10	3/31/2010	X	X	X	X	X	X	X	X	--	--	--	--
MW-08	24-26	4/2/2010	X	X	X	X	X	X	X	X	--	--	--	--
MW-10	24-26	4/1/2010	X	X	X	X	X	X	X	X	--	--	--	--
G41	10	3/27/2013	--	--	--	--	--	--	--	--	X	--	--	X
G42	11	3/27/2013	--	--	--	--	--	--	--	--	X	--	--	X
G43	8	3/27/2013	--	--	--	--	--	--	--	--	X	--	--	X
ST-01	0	4/2/2010	X	--	--	--	--	--	--	--	--	--	--	--
ST-02	0	4/2/2010	X	--	--	--	--	--	--	--	--	--	--	--
Groundwater Samples														
MW-02	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
MW-03	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
MW-04	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
MW-05	--	multiple[17]	--	--	--	--	--	--	--	--	--	X[19]	X[20]	X
MW-06	--	multiple[17]	--	--	--	--	--	--	--	--	--	X[19]	X[20]	X
MW-07	--	multiple[18]	--	--	--	--	--	--	--	--	--	X[19]	X[20]	X
MW-08	--	multiple[16]	--	--	--	--	--	--	--	--	X	X	--	X
MW-09	--	multiple[18]	--	--	--	--	--	--	--	--	X	X[19]	X[20]	X
MW-10	--	multiple[16]	--	--	--	--	--	--	--	--	--	X	--	--
MW-11	--	multiple[16]	--	--	--	--	--	--	--	--	--	X	--	--
Seep Samples														
SP-01	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SP-02	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SP-03	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--

Table 1. Summary of upland remedial investigation samples and analyses (continued)

Sample ID	Depth (feet bgs)	Date(s) Sampled	Geotechnical Testing Methods[1]	Metals[2, 3]	TPH-G[4]	TPH-D[5]	SVOCs[6]	VOCs[7]	PCBs[8]	Pesticides[9]	Dioxins and Furans[10]	Full Water Suite[11]	Reduced Water Suite[12]	2013 Additional Soil and Groundwater Sampling[13]
PHASE II SAMPLES														
Surface Water Samples														
SW-01	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SW-03	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SW-04	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SW-05	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--
SW-06	--	multiple[16]	--	--	--	--	--	--	--	--	--	--	X	--

Notes

1. Geotechnical testing methods were as follows: moisture content by ASTM D2216, particle size distribution by ASTM D422, Atterberg limits by ASTM D4318A, hydraulic conductivity by ASTM D5084, and organic matter/ash content/total solids by ASTM D2974.
2. Phase I soil samples were analyzed for the metals aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, titanium, vanadium, and zinc. Phase II soil samples were analyzed for the same metals as the Phase I samples, except for aluminum, barium, molybdenum, strontium, and titanium.
3. Metals testing methods were as follows: mercury by EPA 7470A; lead, arsenic, nickel, and thorium by EPA 200.8; and all other metals by EPA 6010.
4. The method used for TPH-G was NWTPH-Gx.
5. The method used for TPH-D was NWTPH-Dx. Samples were treated using silica-gel cleanup prior to analysis.
6. The method used for SVOCs was EPA 8270D with low-level PAHs by SIM (select ion monitoring).
7. The method used for VOCs was EPA 8260.
8. The method used for PCBs was EPA 8082.
9. The method used for pesticides was EPA 8081.
10. The method used for dioxins and furans was EPA 1613B.
11. The full water suite included analysis for total and dissolved metals, TPH-G, TPH-D, SVOCs, PAHs, VOCs, PCBs, and pesticides.
12. The reduced water suite includes the total and dissolved metals arsenic, lead, mercury, and thallium; PCBs; and pesticides; plus TPH-D for seep samples.
13. The additional groundwater monitoring included Phase II metals for all samples except MW-08, plus dioxins and furans for MW-08 and MW-09. The additional soil samples were analyzed for dioxins and furans.
14. Sampled during Phase I quarterly monitoring events on October 14–15, 2008, December 17–19, 2008, April 28–29, 2009, and July 23–24, 2009
15. Sampled only during the Phase I December 2008 and April 2009 events.
16. Sampled during Phase II quarterly monitoring events on April 13–15, 2010, July 12–15, 2010, and October 4–8, 2010.
17. Sampled during Phase II quarterly monitoring events and on March 28, 2013.
18. Sampled during Phase II quarterly monitoring events and on March 26, 2013.
19. Full suite analyzed during Phase II quarterly monitoring events.
20. Reduced suite analyzed for during additional sampling in March 2013.

Abbreviations

-- = not applicable
bgs = feet below ground surface
EPA = Environmental Protection Agency
PAHs = polyaromatic hydrocarbons
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH-D = total petroleum hydrocarbons as diesel
TPH-G = total petroleum hydrocarbons as gasoline
VOCs = volatile organic compounds

Table 2. Summary of PCL exceedances for monitoring well and test pit soil samples. October/November 2008 and March/April 2010[1,2]

Analyte[3] Depth (feet bgs)	PCL	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5		
		11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9
		10/7/2008			10/9/2008	10/8/2008		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008		
Metals (mg/kg)																			
Antimony	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	7	--	--	--	--	14 J	--	--	11	--	--	--	--	8.8	--	--	--	--	--
Barium	102	--	--	239	117	--	--	NA	NA	--	115	--	--	--	--	259	--	--	--
Cadmium	1.0	--	--	--	--	--	--	1.3	--	--	2.6	--	--	--	--	2.7	--	--	--
Copper	36	--	--	61	373	44.6	--	60.2	--	--	76	--	76.0	--	--	49.3	--	--	36.4
Lead	118	--	--	--	171	--	--	--	--	--	--	--	--	--	--	238	--	--	--
Mercury	0.07	--	--	--	--	--	--	--	--	--	6.9	--	0.10	0.08	--	0.08	--	--	0.26
Nickel	48	99	81	56	80	83	60	55 J	--	76	90	63	60	--	76	75	62	65	62
Zinc	101	--	--	--	282	--	--	245	--	--	381	--	174	--	--	311	187	225	187
TPH (mg/kg)																			
Gasoline-Range Organics (TPH-G)	30/100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	310 J
Lube Oil (TPH-Oil)	2,000	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
VOCs (µg/kg)																			
Benzene	6.8	--	--	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--
SVOCs (µg/kg)																			
2,4-Dimethylphenol	3,100	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	70	NA	NA	NA	NA	NA	NA	--	--	--	270	--	--	--	--	--	--	--	130
Benzo(a)pyrene	190	NA	NA	NA	NA	NA	NA	--	--	--	240	--	--	--	--	--	--	--	120
Dibenzofuran	90	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	46,000	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	190	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl) phthalate	2,600	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	--	--	--	--	6,000
Chrysene	80	NA	NA	NA	NA	NA	NA	--	--	--	320	--	--	--	--	--	--	--	180
PCBs (µg/kg)																			
Aroclor 1254	4	NA	NA	NA	27	NA	NA	--	--	--	--	--	22	--	--	240	--	--	110 J
Pesticides (µg/kg)																			
4,4'-DDD	3.3	NA	NA	NA	--	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	3.3	NA	NA	NA	--	NA	NA	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin	1.7	NA	NA	NA	--	NA	NA	--	--	--	--	--	--	--	--	--	--	--	390
delta-BHC	1.7	NA	NA	NA	--	NA	NA	--	--	--	--	9.8	120	1.6 U	--	--	--	--	--
Dieldrin	3.3	NA	NA	NA	--	NA	NA	--	--	--	--	--	24	--	--	--	--	--	210

Table 2. Summary of PCL exceedances for monitoring well and test pit soil samples. October/November 2008 and March/April 2010[1,2] (continued)

Analyte[3] Depth (feet bgs)	PCL	G6		G10	G11	G17.5	G29	G30		G32	G35	G37
		6	field dup.	8	11	7	9	7	DRUM [4]	12	15	10
		11/1/2008		11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
Metals (mg/kg)												
Antimony	5.1	--	11 J	--	--	--	--	--	--	--	--	--
Arsenic	7	--	--	--	13	8	--	--	--	--	70	--
Barium	102	--	--	--	--	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.0	--	--	--	--	--	--	--	--	--	--	--
Copper	36	50.0	70.8	--	--	--	--	--	--	261	57.5	--
Lead	118	--	--	--	--	--	--	--	--	--	184	--
Mercury	0.07	--	--	--	--	--	--	--	--	0.13	0.34	--
Nickel	48	69	69	67	--	55 J	78 J	211 J	190 J	179 J	495 J	361 J
Zinc	101	175	345	--	--	--	--	--	133	413	149	--
TPH (mg/kg)												
Gasoline-Range Organics (TPH-G)	30/100	--	--	--	--	--	--	--	--	350	90	--
Lube Oil (TPH-Oil)	2,000	--	--	--	--	--	3,400	--	--	--	--	--
VOCs (µg/kg)												
Benzene	6.8	--	--	--	--	--	--	--	NA	11	--	--
SVOCs (µg/kg)												
2,4-Dimethylphenol	3,100	--	--	--	--	--	--	--	--	--	130,000	--
Benzo(a)anthracene	70	--	--	--	--	--	--	--	--	100 J	--	--
Benzo(a)pyrene	190	--	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	90	--	--	--	--	--	--	--	--	240	--	--
Phenol	46,000	--	--	--	--	--	--	--	--	73,000	--	--
2-Methylphenol	190	--	--	--	--	--	--	--	--	--	130,000	--
bis(2-Ethylhexyl) phthalate	2,600	--	--	--	--	--	--	--	--	--	--	--
Chrysene	80	--	--	--	--	--	1,100 J	--	--	190	--	--
PCBs (µg/kg)												
Aroclor 1254	4	76	31	--	--	--	--	--	--	42	--	--
Pesticides (µg/kg)												
4,4'-DDD	3.3	--	--	--	--	--	4.4	--	--	--	--	--
4,4'-DDE	3.3	--	--	--	--	--	--	--	--	--	620	--
Aldrin	1.7	--	--	--	--	--	--	--	--	--	--	--
delta-BHC	1.7	2.8	3.1	--	--	--	--	--	--	--	--	--
Dieldrin	3.3	--	--	--	--	--	--	--	--	--	--	--

Notes

1. Data qualifiers are as follows:
2. U = The analyte was not detected at the reporting limit indicated.
3. J = Reported value is an estimate.
4. Sample IDs beginning with "G" are test pits; sample IDs beginning with "MW" are monitoring wells.
5. Analyte not shown if detected concentration did not exceed PCL in any soil sample.
6. Material sample found in a drum in the test pit.

Abbreviations

-- = Analyte does not exceed the applicable PCL
µg/kg = micrograms per kilogram
bgs = below ground surf
NA = not analyzesace
mg/Kg = mg/Kg
PCB = polychlorinated biphenyls
PCL = preliminary cleanup level
SVOCs = semivolatile organic compounds
TPH-D = total petroleum hydrocarbons as diesel
TPH-G = total petroleum hydrocarbons as gasoline
VOCs = volatile organic compounds

Table 3. Summary of PCL exceedances in groundwater and seep samples[1]

Analyte	PCL	MW-02							MW-03						
		10/14/08	12/18/08	4/29/09	7/24/09	4/13/10	7/13/10	10/5/10	10/14/08	12/18/08	4/28/09	7/23/09	4/13/10	7/13/10	10/5/10
Dissolved Metals (µg/L)															
Arsenic	0.2	1.9	2.2	2.3 J-	2.5	2.3	2.9	2.7	4.1	0.5	0.5 J-	4.1	2.5	3.5	4.3
Copper	2.4	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Iron	1,000	--	--	--	--	NA	NA	NA	11,800	--	--	13,400	NA	NA	NA
Lead	2.5	--	--	--	--	3	--	--	--	--	--	--	--	--	--
Manganese	50	--	--	--	--	NA	NA	NA	332	227	276 J-	319	NA	NA	NA
Selenium	5	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Silver	1.9	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Total Metals (µg/L)															
Aluminum	87	--	--	--	--	NA	NA	NA	460 J	--	--	--	NA	NA	NA
Arsenic	0.2	2	2.2	2.3	2.8	4.8	2.9	2.5	4.9	2.7	2.8	4.1	2.5	3.5	4.1
Copper	2.4	--	--	--	--	NA	NA	NA	3	--	--	--	NA	NA	NA
Iron	1,000	--	--	--	--	NA	NA	NA	13,400	12,200	14,600	12,500	NA	NA	NA
Lead	2.5	--	--	--	--	2	--	--	16 J	--	--	--	--	--	--
Manganese	50	--	--	--	64	NA	NA	NA	350	254	301	307	NA	NA	NA
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	1.9	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
PCBs (µg/L)															
Aroclor 1232	0.014	--	--	--	--	--	--	--	--	0.029 J	0.019	--	--	--	--
Aroclor 1242	0.014	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--
Aroclor 1248	0.014	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides (µg/L)															
4,4'-DDD	0.00125	--	--	--	--	--	--	--	--	0.0056 J	0.0058	0.0075	0.0072	0.0074	--
4,4'-DDE	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--
alpha-BHC	0.0006	--	--	--	--	--	--	--	0.015	0.031 J	0.041	0.016	0.026	0.034	0.027
SVOCs (µg/L)															
1-Methylnaphthalene	1.51	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
2,4-Dimethylphenol	380	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Benzo(a)anthracene	0.01	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
bis(2-ethylhexyl)phthtlate	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Chrysene	0.01	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
VOCs (µg/L)															
Benzene	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA

Table 3. Summary of PCL exceedances in groundwater and seep samples[1] (continued)

		MW-03 Field Duplicate				MW-04							MW-05				
Analyte	**PCL**	**10/14/08**	**12/18/08**	**4/28/09**	**7/23/09**	**10/14/08**	**12/19/08**	**4/29/09**	**7/24/09**	**4/13/10**	**7/13/10**	**10/5/10**	**4/14/10**	**7/14/10**	**10/7/10**	**3/28/13**	**8/17/13**
Dissolved Metals (µg/L)																	
Arsenic	0.2	4	0.4	0.5 J-	4.1	4.6	4.4	5.5 J-	5.9	5.6	6.1	6.4	2.5	2.2	2.3	1.4	1.6
Copper	2.4	--	--	--	--	--	--	--	--	NA	NA	NA	3	4	--	--	--
Iron	1,000	12,000	--	1,360 J-	13,600	--	--	--	--	NA	NA	NA	4,510	6,980	8,450	20,000	15,500
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	336	226	284 J-	327	127	121	124 J-	125	NA	NA	NA	294	573	487	664	511
Selenium	5	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	50	--	--
Silver	1.9	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	--	--
Total Metals (µg/L)																	
Aluminum	87	--	--	--	--	160	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.2	4.4	2.8	2.7	4	4.1	4.8	5.6	5.6	5.8	6.1	6.3	1.7	3	2.2	1.4	1.8
Copper	2.4	--	--	--	--	--	--	--	--	NA	NA	NA	5	5	--	--	--
Iron	1,000	12,400	12,300	13,300	12,900	--	--	--	--	NA	NA	NA	4,820	6,020	8,440	20,100	9,590
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	349	258	282	316	136	129	124	127	NA	NA	NA	309	570	484	665	341
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	28.6	--	--
Silver	1.9	--	--	--	--	--	--	--	--	NA	NA	NA	7	--	--	--	--
PCBs (µg/L)																	
Aroclor 1232	0.014	--	0.031 J	0.022	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Aroclor 1242	0.014	0.031	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Aroclor 1248	0.014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Total PCBs	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Pesticides (µg/L)																	
4,4'-DDD	0.00125	--	0.0061 J	0.0061	0.0082	--	--	--	--	--	--	--	--	--	--	NA	NA
4,4'-DDE	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
alpha-BHC	0.0006	0.015	0.036 J	0.039	0.018	--	--	--	--	--	--	--	--	--	--	NA	NA
SVOCs (µg/L)																	
1-Methylnaphthalene	1.51	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA
2,4-Dimethylphenol	380	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA
Benzo(a)anthracene	0.01	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA
bis(2-ethylhexyl)phthtlate	1.2	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA
Chrysene	0.01	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA
VOCs (µg/L)																	
Benzene	1.2	--	--	--	--	--	--	--	--	NA	NA	NA	--	--	--	NA	NA

Table 3. Summary of PCL exceedances in groundwater and seep samples[1] (continued)

Analyte	PCL	MW-06					MW-07					MW-08			MW-09				
		4/15/10	7/14/10	10/7/10	3/28/13	8/17/13	4/15/10	7/14/10	10/6/10	3/26/13	8/17/13	4/14/10	7/13/10	10/7/10	4/14/10	7/13/10	10/7/10	3/26/13	8/17/13
Dissolved Metals (µg/L)																			
Arsenic	0.2	0.7	0.7	0.8	1.2	0.9	--	--	--	--	0.9	2.2	1.8	1.6	1.2	1.4	1.4	1.7	1.5
Copper	2.4	--	--	--	--	--	5	6	--	--	--	--	--	--	--	--	--	--	--
Iron	1,000	98,400	102,000	97,700	77,900	92,200	4,520	3,940	2,370	5,820	1,540	34,300	36,600	46,600	19,000	22,400	21,300	22,700	24,500
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	2,730	2,670	2,220	2,310	2,300	579	372	217	673	183	1,680	1,660	2,390	449	543	447	529	565
Selenium	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals (µg/L)																			
Aluminum	87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.2	1	1.2	0.7	1.2	1.0	--	0.9	--	--	1	2.2	1.7	1.8	1.4	1.3	1.4	1.8	1.4
Copper	2.4	--	--	--	--	--	9	5	--	--	4	3	--	--	3	3	--	--	--
Iron	1,000	101,000	102,000	95,700	74,600	91,400	4,590	3,650	2,710	5,720	1,590	38,800	37,300	42,900	19,600	22,800	19,400	23,100	24,000
Lead	2.5	--	--	--	--	--	--	--	--	--	--	3	--	--	3	--	--	--	--
Manganese	50	2,720	2,690	2,270	2,240	2,340	581	356	234	672	185	1,990	1,790	2,140	464	548	411	555	551
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs (µg/L)																			
Aroclor 1232	0.014	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
Aroclor 1242	0.014	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
Aroclor 1248	0.014	0.017	--	--	NA	NA	--	--	--	NA	NA	0.015	--	--	--	--	--	NA	NA
Total PCBs	0.07	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
Pesticides (µg/L)																			
4,4'-DDD	0.00125	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
4,4'-DDE	0.00125	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
alpha-BHC	0.0006	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
SVOCs (µg/L)																			
1-Methylnaphthalene	1.51	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
2,4-Dimethylphenol	380	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
Benzo(a)anthracene	0.01	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA
bis(2-ethylhexyl)phththlate	1.2	--	--	1.3	NA	NA	--	--	--	NA	NA	--	--	--	--	--	2.4	NA	NA
Chrysene	0.01	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	0.014	0.015	0.011	NA	NA
VOCs (µg/L)																			
Benzene	1.2	--	--	--	NA	NA	--	--	--	NA	NA	--	--	--	--	--	--	NA	NA

Table 3. Summary of PCL exceedances in groundwater and seep samples[1] (continued)

		MW-09 Field Dup.	MW-10			MW-11			MW-11 Field Duplicate			SP-01						
Analyte	**PCL**	**3/26/13**	**4/15/10**	**7/13/10**	**10/7/10**	**4/15/10**	**7/14/10**	**10/8/10**	**4/15/10**	**7/14/10**	**10/8/10**	**10/15/08**	**12/17/08**	**4/28/09**	**7/24/09**	**4/14/10**	**7/15/10**	**10/7/10**
Dissolved Metals (µg/L)																		
Arsenic	0.2	1.7	2.8	2.8	3	1.8	1.4	1.9	1.8	1.4	2	0.4	--	0.4 J-	1.2	0.4	1.2	1.2
Copper	2.4	--	--	3	--	--	--	--	--	3	--	--	--	--	--	NA	NA	NA
Iron	1,000	22,900	11,300	13,800	13,900	10,600	11,100	13,000	10,800	11,100	12,200	--	--	--	12,300	NA	NA	NA
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	531	210	200	200	320	271	294	326	272	279	154	233	225 J-	173	NA	NA	NA
Selenium	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
Silver	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
Total Metals (µg/L)																		
Aluminum	87	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	150	--	--	NA	NA	NA
Arsenic	0.2	1.7	2.7	2.7	3	1.8	1.4	1.9	1.9	1.4	1.9	1.4	1.4	1.3	1.3	1.4	1.3	1.3
Copper	2.4	--	3	--	--	--	3	--	--	3	--	--	--	--	--	NA	NA	NA
Iron	1,000	22,800	11,300	13,100	14,100	10,800	9,930	12,500	10,800	10,800	12,100	15,900	22,100	15,500	12,100	NA	NA	NA
Lead	2.5	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	546	210	190	202	323	240	287	324	264	284	173	251	238	163	NA	NA	NA
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
PCBs (µg/L)																		
Aroclor 1232	0.014	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1242	0.014	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1248	0.014	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	0.07	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides (µg/L)																		
4,4'-DDD	0.00125	NA	--	0.0058 J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	0.00125	NA	0.16	0.058 J	--	--	0.34 J	--	--	0.32 J	--	--	--	--	--	--	0.082 J	--
alpha-BHC	0.0006	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SVOCs (µg/L)																		
1-Methylnaphthalene	1.51	NA	--	--	--	2.8	2.8	3.1	2.7	2.8	2.6	--	--	--	--	NA	NA	NA
2,4-Dimethylphenol	380	NA	--	--	--	640	--	--	650	--	--	--	--	--	--	NA	NA	NA
Benzo(a)anthracene	0.01	NA	--	--	--	--	--	--	--	0.012 J	--	--	--	--	--	NA	NA	NA
bis(2-ethylhexyl)phthtlate	1.2	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
Chrysene	0.01	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
VOCs (µg/L)																		
Benzene	1.2	NA	--	--	2.7	8.3	3.7	6.4	8.6	3.9	5.9	2.6	2.4	1.9	2.2	NA	NA	NA

Table 3. Summary of PCL exceedances in groundwater and seep samples[1] (continued)

Analyte	PCL	SP-02							SP-03						
		10/15/08	12/18/08	4/28/09	7/24/09	4/15/10	7/15/10	10/7/10	10/15/08	12/18/08	4/28/09	7/24/09	4/15/10	7/15/10	10/7/10
Dissolved Metals (µg/L)															
Arsenic	0.2	--	--	0.7 J-	1.1	--	1.3	12	0.8	--	0.6 J-	0.8	--	--	0.8
Copper	2.4	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Iron	1,000	--	--	--	18,200	NA	NA	NA	--	--	3,940 J-	25,800	NA	NA	NA
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	126	364	332 J-	321	NA	NA	NA	434	477	545 J-	444	NA	NA	NA
Selenium	5	--	--	--	--	NA	NA	NA	--	--	--	50	NA	NA	NA
Silver	1.9	11	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Total Metals (µg/L)															
Aluminum	87	270	2,230	680	900	NA	NA	NA	580	--	--	--	NA	NA	NA
Arsenic	0.2	--	1.4	1.7	2.4	0.6	0.5	0.9	1.3	--	1.1	0.8	0.9	1.5	2.2
Copper	2.4	--	5	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Iron	1,000	5,890	21,400	25,100	26,400	NA	NA	NA	55,300	19,800	41,100	25,400	NA	NA	NA
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	NA	NA	--
Manganese	50	85	409	373	314	NA	NA	NA	557	495	570	395	NA	NA	NA
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	1.9	8	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
PCBs (µg/L)															
Aroclor 1232	0.014	--	--	0.028	--	--	--	--	--	0.086 J	0.091	--	--	--	--
Aroclor 1242	0.014	--	--	--	--	--	--	--	0.035 J	0.029 J	--	--	--	--	--
Aroclor 1248	0.014	--	--	--	--	--	--	--	--	--	--	--	0.017 J	--	--
Total PCBs	0.07	--	--	--	--	--	--	--	0.035 J	0.115	0.091	--	0.017 J	--	--
Pesticides (µg/L)															
4,4'-DDD	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--
alpha-BHC	0.0006	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SVOCs (µg/L)															
1-Methylnaphthalene	1.51	--	--	--	--	NA	NA	NA	4	5.2	5.3	3.6	NA	NA	NA
2,4-Dimethylphenol	380	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
Benzo(a)anthracene	0.01	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
bis(2-ethylhexyl)phthtlate	1.2	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
Chrysene	0.01	--	--	--	--	--	--	--	--	--	--	--	NA	NA	NA
VOCs (µg/L)															
Benzene	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA

Notes

Data qualifiers are as follows:
J = analyte was positively identified; result is an estimated concentration.
J- = value is estimated with a possible low bias

Abbreviations

-- = does not exceed the PCL
µg/L = micrograms per liter
NA = not analyzed
PCBs = polychlorinated biphenyls
PCL = preliminary cleanup level
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

Table 4. Summary of PCL exceedances in surface water samples[1]

Analyte	PCL	SW-01							SW-03						
		10/14/2008	12/14/2008	4/28/2009	7/23/2009	4/13/2010	7/12/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/12/2010	10/5/2010
Dissolved Metals (µg/L)															
Arsenic	0.2	3.2	2.4	2.9 J-	5.1	2.4	3.8	4.1	1.1	--	1.8 J-	1.8	1.3	3.8	1.1
Copper	2.4	--	--	--	--	NA	NA	NA	--	3	--	--	NA	NA	NA
Manganese	50	--	--	391 J-	150	NA	NA	NA	203	335	159 J-	180	NA	NA	NA
Nickel	8.2	--	--	--	--	NA	NA	NA	--	9	--	--	NA	NA	NA
Silver	1.9	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Total Metals (µg/L)															
Aluminum	87	170	650	440	13,200	NA	NA	NA	290	100	3,080	140	NA	NA	NA
Arsenic	0.2	4.8	5.8	5	21.3 J	6.6	20.1	6.5	2.2	--	3	2.5 J	2	11	1.7
Copper	2.4	--	5	--	38	NA	NA	NA	--	4	10	3	NA	NA	NA
Iron	1,000	--	1,610	--	16,500	NA	NA	NA	1,790	--	7,920	1,360	NA	NA	NA
Lead	2.5	--	--	--	24	--	9	--	--	--	3	--	--	13	--
Manganese	50	--	660	414	313	NA	NA	NA	230	353	276	195	NA	NA	NA
Mercury	0.02	--	0.0284	--	0.0649	--	--	0.0215	--	--	--	--	--	0.071	--
Nickel	8.2	--	--	--	72.2 J	NA	NA	NA	--	9	12.6	--	NA	NA	NA
Silver	1.9	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Zinc	81	--	--	--	150	NA	NA	NA	--	--	--	--	NA	NA	NA
Pesticides (µg/L)															
4,4'-DDD	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SVOCs (µg/L)															
Butylbenzylphthalate	8.32	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Bis(2-ethylhexyl) phthalate	1.2	--	1.6	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Chrysene	0.01	--	--	--	0.014	NA	NA	NA	--	--	--	--	NA	NA	NA
VOCs (µg/L)															
Benzene	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA

Table 4. Summary of PCL exceedances in surface water samples[1] (continued)

Analyte	PCL	SW-04							SW-05						
		10/15/2008	12/18/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010
Dissolved Metals (µg/L)															
Arsenic	0.2	2	--	2 J-	3	1.4	4.6	1.6	--	--	1.7 J-	3	0.6	2.5	1.3
Copper	2.4	--	5	3 J-	3	NA	NA	NA	--	3	--	4	NA	NA	NA
Manganese	50	68	246	164 J-	55	NA	NA	NA	345	227	795 J-	75	NA	NA	NA
Nickel	8.2	--	11	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Silver	1.9	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Total Metals (µg/L)															
Aluminum	87	1,570	4,240	440	1,090	NA	NA	NA	120	400	190	90	NA	NA	NA
Arsenic	0.2	2.8	8	2	4 J	1.4	5.2	1.6	1.5	0.8	1.6	4 J	1.2	3.2	1.9
Copper	2.4	4	12	4	6	NA	NA	NA	--	4	3	4	NA	NA	NA
Iron	1,000	3,490	7,580	1,020	2,440	NA	NA	NA	1,700	1,080	2,010	720	NA	NA	NA
Lead	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	50	125	382	176	107	NA	NA	NA	366	243	782	89	NA	NA	NA
Mercury	0.02	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	8.2	--	17	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Silver	1.9	--	--	--	--	NA	NA	NA	3	--	--	--	NA	NA	NA
Zinc	81	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Pesticides (µg/L)															
4,4'-DDD	0.00125	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SVOCs (µg/L)															
Butylbenzylphthalate	8.32	--	--	--	--	NA	NA	NA	23	--	--	--	NA	NA	NA
Bis(2-ethylhexyl) phthalate	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
Chrysene	0.01	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA
VOCs (µg/L)															
Benzene	1.2	--	--	--	--	NA	NA	NA	--	--	--	--	NA	NA	NA

Table 4. Summary of PCL exceedances in surface water samples[1] (continued)

Analyte	PCL	SW-06							SW-07	
		10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010	12/17/2008	4/28/2009
Dissolved Metals (µg/L)										
Arsenic	0.2	3	--	4 J-	5	1	3	2	0.5	0.6 J-
Copper	2.4	--	3	3 J-	6	NA	NA	NA	--	--
Manganese	50	80	132	289 J-	--	NA	NA	NA	229	169 J-
Nickel	8.2	--	--	--	--	NA	NA	NA	--	--
Silver	1.9	8	--	--	--	NA	NA	NA	--	--
Total Metals (µg/L)										
Aluminum	87	--	2,250	370	--	NA	NA	NA	110	--
Arsenic	0.2	3	3	3	5 J	1.4	4	0.8	1.7	1.4
Copper	2.4	--	8	4	7	NA	NA	NA	3	--
Iron	1,000	--	4,620	1,370	--	NA	NA	NA	18,000	12,800
Lead	2.5	--	--	--	--	--	--	--	--	--
Manganese	50	90	239	300	--	NA	NA	NA	262	197
Mercury	0.02	--	--	--	--	--	--	--	--	--
Nickel	8.2	--	11	--	10 J	NA	NA	NA	--	--
Silver	1.9	7	--	--	--	NA	NA	NA	--	--
Zinc	81	--	--	--	--	NA	NA	NA	--	--
Pesticides (µg/L)										
4,4'-DDD	0.00125	--	0.0019 J	--	--	--	--	--	--	--
SVOCs (µg/L)										
Butylbenzylphthalate	8.32	--	--	--	--	NA	NA	NA	--	--
Bis(2-ethylhexyl) phthalate	1.2	--	--	--	--	NA	NA	NA	--	--
Chrysene	0.01	--	--	--	--	NA	NA	NA	--	--
VOCs (µg/L)										
Benzene	1.2	--	--	--	--	NA	NA	NA	2.2	3.6

Table 5. Landfill gas monitoring data

Date	Sampling Location	Methane (% by volume)	Carbon Dioxide (% by volume)	Oxygen (% by volume)	Nitrogen[1] (% by volume)	Relative Pressure (inches of water)	Barometric Pressure (inches of mercury)	Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Woodwaste Interval (feet bgs)	Refuse interval (feet bgs)
10/5/11		32.0	12.2	0.0	55.3	-0.29	29.53					
1/24/12	LFGP-01	29.1	10.2	0.5	60.2	0.49	29.59	10.5	5	10	0–2	4–9
4/3/12		30.8	9.1	0.1	60.0	-0.05	29.70					
10/5/11		39.4	2.1	0.0	58.4	-0.29	29.52					
1/24/12	LFGP-02	38.7	2.4	0.0	58.9	-0.51	29.44	11	6	11	0–1	6–10.5
4/3/12		40.2	4.3	0.7	54.8	-0.33	29.67					
10/5/11		16.9	11.2	0.0	71.9	-0.51	29.60					
1/24/12	LFGP-03	17.8	9.8	0.0	72.4	-0.78	29.48	9	4	9	0–1.5	3–9
4/3/12		11.0	9.7	0.0	79.3	-0.66	29.67					
10/5/11		70.6	29.3	0.0	0.1	-0.43	29.58					
1/24/12	LFGP-04	67.3	32.6	0.0	11.0	-0.51	29.44	15	5	15	0–7.5	7.5–15
4/3/12		68.2	31.7	0.0	0.1	-0.48	29.66					
10/5/11		1.0	2.9	19.6	76.2	1.34	29.60					
1/24/12	PZ-01	0.1	0.0	21.2	78.7	-0.51	29.48	13.5	6	11	0–1	5–11
4/3/12		0.1	0.1	21.1	78.7	-0.09	29.67					
10/5/11		10.8	22.7	0.0	66.3	-0.39	29.61					
1/24/12	LFGP-06	5.3	16.0	0.0	78.7	-0.78	29.48	9	4	9	0–1.5, 4.5–5.5	1.5–5.5
4/3/12		5.5	11.1	0.3	83.1	-0.52	29.70					
10/5/11		0.1	9.2	12.9	77.8	-0.41	29.61					
1/24/12	LFGP-07	0.2	8.7	14.2	76.8	-38.6	29.59	10	5	10	NA	0–6
4/3/12		0.0	8.2	14.3	77.5	-0.82	29.70					
10/5/11		29.4	16.9	0.0	53.6	-0.38	29.61					
1/24/12	LFGP-05	33.2	13.2	0.0	53.5	-38.6	29.59	9	4	9	0–4.5	4.5–9
4/3/12		29.5	12.0	0.0	58.5	-0.61	29.70					
10/5/11		18.1	22.2	0.0	59.7	-0.38	29.61					
1/24/12	LFGP-08	66.8	24.0	0.0	9.0	-38.6	29.59	9	4	9	0–4.5	1–9
4/3/12		31.6	18.5	0.0	49.9	-0.82	29.70					
10/5/11		22.3	14.0	0.0	63.6	-0.43	29.62					
1/24/12	LFGP-10	69.7	9.4	0.0	20.6	0.49	29.59	8	3	8	0–2.5	4.5–8
4/3/12		58.3	13.3	0.1	28.3	0.05	29.70					
10/5/11		40.4	32.5	0.0	27.0	-0.52	29.62					
1/24/12	LFGP-09	44.3	27.6	0.0	28.1	0.49	29.59	10.5	5	10	0–9	6–10.5
4/3/12		39.8	25.8	0.2	34.2	0.10	29.70					
10/5/11		0.5	0.5	21.1	77.9	-0.39	29.62					
1/24/12	MW-08	3.9	1.6	20.0	75.1	-0.78	29.48	34	10	20	0–7	12–23
4/3/12		1.0	0.6	20.9	77.5	-0.20	29.67					
10/5/11		0.1	0.1	21.5	78.3	-0.42	29.62					
1/24/12	MW-10	32.0	18.8	0.0	49.1	-0.78	29.48	34	10	20	1.5–10	11.5–23.5
4/3/12		0.1	0.1	21.1	78.7	-0.21	29.67					

Note
1. GEM-2000 reports nitrogen % as "balance," the majority of which is assumed to represent atmospheric nitrogen.

Abbreviation(s)
bgs = below ground surface
MW = monitoring well
LFGP = landfill gas probe
PZ = piezometer

Table 6. Summary of vertical gradients

Date	Well Pair PZ-01 (shallow) and MW-05 (deep)[1]				Well Pair PZ-03 (shallow) and MW-07 (deep)[2]			
	Groundwater Elevations (feet NAVD88)		Difference in Groundwater Elevation	Vertical Gradient (feet per foot)[3]	Groundwater Elevations (feet NAVD88)		Difference in Groundwater Elevation	Vertical Gradient (feet per foot)[3]
	MW-05	PZ-01			MW-07	PZ-03		
4/26/10	6.870	9.858	2.988	-0.147	6.080	8.139	2.059	-0.267
7/26/10	6.834	9.603	2.770	-0.136	6.028	7.714	1.686	-0.219
10/26/10	7.544	9.341	1.797	-0.088	7.592	7.610	0.019	-0.002
1/26/11	7.770	10.764	2.994	-0.147	7.695	8.773	1.077	-0.140
4/26/11	6.847	10.125	3.277	-0.161	6.478	8.185	1.707	-0.222
7/26/11	6.559	9.629	3.070	-0.151	5.763	7.596	1.834	-0.238
10/2/11	7.371	9.334	1.963	-0.097	7.437	7.308	-0.129	0.017

Notes

1. Distance between mid-points of screened interval for well pair PZ-01/MW-05 is 20.3 feet.
2. Distance between mid-points of screened interval for well par PZ-03/MW-07 is 7.7 feet.
3. Negative number indicates downward vertical gradient.

Abbreviations

NAVD88 = North American Vertical Datum of 1988

Table 7. Constituents of concern in soil[1]

Metals		PCBs/Pesticides	
Antimony	Lead	4,4'-DDD	Dieldrin
Arsenic	Mercury	4,4'-DDE	Aroclor 1254
Barium	Nickel	Aldrin	
Cadmium	Zinc		
Copper			
SVOCs		**VOCs**	**TPH**
2,4-Dimethylphenol	Chrysene	Benzene	Gasoline
2-Methylphenol	Dibenzofuran		Lube oil range hydrocarbons
Benzo(a)anthracene	Phenol		
Benzo(a)pyrene			
bis(2-Ethylhexyl) phthalate			

Note

1. Constituents were evaluated as constituents of concern based on criteria described in text.

Abbreviations

PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbon
VOCs = volatile organic compounds

Table 8. Constituents of concern in groundwater and seeps[1]

Inorganics	SVOCs	Pesticides/PCBs	VOCs
Arsenic	1-Methylnaphthalene	4,4'-DDD	Benzene
Copper	2,4-Dimethylphenol	4,4'-DDE	
Iron	Benzo(a)anthracene	alpha-BHC	
Lead	bis(2-Ethylhexyl)phthalate	Aroclor 1232	
Manganese	Chrysene	Aroclor 1242	
Mercury		Aroclor 1248	
Selenium		Total PCBs	
Silver			

Note

1. Constituents were evaluated as constituents of concern based on criteria described in text.

Abbreviations

PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

Table 9. Constituents of concern in surface water[1]

Inorganics	SVOCs
Arsenic	Butylbenzylphthalate
Copper	Chrysene
Lead	bis(2-ethylhexyl)phthalate
Manganese	**VOCs**
Mercury	Benzene
Nickel	**Pesticides/PCBs**
Silver	4,4'-DDD
Zinc	

Note
Constituents were evaluated as constituents of concern based on criteria described in text.

Abbreviations
SVOCs = semivolatile organic compounds TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

Table 10. Summary of final cleanup levels

Analyte	Chemical Abstracts Service No.	Final Cleanup Level	Method Group	Units
FINAL SOIL CLEANUP LEVELS				
Antimony	7440-36-0	5.1	Metals	mg/kg
Arsenic	7440-38-2	7.0		
Barium	7440-39-3	102		
Cadmium	7440-43-9	1.0		
Copper	7440-50-8	36		
Lead	7439-92-1	108		
Mercury	7439-97-6	0.07		
Nickel	7440-02-0	48		
Zinc	7440-66-6	101		
TPH - Heavy oil range	NA	2000	TPH	mg/kg
TPH - Gasoline range	NA	30/100		
2,4-Dimethylphenol	105-67-9	3.1	SVOCs	mg/kg
2-Methylphenol	95-48-7	2.3		
Benzo(a)anthracene	56-55-3	0.10		
Benzo(a)pyrene	50-32-8	0.12		
Bis(2-ethylhexyl) phthalate	117-81-7	2.6		
Chrysene	218-01-9	0.08		
Dibenzofuran	132-64-9	0.09		
Phenol	108-95-2	46		
Aroclor 1254	11097-69-1	0.65	PCBs	mg/kg
Total polychlorinated biphenyls (PCBs)	n/a	0.65		
Benzene	71-43-2	0.0068	VOCs	mg/kg
Aldrin	309-00-2	0.0017(2)	Pesticides	mg/kg
4,4'-DDD	72-54-8	0.0033(2)		
4,4'-DDE	72-55-9	0.0033(2)		
Dieldrin	60-57-1	0.0033(2)		
FINAL GROUNDWATER/SEEP CLEANUP LEVELS				
Arsenic	7440-38-2	0.14	Metals	µg/L
Copper	7440-50-8	2.4		
Iron	7439-89-6	1000		
Lead	7439-92-1	0.54		
Manganese	7439-96-5	20		
Mercury	7439-97-6	0.025		
Selenium	7782-49-2	5.0		
Silver	7440-22-4	1.9		

Analyte	Chemical Abstracts Service No.	Final Cleanup Level	Method Group	Units
1-Methylnaphthalene	90-12-0	1.51	SVOCs	µg/L
2,4-Dimethylphenol	105-67-9	50.0		
Benzo(a)anthracene	56-55-3	0.01(2)		
Chrysene	218-01-9	0.01(2)		
Benzene	71-43-2	1.2	VOCs	µg/L
Aroclor 1232 (1)	11141-16-5	0.014	PCBs	µg/L
Aroclor 1242 (1)	53469-21-9	0.014		
Aroclor 1248 (1)	12672-29-6	0.014		
Total polychlorinated biphenyls (PCBs) (1)	1336-36-3	0.07		
4,4'-DDD	72-54-8	0.05(2)	Pesticides	µg/L
4,4'-DDE	72-55-9	0.05(2)		
a-Hexachlorocyclohexane (3)	319-84-6	0.025(2)		
FINAL SURFACE WATER CLEANUP LEVELS				
Arsenic	7440-38-2	0.14	Metals	µg/L
Copper	7440-50-8	2.4		
Lead	7439-92-1	2.5		
Manganese	7439-96-5	50.0		
Mercury	7439-97-6	0.025		
Nickel	7440-02-0	8.2		
Selenium	7782-49-2	5.0		
Silver	7440-22-4	1.9		
Zinc	7440-66-6	81		
Butyl benzyl phthalate	85-68-7	8.2	SVOCs	µg/L
bis(2-ethylhexyl)phthalate	117-81-7	1.2		
Chrysene	218-01-9	0.01(2)		
Benzene	71-43-2	1.2	VOCs	µg/L
4,4'-DDD (1)	72-54-8	0.05(2)	Pesticides	µg/L

Notes

(1) = PCBs by EPA Method 1668A or EPA 1668C
(2) = Limit of Quantitaion or Reporting Limit per Analytical Resources, Inc., a Washington State Department of Ecology certified laboratory.
(3) = Also known as α-BHC
µg/L = microgram per liter
mg/kg = milligram per kilogram
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

Table 11. Comparison of remedial alternatives

Standards/Criteria		1 - No Action	2 - Restoration of Existing Soil Cover	3 - GCLL Cap	4 - HDPE Cap	5 - HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal
Protectiveness	**Pros**	Informs the public.	Generally protective of the public and environment..	Protective of the public and the environment.	Protective of the public and the environment.	Protective of the public and the environment; virtually no hydraulic connectivity with the Bay Mud.	Protective of the public and the environment.	Removes all environmental concerns from the site.
	Cons	Not protective of the environment.	Allows some hydraulic connectivity with Padilla Bay and allows more infiltration than the engineered caps in Alternatives 3 through 6.	May allow some hydraulic connectivity with Padilla Bay.	May allow some hydraulic connectivity with Padilla Bay.	Leaves refuse in place.	Allows some hydraulic connectivity with Padilla Bay due to potential weathering due to wet/dry cycling along shoreline.	Transfers refuse to waste disposal facility.
	Rating	Low (3)	Low-Moderate (4)	High (8)	High (8)	High (8)	Moderate to High (7)	Very High (9)
Permanence	**Pros**	Institutional controls would remain in place permanently.	The renovated cover would drain better than the current cover.	GCLL is a natural and durable product as cap. Its flexibility would allow it to conform to small surface irregularities.	HDPE is a durable product as cap.	HDPE is a durable product as cap.	Long-lasting material.	All possibility of contamination is removed.
	Cons	Existing exposure pathways would remain.	Renovated cover would use sandy materials that would be more susceptible to erosion than the engineered caps.	Would require some maintenance.	Would require somemaintenance.	Would require somemaintenance.	PVC not as durable as HDPE.	There may be some liability associated with disposal elsewhere.
	Rating	Low to Moderate (4)	Moderate (5)	High (8)	High (8)	High (8)	Medium High (7)	Very High (9)
Long-Term Effectiveness	**Pros**	Informs the public.	Addresses most of the RAOs.	Addresses the RAOs.	Addresses the RAOs.	Addresses the RAOs.	Addresses the RAOs.	Most effective by eliminating the source.
	Cons	Not protective of the environment.	Some hydraulic connection with Padilla Bay will remain.	Would require some maintenance.	Would require somemaintenance.	Would require somemaintenance.	Maintains some hydraulic connectivity with Padilla Bay and will require some maintenance.	May cause concerns off site.
	Rating	Low (3)	Low to Moderate (4)	High (8)	High (8)	High (8)	Medium High (7)	Highest (10)
Short-Term Risk	**Pros**	No risks associated with implementation.	Low risk since refuse is only minimally disturbed during regrading.	Low risk to relocate some waste on site.	Low risk to relocate some waste on site.	Low risk to relocate some waste on site.	Low risk to relocate some waste on site.	Removes risk after completion.
	Cons	Does not address environmental risks.	Some releases to Padilla Bay may occur during construction, but less than other alternatives.	Some releases to Padilla Bay may occur during construction, but less than other alternatives.	Some releases to Padilla Bay may occur during construction.	Some releases to Padilla Bay may occur during construction.	Some releases to Padilla Bay may occur during construction.	Highest risk of releases to the environment and off site during implementation - construction.
	Rating	High (8)	High (8)	Medium High (7)	Moderate to High (6)	Moderate to High (6)	Moderate to High (6)	Low (3)
Technical and Administrative Implementability	**Pros**	No challenges in implementation.	This type of construction has routinely been performed for waterfront remediation.	This type of construction has routinely been performed for waterfront remediation. Can be installed during tidal cycle.	This type of constructionhas routinely been performed for waterfront remediation.	This type of constructionhas routinely been performed for waterfront remediation.	This type of constructionhas routinely been performed for waterfront remediation.	This type of construction has been performed for waterfront remediation.
	Cons	Not protective of the environment.	Few challenges presented since existing shoreline remains intact.	Excavation and backfill within tidal zone present some challenges.	Excavation and backfill within tidal zone present some challenges. In addition a berm must be constructed to install cover during tidal cycle.	Excavation and backfill within tidal zone present some challenges. In addition a berm must be constructed to install cover during tidal cycle.	Excavation and backfill within tidal zone present some challenges. In addition a berm must be constructed to install cover during tidal cycle.	Excavation and backfill within tidal zone present some challenges, particularly due to a decrease in available space on site as construction proceeds.
	Rating	High (8)	High (8)	Very High (9)	High (8)	High (8)	High (8)	Moderate to High (6)
Public Concerns	**Pros**	Informs the public.	Addresses most public concerns.	Addresses public concerns.	Addresses public concerns.	Addresses public concerns.	Addresses public concerns.	Addresses public concerns.
	Cons	Does not address the public's environmental concerns.	Concerns with respect to hydraulic connection with Padilla Bay may remain.	Refuse left in-place may cause some concerns.	Refuse left in-place may cause some concerns.	Refuse left in-place may cause some concerns.	Some concerns with respect to hydraulic connection with Padilla Bay may remain.	May initiate new public concerns over off- site transport.
	Rating	Low (3)	Moderate (5)	High (8)	High (8)	High (8)	Moderate to High (6)	High (8)
Cost	**Pros**	Cost very low.	Restores original surface cover and improves surface water drainage and lessens infiltration at lower cost than majority of alternatives.	Closes the landfill and achieves RAOs in accordance with minimum functional standards (WAC 173-304).	Closes the landfill and achieves RAOs in accordance with minimum functional standards (WAC 173-304).	Closes the landfill and achieves RAOs in accordance with minimum functional standards (WAC 173-304).	Closes the landfill and achieves RAOs in accordance with minimum functional standards (WAC 173-304).	All waste is removed.
	Cons	Does not meet the RAOs.	Infiltration of surface water would be slightly higher than Alternatives 4 to 6, with lower permeability capping materials.	May increase long-term maintenance cost.	May increase long-term maintenance cost.	May increase long-term maintenance cost.	May increase long-term monitoring cost due to remaining hydraulic connectivity with Padilla Bay.	Unrealistically high cost without any appreciable/significant benefit.
	Notes	Low (3)	Low to Moderate (4)	Moderate (5)	High (8)	High (8)	High (8)	Highest (10)

Abbreviations

GCLL = geosynthetic clay laminated liner
HDPE = high density polyethylene
PVC = polyvinyl chloride
RAO = remedial action objective
WAC = Washington Administrative Code

Rating numerical scale

Low	3
Low to moderate	4
Moderate	5
Moderate to high	6
Medium high	7
High	8
Very high	9
Highest	10

Table 12. Cost benefit ratios and disproportionate cost analysis

Components		Alternatives						
		1- No Action	2- Restoration of Existing Soil Cover	3- GCLL Cap	4- HDPE Cap	5- HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal
Brief Description of Alternative		A base line against other alternatives, institutional/engineering controls only implemented	Regrading of the existing landfill soil cover, seeded topsoil for vertical/lateral containment	GCLL veneer for lateral/vertical cap. Bentonite GCLL above 16 feet in elevation, bentonite/polymer GCLL below that elevation along shoreline	HDPE veneer for lateral/vertical containment, bentonite/polymer GCLL along shoreline below 16 feet in elevation	HDPE veneer for lateral/vertical containment and anchoring	PVC veneer for lateral/vertical containment, bentonitte/polymer GCLL along shoreline below 16 feet in elevation	Complete removal and off-site disposal of 400,000 cubic yards of solid waste
Cost	***Capital + Periodic (for 30 years); $ Unit is $1,000***	**$231**	**$6,397**	**$12,040**	**$15,272**	**$15,292**	**$15,225**	**$82,837**

A. Evaluation of Components/ARARs

Components (WAC 173-340, 304, 351)	Institutional/engineering controls	YES	YES	YES	YES	YES	YES	YES
	Landfill cover materials	NA	Existing soil cover	GCLL	HDPE	HDPE	PVC	NA
	Lateral containment apron along shoreline	NA	NA	Enhanced GCLL	Enhanced GCLL	HDPE	Enhanced GCLL	NA
	Amount of solid waste excavation to make the embankment and smooth joining the capping materials (CY)	NA	NA	35,000	55,000	55,000	55,000	340,000
	Off-site disposal of excavated solid waste (CY)	NA	NA	NA	NA	NA	NA	340,000
	Stormwater control measures	NO	YES	YES	YES	YES	YES	YES
	Wastewater generated during the construction for the treatment (MG)	NA	NA	1.3	3.3	3.3	3.3	14.5
	Installation of landfill gas collection/treatment system	NO	NO	YES	YES	YES	YES	NA
	Groundwater collection/treatment as needed to prevent off-site migration	NA	NO	YES	YES	YES	YES	NA
	Long-term monitoring/operation of landfill closure facility	NA	YES	YES	YES	YES	YES	NA
	Long-term groundwater monitoring and groundwater elevation for hydraulic control	NO	YES	YES	YES	YES	YES	NA
	Long-term monitoring of seepage & landfill gas	NO	YES	YES	YES	YES	YES	NA
	Habitat restoration at the shoreline	NA	YES	YES	YES	YES	YES	YES
ARARs	Meet WAC 173-304 for all elements for "municipal landfill closure"	NO	NO	YES	YES	YES	YES	YES
	Estimated restoration time frame (WAC 173-340-360(2)(b)(i)) estimated	unknown	unknown	5 to 10 years	5 to 10 years	5 to 10 years	5 to 10 years	5 years
	Meets MTCA (173-340) criteria for "human health and environmental risk"	NO	NO	YES	YES	YES	YES	YES
	Meets MTCA (173-340) criteria for "long-term monitoring of off-site contaminant migration per WAC 1730340-360(2)(a)(iv)"	NO	NO	YES	YES	YES	YES	NA

Components		Alternatives						
		1- No Action	2- Restoration of Existing Soil Cover	3- GCLL Cap	4- HDPE Cap	5- HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal
Brief Description of Alternative		A base line against other alternatives, institutional/engineering controls only implemented	Regrading of the existing landfill soil cover, seeded topsoil for vertical/lateral containment	GCLL veneer for lateral/vertical cap. Bentonite GCLL above 16 feet in elevation, bentonite/polymer GCLL below that elevation along shoreline	HDPE veneer for lateral/vertical containment, bentonite/polymer GCLL along shoreline below 16 feet in elevation	HDPE veneer for lateral/vertical containment and anchoring	PVC veneer for lateral/vertical containment, bentonitte/polymer GCLL along shoreline below 16 feet in elevation	Complete removal and off-site disposal of 400,000 cubic yards of solid waste
Cost	***Capital + Periodic (for 30 years); $ Unit is $1,000***	**$231**	**$6,397**	**$12,040**	**$15,272**	**$15,292**	**$15,225**	**$82,837**

B. Disproportionate Cost Analysis

	Criteria	Weight (%)[1]	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score	Raw Score[3]	Weighted Score
DCA and Relative Benefits Ranking Calculation (WAC 173-340-360(3)(f))	Protectiveness	30%	3	0.9	4	1.2	8	2.4	8	2.4	8	2.4	7	2.1	9	2.7
	Permanence	20%	4	0.8	5	1	8	1.6	8	1.6	8	1.6	7	1.4	9	1.8
	Long-term effectiveness	20%	3	0.6	4	0.8	8	1.6	8	1.6	8	1.6	7	1.4	10	2.0
	Short-term risks	10%	8	0.8	8	0.8	7	0.7	6	0.6	6	0.6	6	0.6	3	0.3
	Technical and administrative implementability	10%	8	0.8	8	0.8	9	0.9	8	0.8	8	0.8	8	0.8	6	0.6
	Public concerns[2]	10%	3	0.3	5	0.5	8	0.8	8	0.8	8	0.8	6	0.6	8	0.8
	Composite Totals	100%	4.2		5.1		8		7.8		7.8		6.9		8.2	
	Overall Alternative Benefit Ranking		7		6		3		4		2		5		1	
	Ratio of Cost/Benefit		55		1,254		1,505		1,958		1,961		2,207		10,102	

Components		Alternatives						
		1- No Action	2- Restoration of Existing Soil Cover	3- GCLL Cap	4- HDPE Cap	5- HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal
Brief Description of Alternative		A base line against other alternatives, institutional/engineering controls only implemented	Regrading of the existing landfill soil cover, seeded topsoil for vertical/lateral containment	GCLL veneer for lateral/vertical cap. Bentonite GCLL above 16 feet in elevation, bentonite/polymer GCLL below that elevation along shoreline	HDPE veneer for lateral/vertical containment, bentonite/polymer GCLL along shoreline below 16 feet in elevation	HDPE veneer for lateral/vertical containment and anchoring	PVC veneer for lateral/vertical containment, bentonitte/polymer GCLL along shoreline below 16 feet in elevation	Complete removal and off-site disposal of 400,000 cubic yards of solid waste
Cost	***Capital + Periodic (for 30 years); $ Unit is $1,000***	**$231**	**$6,397**	**$12,040**	**$15,272**	**$15,292**	**$15,225**	**$82,837**

C. Decision Criteria

Does this alternative "meet both MTCA and ARARs?"	NO		NO		YES		YES		YES		YES		YES	
Is the alternative "permanent to maximum extent practicable?"	NA[4]		NA[4]		YES		YES		YES		NO		YES	

Notes

1. Refer to Section 13.3 for the rationale for assigning these weight fraction to each criteria.
2. The consideration of public concerns criterion will be re-evaluated after the public comment period as necessary.
3. Raw score for each alternative is based on the qualitative rating provided by the PLPs and consultants' similar type of project experiences and references.
4. Refer to Table 21 and Section 13 for details.
5. Alternatives 1 and 2 do not fully comply with MTCA threshold criteria and ARARs including WAC 173-304.

Rating	Numerical Scale
Low	3
Low to moderate	4
Moderate	5
Moderate to high	6
Medium high	7
High	8
Very high	9
Highest	10

Abbreviations

ARAR = applicable or relevant and appropriate requirement

GCLL = geosynthetic clay laminated liner

MTCA = Model Toxics Control Act

CY = cubic yard

DCA = disproportionate cost analysis

HDPE = high density polyethylene

MG = million gallons NA = not applicable

PVC = polyvinyl chloride

WAC = Washington Administrative Code

Table 13. Cost estimate for cleanup action

Description	Rate	Units	GCLL Cap Quantity	GCLL Cap Cost	Backup Information
CONTRACTOR					
Mobilization/Demobilization	$370,000	LS	1	$370,000	Estimated @ about 5% of the contractor cost
Site Setup and Maintenance	$212,000	LS	1	$212,000	
Railroad Requirements	$80,000	LS	1	$80,000	Insurance, flagger
Site Clearing (Trees)	$7,000	Acre	10	$70,000	Past experience
Refuse Excavation and Grading	$21	CY	30,000	$630,000	Unit price from recent experience
Groundwater Removal and Treatment System	$106,000	LS	1	$106,000	Estimated
Groundwater Management	$53,000	MO	3	$159,000	Estimated
Ditch Construction	$27	LF	2,600	$70,200	Past experience
Existing Cover Soil salvage and Reuse	$16	CY	22,000	$352,000	Vendor pricing on material
GCLL	$0.80	SF	900,000	$720,000	Vendor pricing
Enhanced GCLL	$1.35	SF	100,000	$135,000	Vendor pricing
LFG Venting Piping	$21	LF	5,000	$105,000	Pricing from past project
Placement and Grading Cover Soil	$21	Tons	40,000	$840,000	Vendor pricing on material
Placement and Grading Crushed Rock	$27	Tons	42,000	$1,134,000	
Topsoil Import and Placement	$53	CY	12,000	$636,000	Past experience
Sand and Gravel Import and Placement	$21	Ton	8,000	$168,000	Vendor pricing on material
Hydroseeding	$3,200	Acre	15	$48,000	Pricing based on recent experience
Plants	$53,000	Acre	1.6	$84,800	Pricing based on recent experience
Irrigation System	$106,000	LS	1	$106,000	Pricing based on recent experience
Perimeter road	$53	LF	3,600	$190,800	Estimated vendor pricing on material
Security Fence	$26	LF	4,500	$117,000	Vendor pricing
Gates	$6,400	LS	2	$12,800	Vendor pricing
Subtotal				**$6,346,600**	
Prevailing Wage Allowance	8.0	%		$507,728	
SUBTOTAL				**$6,854,328**	
Sales Tax	8.50	%		$582,618	
CONTRACTOR COST				**$7,436,946**	
CONSULTANT					
Field Investigation	$160,000	LS	1	$160,000	Estimated
Well Abandonment	$11,000	LS	10	$110,000	Past experience
Surveying	$3,000	Day	10	$30,000	Past experience
Heron Habitat Management Plan	$250,000	LS	1	$250,000	Estimated
Design	$160,000	LS	1	$160,000	Estimated
Permitting	$140,000	LS	1	$140,000	Recent experience
Well Installation	$4,500	Sets	4	$18,000	Past experience
Project Management	$2,400	MO	30	$72,000	Estimated
Sampling and Analysis	$70,000	LS	1	$70,000	
Construction Management	$21,000	WK	20	$420,000	2 full time staff; part-time senior oversight
Construction Report	$80,000	LS	1	$80,000	Estimated
CONSULTANT COST				**$1,510,000**	
CAPITAL COST SUBTOTAL				**$8,947,000**	
CONTINGENCY	20	%		$1,789,400	
TOTAL CAPITAL COST				**$10,736,000**	
OPERATION AND MAINTENANCE					
Years 1 through 5					
Inspections - Year 1	$17,000	Annual	1	$17,000	
Inspections - Years 2 through 5	$12,500	Annual	4	$50,000	
Groundwater Monitoring	$32,000	Annual	5	$160,000	
Cap Repair	$32,000	Annual	3	$96,000	
Mowing	$6,400	Annual	5	$32,000	
Project Management	$26,000	Annual	5	$130,000	
Years 6 through 30					
Inspections	$3,200	Annual	5	$16,000	
Groundwater Monitoring	$11,500	Annual	5	$57,500	
Cap Repair	$106,000	LS	2	$212,000	
Mowing	$6,200	Annual	25	$155,000	
Project Management	$6,200	Annual	25	$155,000	
O&M COST SUBTOTAL				**$1,080,500**	
Contingency	30	%		$324,150	
Groundwater Removal	$320,000	Round	5	**$1,600,000**	
TOTAL O&M COST				**$3,005,000**	
TOTAL PROJECT COST **$13,741,000**					

Abbreviations
CY = cubic yard
GCL = geosynthetic clay liner
GCLL = geosynthetic clay laminated liner
HDPE = high density polyethylene
LF = linear foot
LFG = landfill gas
LS = lump sum
MO = month
O&M = operation and maintenance
SF = square foot
WK = week

Table 14. Proposed confirmation monitoring plan

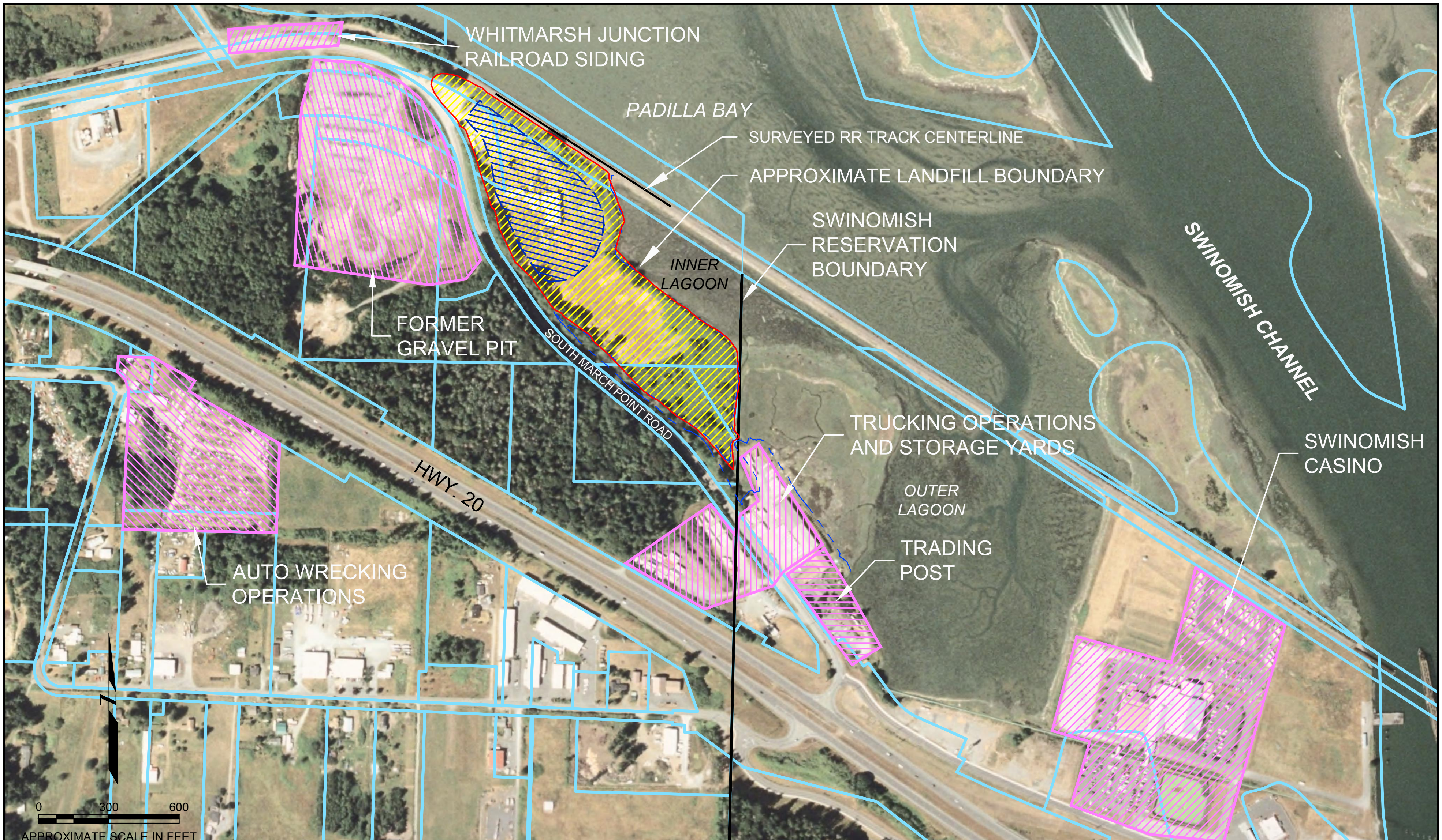
Program	Monitoring Location	Measurements	Trigger Event or Observation	Analytes[1]	Frequency
Leachate Monitoring: Prior to the 10-year	Seven leachate wells installed near the base of the solid	Continuous leachate levels recorded using self-logging transducers	Significantly rising leachate levels could be indicative of hydrologic failure.	Not applicable.	As needed
Visual Inspections: Prior to the 10-year restoration time	Seeps along shoreline	SC, temperature	Visual evidence of hydrologic failure (e.g., seep condition worsening).	Dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc; polychlorinated biphenyls; and SVOCs.	As needed
Groundwater Monitoring: After the 10 year restoration time frame	Six conditional point of compliance wells installed through the solid waste	Temperature, SC, pH, and continous water levels	Three consecutive exceedances of cleanup levels followed by positive trends of constituent of concern concentrations and upward trend in water levels.	Chloride, nitrate, nitrite, and ammonia as nitrogen; sulfate; 1-methylnaphthalene; 2,4-dimethylphenol; benzo(a)anthracene; chrysene; benzene; total polychlorinated biphenyls; and dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc.	Quarterly[2]
Leachate Monitoring: After the 10-year restoration time frame	Seven leachate wells installed near the base of the solid waste	Continuous leachate levels recorded using self-logging transducers	If seeps are detected, leachate levels will be examined and compared to precipitation records. Trend charts will track leachate levels over time.	Not applicable.	As needed
Seep Monitoring: After the 10-year restoration time	Seeps along shoreline	SC, temperature	Presence of iron-staining or SC << seawater or lagoon water.	Dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc; polychlorinated biphenyls; and SVOCs.	First year: quarterly Thereafter: twice yearly in wet and dry season
Landfill Gas Monitoring: After the 10-year restoration	Passive vents or landfill gas probes	Methane, carbon monoxide, carbon dioxide, and balance (nitrogen) using GEM meter or	Above lower explosive limit inside landfill and at probes near South March Point Road.	Not applicable.	Quarterly per WAC 173-304
Stormwater Monitoring: After the 10-year restoration time frame	Seeps along shoreline and drainage channel/cap erosion	SC, temperature	Excessive erosion or presence of iron-staining or SC << seawater or lagoon water.	Dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc; polychlorinated biphenyls; and SVOCs.	Quarterly and after 1-inch+ storm event for 3 years
Surface Water Sampling: After the 10- year restoration time frame	Inner Lagoon	Not applicable	Observation of ongoing seeps after 5 years.	Dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc; polychlorinated biphenyls; and SVOCs.	Not applicable

Notes:

1. Samples will be analyzed using the following methods: Chloride, nitrate, nitrite, sulfate by EPA 300.0, ammonia as nitrogen by EPA 350.1, 1-methylnaphthalene and 2,4-dimethylphenol by EPA 8270D, benzo(a)anthracene and chrysene by EPA 8270D with selected ion monitoring, benzene by EPA 8260C, total polychlorinated biphenyls by EPA 1668A or 1668C, dissolved metals including arsenic, copper, iron, lead, manganese, mercury, selenium, silver and zinc by EPA 6010C.
2. Quarterly sampling is proposed for the first five years of post-construction monitoring. If performance is satisfactory, semi-annual sampling will be instituted. One field duplicate (quality assurance/quality control) sample will be collected during each sampling event.

Abbreviations:
EPA = Environmental Protection Agency
SC = specific conductivity
SVOCs = semivolatile organic compounds
WAC = Washington Administrative Code

Figures



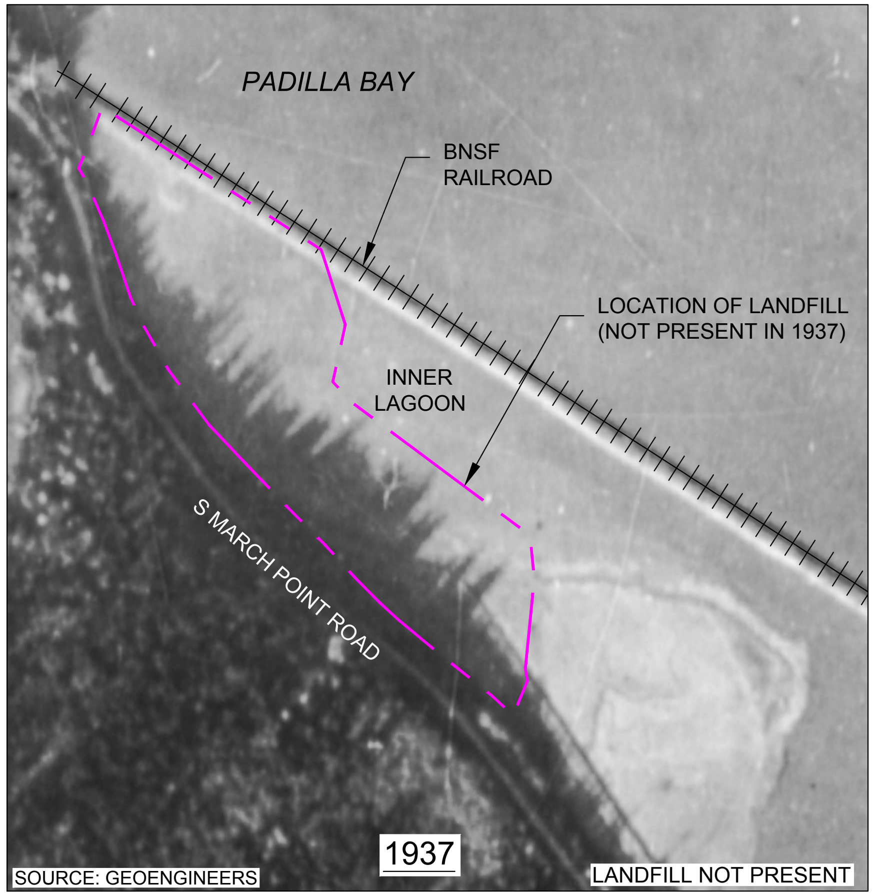
EXPLANATION

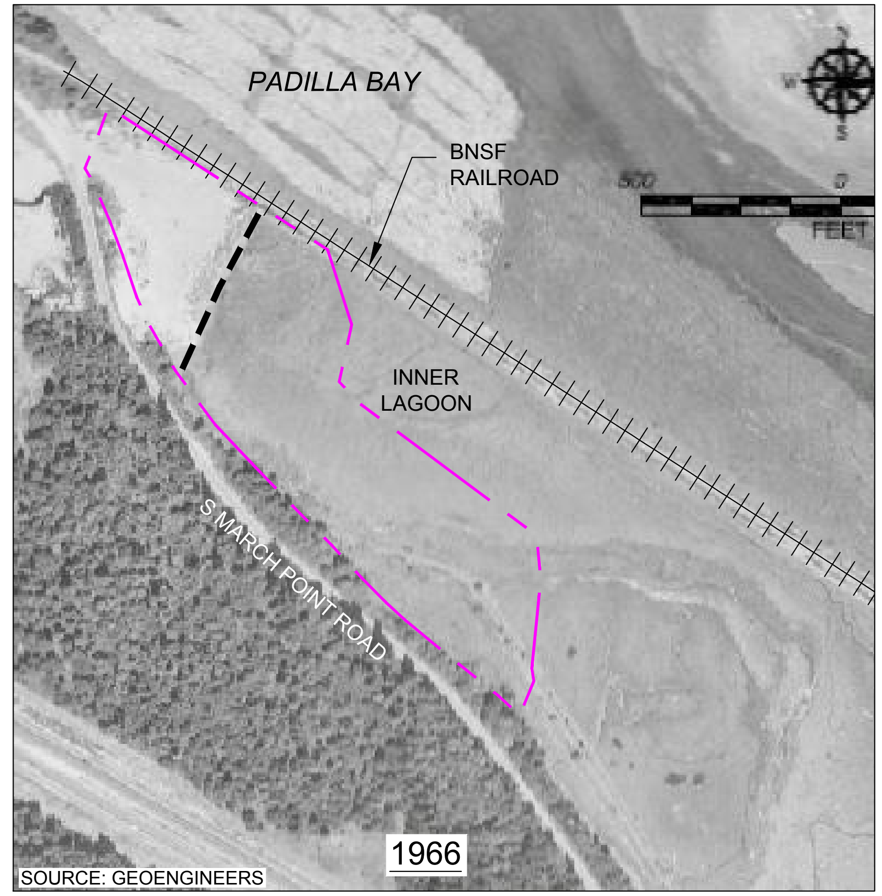
- FORMER SNOW MOUNTAIN LOG MILL
- NEARBY PROPERTIES AND ASSOCIATED USES
- FORMER WHITMARSH LANDFILL APPROXIMATE FOOTPRINT
- PARCEL LINES FROM SKAGIT COUNTY (SEE FIGURE 3 FOR MORE ACCURATE ON-SITE DETAIL)

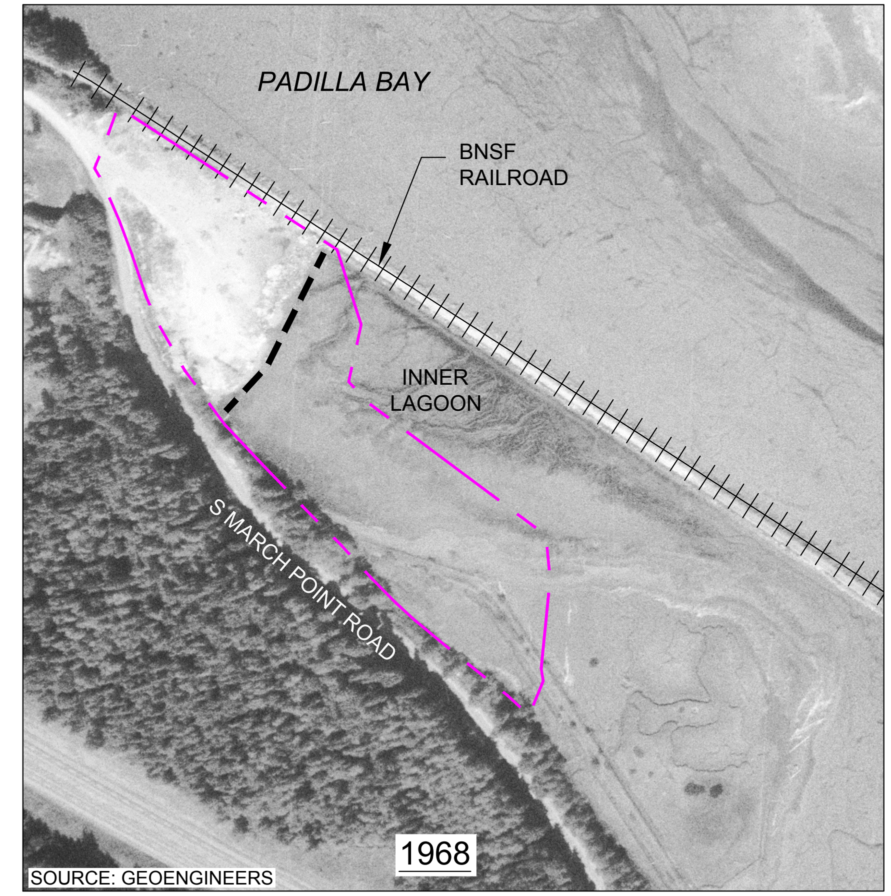
SITE VICINITY
March Point (Whitmarsh) Landfill
Skagit County, Washington

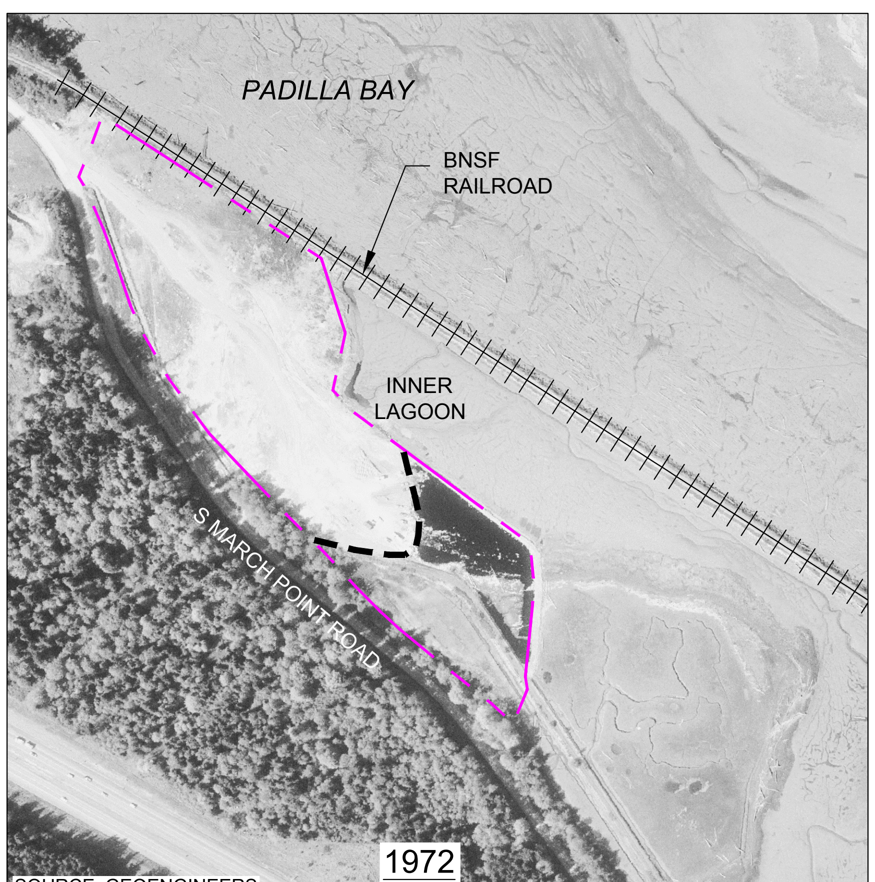
Date: 04/10/17

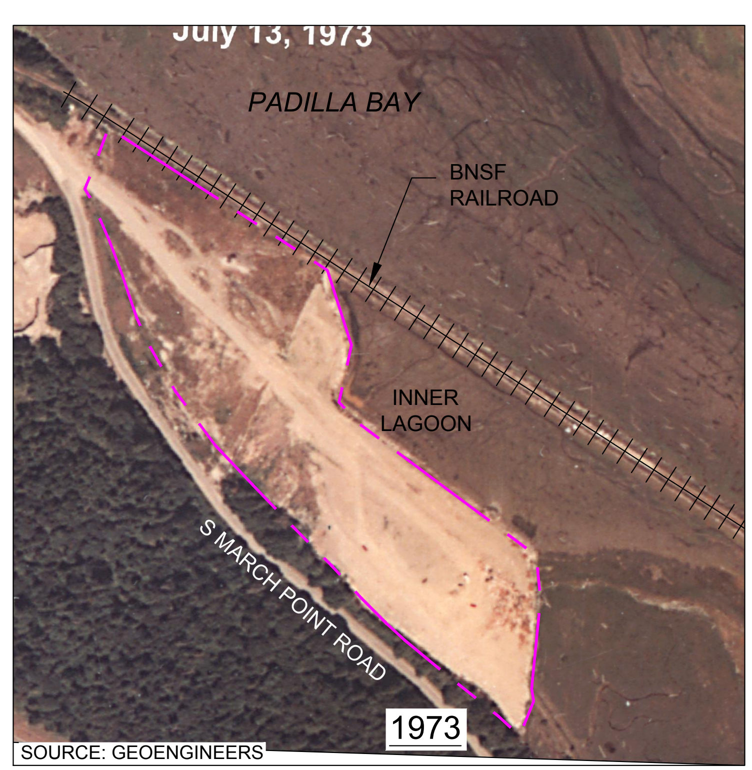
Figure 1











EXPLANATION

APPROXIMATE FOOTPRINT FORMER WHITMARSH LANDFILL

APPROXIMATE EXTENT OF SOLID WASTE

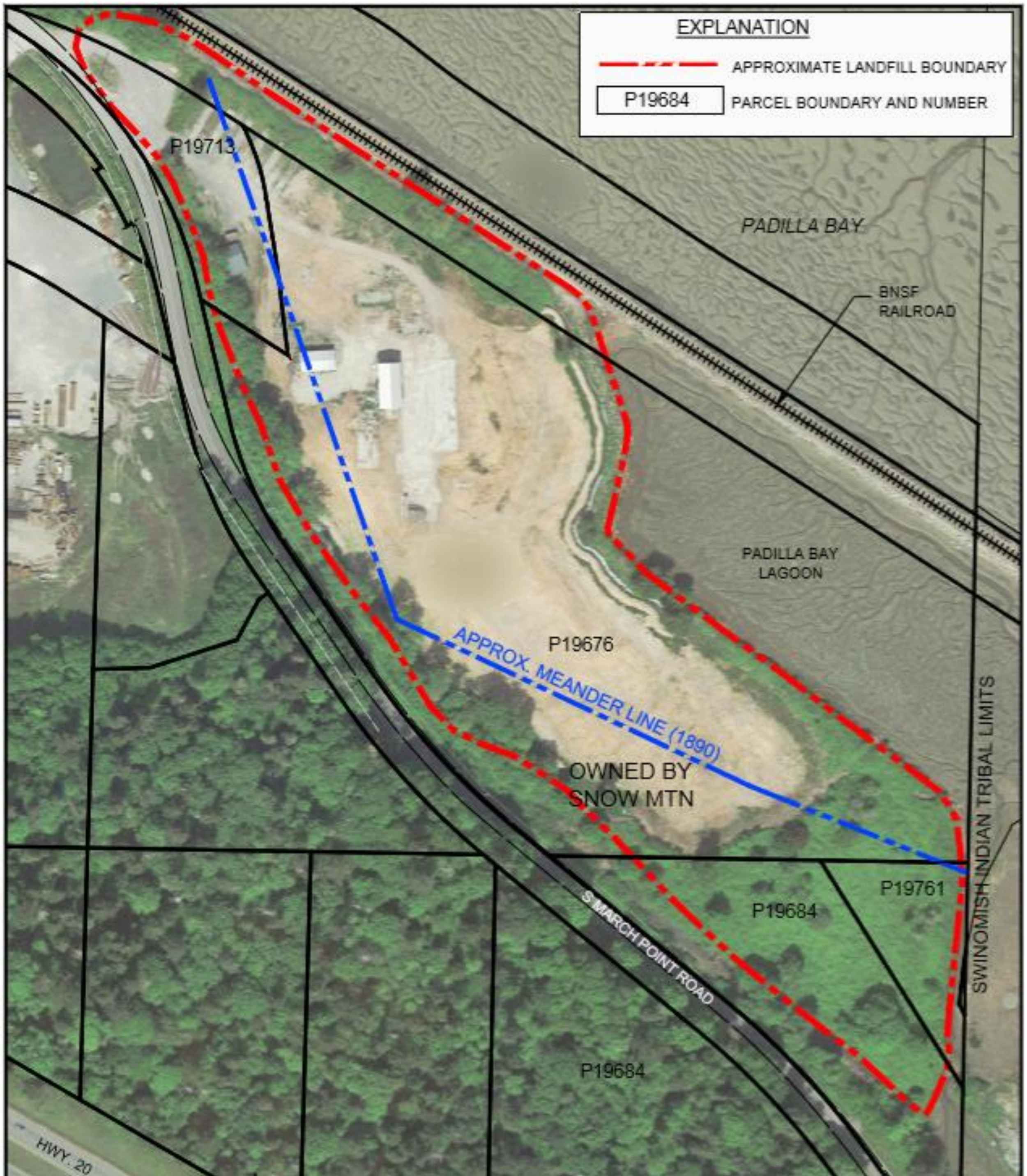
0 250 500

APPROXIMATE SCALE IN FEET

HISTORICAL AERIAL PHOTOGRAPHS
SHOWING FILLING OF LANDFILL
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 03/31/17

Figure 2



State of Washington is owner of the filled tidelands lying between the meander line and railroad right of way.

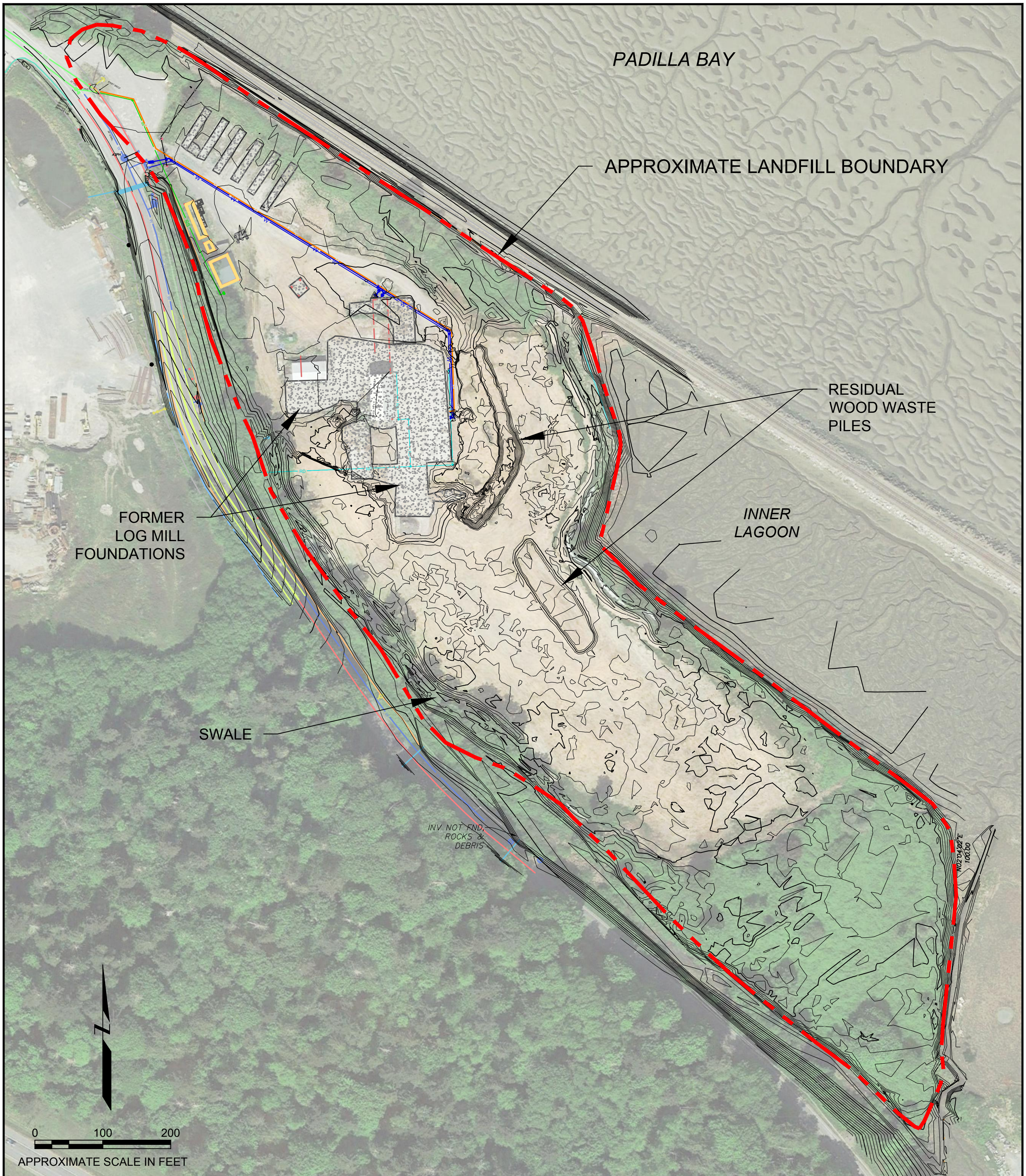
Aerial Photo Courtesy of Google Earth (May, 2015)

0 100 200
APPROXIMATE SCALE IN FEET

SITE PLAN AND PARCEL BOUNDARIES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 03/31/17

Figure 3



Aerial Photo Courtesy of Google Earth (May, 2015)

Topography provided by
Northwest Datum & Design, Inc
(Contours in 1-ft intervals)

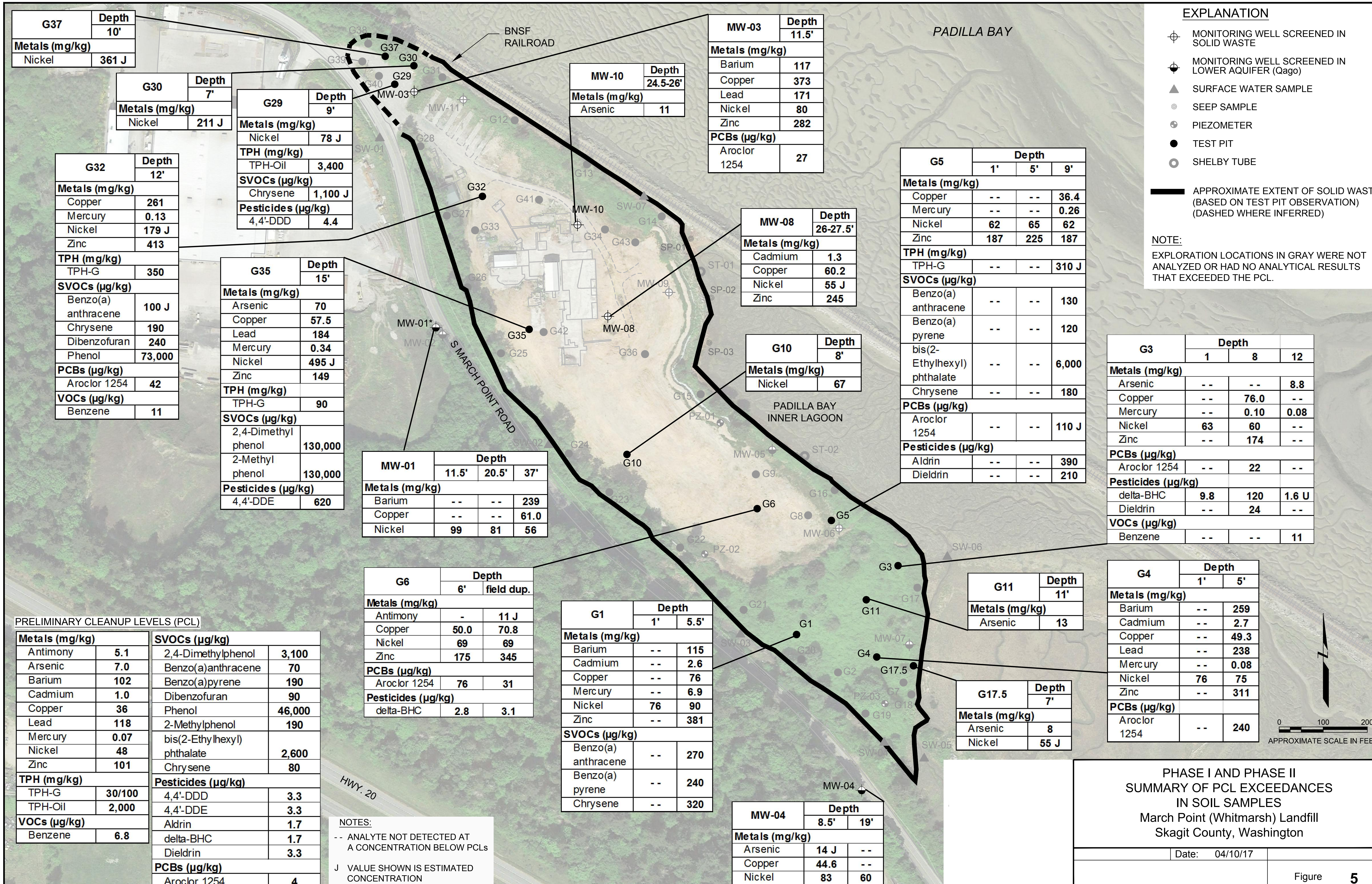
EXPLANATION

FORMER WHITMARSH LANDFILL APPROXIMATE FOOTPRINT

CURRENT TOPOGRAPHY AND SURFACE FEATURES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 03/31/17

Figure 4



EXPLANATION

- MONITORING WELL SCREENED IN SOLID WASTE
- MONITORING WELL SCREENED IN LOWER AQUIFER (Qago)
- SURFACE WATER SAMPLE
- SEEP SAMPLE
- PIEZOMETER
- TEST PIT
- SHELBY TUBE
- APPROXIMATE EXTENT OF SOLID WASTE (BASED ON TEST PIT OBSERVATION) (DASHED WHERE INFERRED)

NOTE:

EXPLORATION LOCATIONS IN GRAY WERE NOT ANALYZED OR HAD NO ANALYTICAL RESULTS THAT EXCEEDED THE PCL.

G37	Depth 10'
Metals (mg/kg)	
Nickel	361 J

G30	Depth 7'
Metals (mg/kg)	
Nickel	211 J

G29	Depth 9'
Metals (mg/kg)	
Nickel	78 J
TPH (mg/kg)	
TPH-Oil	3,400
SVOCs (µg/kg)	
Chrysene	1,100 J
Pesticides (µg/kg)	
4,4'-DDD	4.4

MW-10	Depth 24.5-26'
Metals (mg/kg)	
Arsenic	11

MW-03	Depth 11.5'
Metals (mg/kg)	
Barium	117
Copper	373
Lead	171
Nickel	80
Zinc	282
PCBs (µg/kg)	
Aroclor 1254	27

G32	Depth 12'
Metals (mg/kg)	
Copper	261
Mercury	0.13
Nickel	179 J
Zinc	413
TPH (mg/kg)	
TPH-G	350
SVOCs (µg/kg)	
Benzo(a) anthracene	100 J
Chrysene	190
Dibenzofuran	240
Phenol	73,000
PCBs (µg/kg)	
Aroclor 1254	42
VOCs (µg/kg)	
Benzene	11

G35	Depth 15'
Metals (mg/kg)	
Arsenic	70
Copper	57.5
Lead	184
Mercury	0.34
Nickel	495 J
Zinc	149
TPH (mg/kg)	
TPH-G	90
SVOCs (µg/kg)	
2,4-Dimethyl phenol	130,000
2-Methyl phenol	130,000
Pesticides (µg/kg)	
4,4'-DDE	620

MW-08	Depth 26-27.5'
Metals (mg/kg)	
Cadmium	1.3
Copper	60.2
Nickel	55 J
Zinc	245

G10	Depth 8'
Metals (mg/kg)	
Nickel	67

G5	Depth 1'	5'	9'
Metals (mg/kg)			
Copper	- -	- -	36.4
Mercury	- -	- -	0.26
Nickel	62	65	62
Zinc	187	225	187
TPH (mg/kg)			
TPH-G	- -	- -	310 J
SVOCs (µg/kg)			
Benzo(a) anthracene	- -	- -	130
Benzo(a) pyrene	- -	- -	120
bis(2-Ethylhexyl) phthalate	- -	- -	6,000
Chrysene	- -	- -	180
PCBs (µg/kg)			
Aroclor 1254	- -	- -	110 J
Pesticides (µg/kg)			
Aldrin	- -	- -	390
Dieldrin	- -	- -	210

G3	Depth 1	8	12
Metals (mg/kg)			
Arsenic	- -	- -	8.8
Copper	- -	76.0	- -
Mercury	- -	0.10	0.08
Nickel	63	60	- -
Zinc	- -	174	- -
PCBs (µg/kg)			
Aroclor 1254	- -	22	- -
Pesticides (µg/kg)			
delta-BHC	9.8	120	1.6 U
Dieldrin	- -	24	- -
VOCs (µg/kg)			
Benzene	- -	- -	11

MW-01	Depth 11.5'	20.5'	37'
Metals (mg/kg)			
Barium	- -	- -	239
Copper	- -	- -	61.0
Nickel	99	81	56

G6	Depth 6'	field dup.
Metals (mg/kg)		
Antimony	-	11 J
Copper	50.0	70.8
Nickel	69	69
Zinc	175	345
PCBs (µg/kg)		
Aroclor 1254	76	31
Pesticides (µg/kg)		
delta-BHC	2.8	3.1

G1	Depth 1'	5.5'
Metals (mg/kg)		
Barium	- -	115
Cadmium	- -	2.6
Copper	- -	76
Mercury	- -	6.9
Nickel	76	90
Zinc	- -	381
SVOCs (µg/kg)		
Benzo(a) anthracene	- -	270
Benzo(a) pyrene	- -	240
Chrysene	- -	320

G11	Depth 11'
Metals (mg/kg)	
Arsenic	13

G4	Depth 1'	5'
Metals (mg/kg)		
Barium	- -	259
Cadmium	- -	2.7
Copper	- -	49.3
Lead	- -	238
Mercury	- -	0.08
Nickel	76	75
Zinc	- -	311
PCBs (µg/kg)		
Aroclor 1254	- -	240

G17.5	Depth 7'
Metals (mg/kg)	
Arsenic	8
Nickel	55 J

MW-04	Depth 8.5'	19'
Metals (mg/kg)		
Arsenic	14 J	- -
Copper	44.6	- -
Nickel	83	60

PRELIMINARY CLEANUP LEVELS (PCL)

Metals (mg/kg)	
Antimony	5.1
Arsenic	7.0
Barium	102
Cadmium	1.0
Copper	36
Lead	118
Mercury	0.07
Nickel	48
Zinc	101
TPH (mg/kg)	
TPH-G	30/100
TPH-Oil	2,000
VOCs (µg/kg)	
Benzene	6.8

SVOCs (µg/kg)	
2,4-Dimethylphenol	3,100
Benzo(a)anthracene	70
Benzo(a)pyrene	190
Dibenzofuran	90
Phenol	46,000
2-Methylphenol	190
bis(2-Ethylhexyl) phthalate	2,600
Chrysene	80
Pesticides (µg/kg)	
4,4'-DDD	3.3
4,4'-DDE	3.3
Aldrin	1.7
delta-BHC	1.7
Dieldrin	3.3
PCBs (µg/kg)	
Aroclor 1254	4

NOTES:

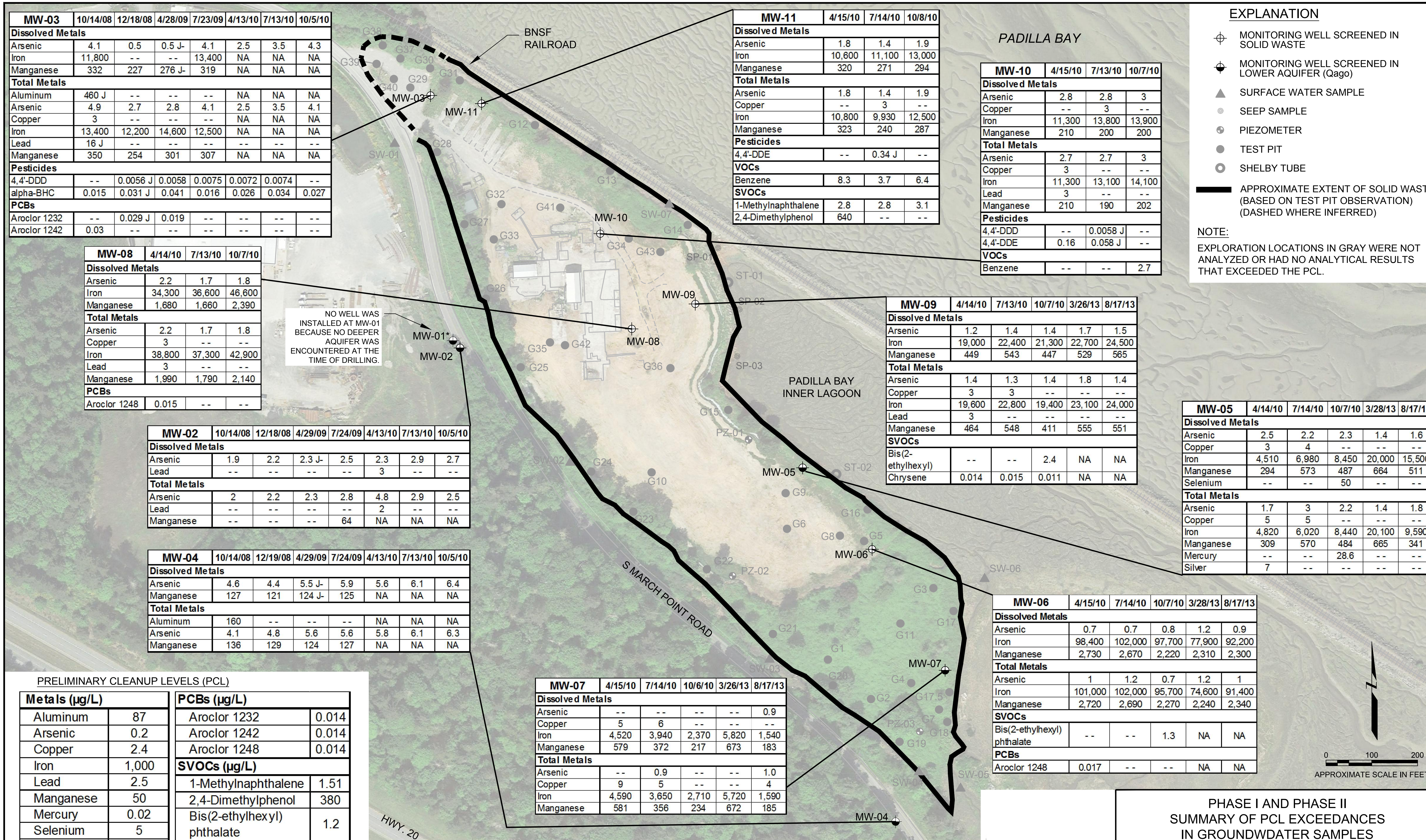
- - ANALYTE NOT DETECTED AT A CONCENTRATION BELOW PCLs

J VALUE SHOWN IS ESTIMATED CONCENTRATION

PHASE I AND PHASE II
SUMMARY OF PCL EXCEEDANCES
IN SOIL SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 5



EXPLANATION

- MONITORING WELL SCREENED IN SOLID WASTE
- MONITORING WELL SCREENED IN LOWER AQUIFER (Qago)
- SURFACE WATER SAMPLE
- SEEP SAMPLE
- PIEZOMETER
- TEST PIT
- SHELBY TUBE
- APPROXIMATE EXTENT OF SOLID WASTE (BASED ON TEST PIT OBSERVATION) (DASHED WHERE INFERRED)

NOTE:

EXPLORATION LOCATIONS IN GRAY WERE NOT ANALYZED OR HAD NO ANALYTICAL RESULTS THAT EXCEEDED THE PCL.

MW-03	10/14/08	12/18/08	4/28/09	7/23/09	4/13/10	7/13/10	10/5/10
Dissolved Metals							
Arsenic	4.1	0.5	0.5 J-	4.1	2.5	3.5	4.3
Iron	11,800	- -	- -	13,400	NA	NA	NA
Manganese	332	227	276 J-	319	NA	NA	NA
Total Metals							
Aluminum	460 J	- -	- -	- -	NA	NA	NA
Arsenic	4.9	2.7	2.8	4.1	2.5	3.5	4.1
Copper	3	- -	- -	- -	NA	NA	NA
Iron	13,400	12,200	14,600	12,500	NA	NA	NA
Lead	16 J	- -	- -	- -	- -	- -	- -
Manganese	350	254	301	307	NA	NA	NA
Pesticides							
4,4'-DDD	- -	0.0056 J	0.0058	0.0075	0.0072	0.0074	- -
alpha-BHC	0.015	0.031 J	0.041	0.016	0.026	0.034	0.027
PCBs							
Aroclor 1232	- -	0.029 J	0.019	- -	- -	- -	- -
Aroclor 1242	0.03	- -	- -	- -	- -	- -	- -

MW-11	4/15/10	7/14/10	10/8/10
Dissolved Metals			
Arsenic	1.8	1.4	1.9
Iron	10,600	11,100	13,000
Manganese	320	271	294
Total Metals			
Arsenic	1.8	1.4	1.9
Copper	- -	3	- -
Iron	10,800	9,930	12,500
Manganese	323	240	287
Pesticides			
4,4'-DDE	- -	0.34 J	- -
VOCs			
Benzene	8.3	3.7	6.4
SVOCs			
1-Methylnaphthalene	2.8	2.8	3.1
2,4-Dimethylphenol	640	- -	- -

MW-10	4/15/10	7/13/10	10/7/10
Dissolved Metals			
Arsenic	2.8	2.8	3
Copper	- -	3	- -
Iron	11,300	13,800	13,900
Manganese	210	200	200
Total Metals			
Arsenic	2.7	2.7	3
Copper	3	- -	- -
Iron	11,300	13,100	14,100
Lead	3	- -	- -
Manganese	210	190	202
Pesticides			
4,4'-DDD	- -	0.0058 J	- -
4,4'-DDE	0.16	0.058 J	- -
VOCs			
Benzene	- -	- -	2.7

MW-08	4/14/10	7/13/10	10/7/10
Dissolved Metals			
Arsenic	2.2	1.7	1.8
Iron	34,300	36,600	46,600
Manganese	1,680	1,660	2,390
Total Metals			
Arsenic	2.2	1.7	1.8
Copper	3	- -	- -
Iron	38,800	37,300	42,900
Lead	3	- -	- -
Manganese	1,990	1,790	2,140
PCBs			
Aroclor 1248	0.015	- -	- -

MW-09	4/14/10	7/13/10	10/7/10	3/26/13	8/17/13
Dissolved Metals					
Arsenic	1.2	1.4	1.4	1.7	1.5
Iron	19,000	22,400	21,300	22,700	24,500
Manganese	449	543	447	529	565
Total Metals					
Arsenic	1.4	1.3	1.4	1.8	1.4
Copper	3	3	- -	- -	- -
Iron	19,600	22,800	19,400	23,100	24,000
Lead	3	- -	- -	- -	- -
Manganese	464	548	411	555	551
SVOCs					
Bis(2-ethylhexyl)	- -	- -	2.4	NA	NA
Chrysene	0.014	0.015	0.011	NA	NA

MW-05	4/14/10	7/14/10	10/7/10	3/28/13	8/17/13
Dissolved Metals					
Arsenic	2.5	2.2	2.3	1.4	1.6
Copper	3	4	- -	- -	- -
Iron	4,510	6,980	8,450	20,000	15,500
Manganese	294	573	487	664	511
Selenium	- -	- -	50	- -	- -
Total Metals					
Arsenic	1.7	3	2.2	1.4	1.8
Copper	5	5	- -	- -	- -
Iron	4,820	6,020	8,440	20,100	9,590
Manganese	309	570	484	665	341
Mercury	- -	- -	28.6	- -	- -
Silver	7	- -	- -	- -	- -

MW-02	10/14/08	12/18/08	4/29/09	7/24/09	4/13/10	7/13/10	10/5/10
Dissolved Metals							
Arsenic	1.9	2.2	2.3 J-	2.5	2.3	2.9	2.7
Lead	- -	- -	- -	- -	3	- -	- -
Total Metals							
Arsenic	2	2.2	2.3	2.8	4.8	2.9	2.5
Lead	- -	- -	- -	- -	2	- -	- -
Manganese	- -	- -	- -	64	NA	NA	NA

MW-04	10/14/08	12/19/08	4/29/09	7/24/09	4/13/10	7/13/10	10/5/10
Dissolved Metals							
Arsenic	4.6	4.4	5.5 J-	5.9	5.6	6.1	6.4
Manganese	127	121	124 J-	125	NA	NA	NA
Total Metals							
Aluminum	160	- -	- -	- -	NA	NA	NA
Arsenic	4.1	4.8	5.6	5.6	5.8	6.1	6.3
Manganese	136	129	124	127	NA	NA	NA

MW-06	4/15/10	7/14/10	10/7/10	3/28/13	8/17/13
Dissolved Metals					
Arsenic	0.7	0.7	0.8	1.2	0.9
Iron	98,400	102,000	97,700	77,900	92,200
Manganese	2,730	2,670	2,220	2,310	2,300
Total Metals					
Arsenic	1	1.2	0.7	1.2	1
Iron	101,000	102,000	95,700	74,600	91,400
Manganese	2,720	2,690	2,270	2,240	2,340
SVOCs					
Bis(2-ethylhexyl) phthalate	- -	- -	1.3	NA	NA
PCBs					
Aroclor 1248	0.017	- -	- -	NA	NA

MW-07	4/15/10	7/14/10	10/6/10	3/26/13	8/17/13
Dissolved Metals					
Arsenic	- -	- -	- -	- -	0.9
Copper	5	6	- -	- -	- -
Iron	4,520	3,940	2,370	5,820	1,540
Manganese	579	372	217	673	183
Total Metals					
Arsenic	- -	0.9	- -	- -	1.0
Copper	9	5	- -	- -	4
Iron	4,590	3,650	2,710	5,720	1,590
Manganese	581	356	234	672	185

PRELIMINARY CLEANUP LEVELS (PCL)

Metals (µg/L)	
Aluminum	87
Arsenic	0.2
Copper	2.4
Iron	1,000
Lead	2.5
Manganese	50
Mercury	0.02
Selenium	5
Silver	1.9
Pesticides (µg/L)	
4,4'-DDD	0.00125
4,4'-DDE	0.00125
alpha-BHC	0.0006

PCBs (µg/L)	
Aroclor 1232	0.014
Aroclor 1242	0.014
Aroclor 1248	0.014
SVOCs (µg/L)	
1-Methylnaphthalene	1.51
2,4-Dimethylphenol	380
Bis(2-ethylhexyl) phthalate	1.2
Chrysene	0.01
VOCs (µg/L)	
Benzene	1.2

NOTE: ALUMINUM HAD A PCL BUT IS NOT A CONSTITUENT OF CONCERN.

NOTES:

NA NOT ANALYZED

- - ANALYTE NOT DETECTED AT A CONCENTRATION GREATER THAN PCLs

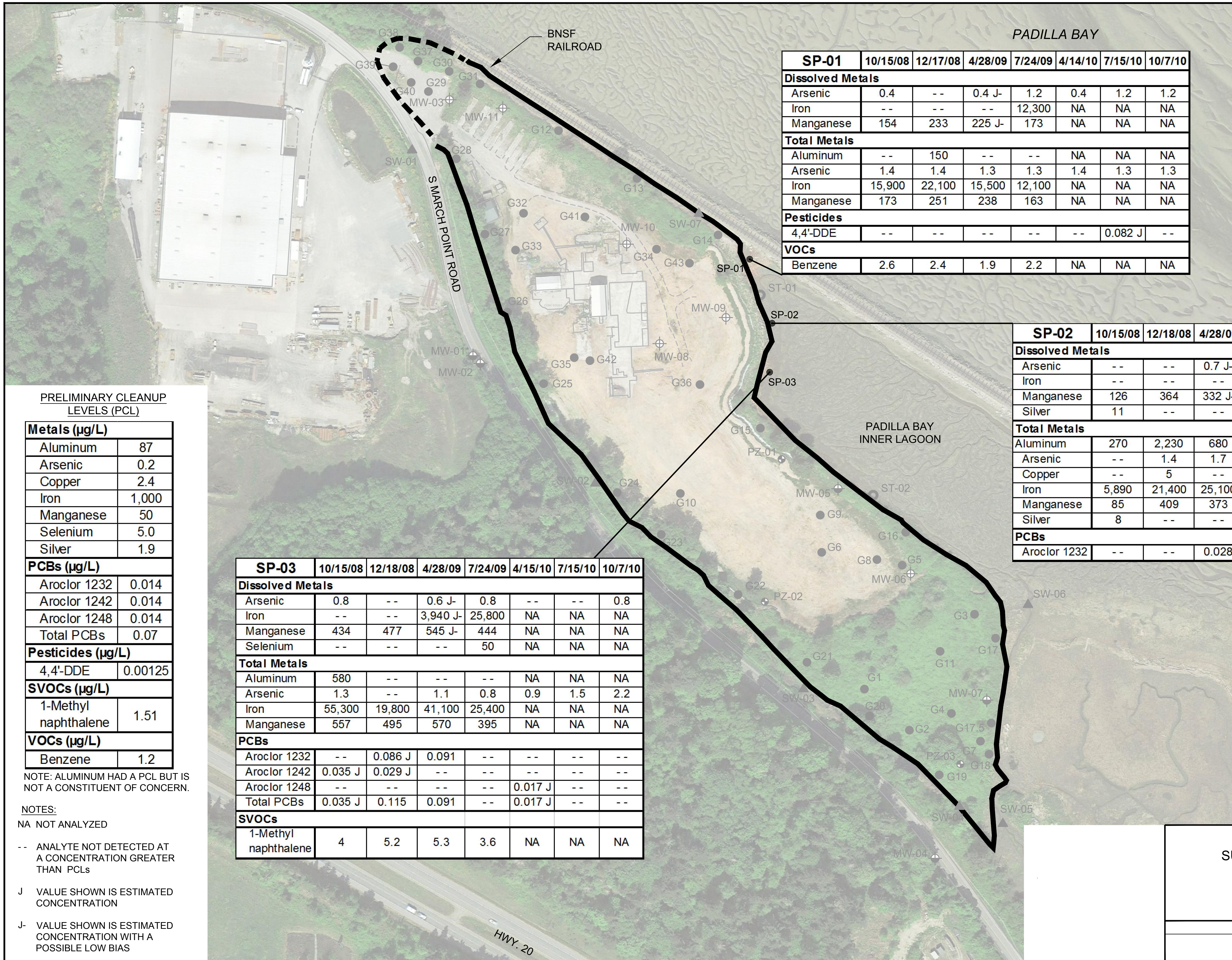
J VALUE SHOWN IS ESTIMATED CONCENTRATION

J- VALUE SHOWN IS ESTIMATED CONCENTRATION WITH A POSSIBLE LOW BIAS

PHASE I AND PHASE II SUMMARY OF PCL EXCEEDANCES IN GROUNDWDATER SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 6



SP-01	10/15/08	12/17/08	4/28/09	7/24/09	4/14/10	7/15/10	10/7/10
Dissolved Metals							
Arsenic	0.4	- -	0.4 J-	1.2	0.4	1.2	1.2
Iron	- -	- -	- -	12,300	NA	NA	NA
Manganese	154	233	225 J-	173	NA	NA	NA
Total Metals							
Aluminum	- -	150	- -	- -	NA	NA	NA
Arsenic	1.4	1.4	1.3	1.3	1.4	1.3	1.3
Iron	15,900	22,100	15,500	12,100	NA	NA	NA
Manganese	173	251	238	163	NA	NA	NA
Pesticides							
4,4'-DDE	- -	- -	- -	- -	- -	0.082 J	- -
VOCs							
Benzene	2.6	2.4	1.9	2.2	NA	NA	NA

SP-02	10/15/08	12/18/08	4/28/09	7/24/09	4/15/10	7/15/10	10/7/10
Dissolved Metals							
Arsenic	- -	- -	0.7 J-	1.1	- -	1.3	12
Iron	- -	- -	- -	18,200	NA	NA	NA
Manganese	126	364	332 J-	321	NA	NA	NA
Silver	11	- -	- -	- -	NA	NA	NA
Total Metals							
Aluminum	270	2,230	680	900	NA	NA	NA
Arsenic	- -	1.4	1.7	2.4	0.6	0.5	0.9
Copper	- -	5	- -	- -	NA	NA	NA
Iron	5,890	21,400	25,100	26,400	NA	NA	NA
Manganese	85	409	373	314	NA	NA	NA
Silver	8	- -	- -	- -	NA	NA	NA
PCBs							
Aroclor 1232	- -	- -	0.028	- -	- -	- -	- -

SP-03	10/15/08	12/18/08	4/28/09	7/24/09	4/15/10	7/15/10	10/7/10
Dissolved Metals							
Arsenic	0.8	- -	0.6 J-	0.8	- -	- -	0.8
Iron	- -	- -	3,940 J-	25,800	NA	NA	NA
Manganese	434	477	545 J-	444	NA	NA	NA
Selenium	- -	- -	- -	50	NA	NA	NA
Total Metals							
Aluminum	580	- -	- -	- -	NA	NA	NA
Arsenic	1.3	- -	1.1	0.8	0.9	1.5	2.2
Iron	55,300	19,800	41,100	25,400	NA	NA	NA
Manganese	557	495	570	395	NA	NA	NA
PCBs							
Aroclor 1232	- -	0.086 J	0.091	- -	- -	- -	- -
Aroclor 1242	0.035 J	0.029 J	- -	- -	- -	- -	- -
Aroclor 1248	- -	- -	- -	- -	0.017 J	- -	- -
Total PCBs	0.035 J	0.115	0.091	- -	0.017 J	- -	- -
SVOCs							
1-Methyl naphthalene	4	5.2	5.3	3.6	NA	NA	NA

PRELIMINARY CLEANUP LEVELS (PCL)

Metals (µg/L)	
Aluminum	87
Arsenic	0.2
Copper	2.4
Iron	1,000
Manganese	50
Selenium	5.0
Silver	1.9
PCBs (µg/L)	
Aroclor 1232	0.014
Aroclor 1242	0.014
Aroclor 1248	0.014
Total PCBs	0.07
Pesticides (µg/L)	
4,4'-DDE	0.00125
SVOCs (µg/L)	
1-Methyl naphthalene	1.51
VOCs (µg/L)	
Benzene	1.2

NOTE: ALUMINUM HAD A PCL BUT IS NOT A CONSTITUENT OF CONCERN.

NOTES:

NA NOT ANALYZED

- - ANALYTE NOT DETECTED AT A CONCENTRATION GREATER THAN PCLs

J VALUE SHOWN IS ESTIMATED CONCENTRATION

J- VALUE SHOWN IS ESTIMATED CONCENTRATION WITH A POSSIBLE LOW BIAS

EXPLANATION

- MONITORING WELL SCREENED IN SOLID WASTE
- MONITORING WELL SCREENED IN LOWER AQUIFER (Qago)
- SURFACE WATER SAMPLE
- SEEP SAMPLE
- PIEZOMETER
- TEST PIT
- SHELBY TUBE
- APPROXIMATE EXTENT OF SOLID WASTE (BASED ON TEST PIT OBSERVATION) (DASHED WHERE INFERRED)

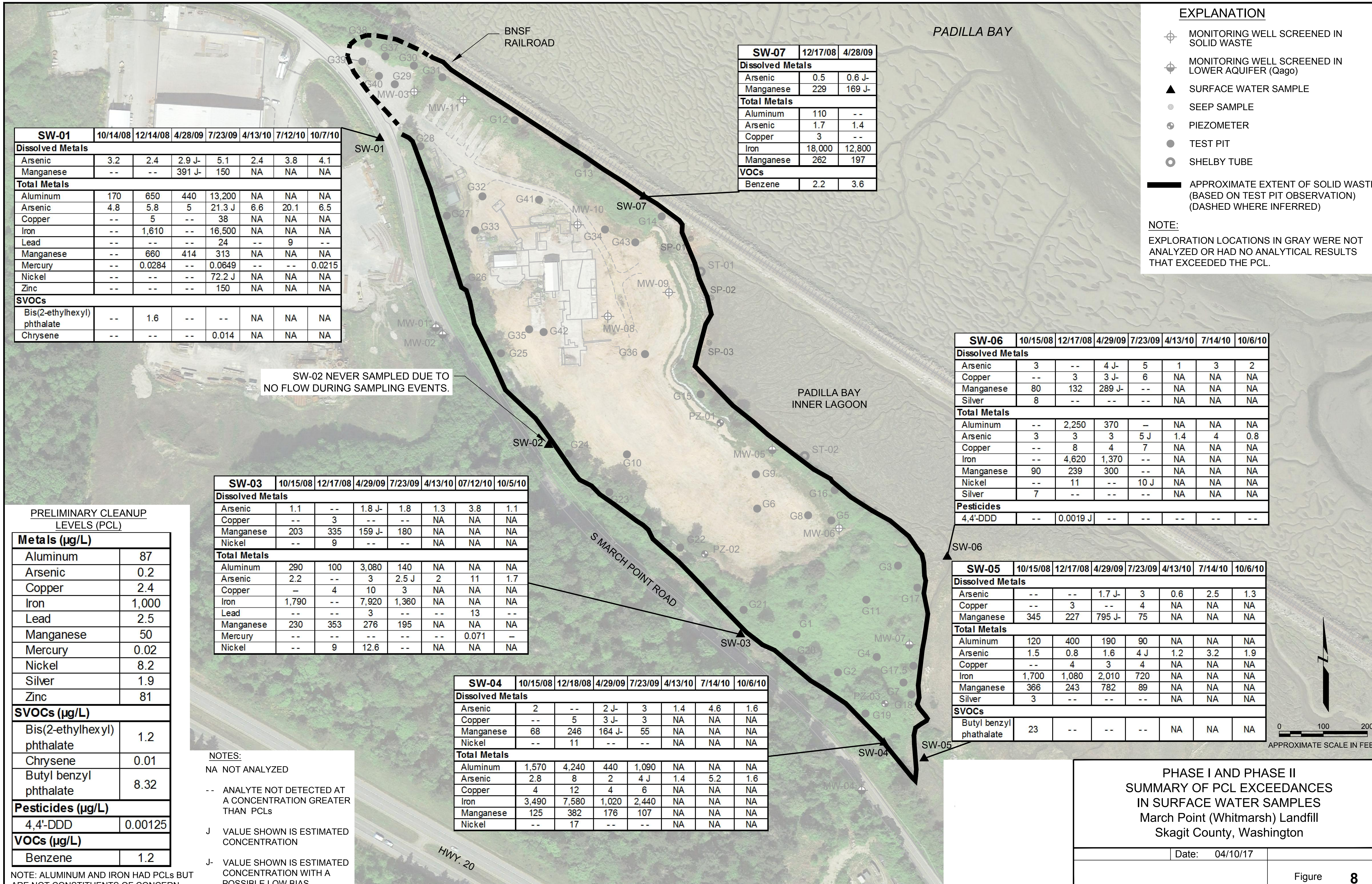
NOTE:

EXPLORATION LOCATIONS IN GRAY WERE NOT ANALYZED OR HAD NO ANALYTICAL RESULTS THAT EXCEEDED THE PCL.

PHASE I AND PHASE II
SUMMARY OF PCL EXCEEDANCES
IN SEEP SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 7



SW-02 NEVER SAMPLED DUE TO NO FLOW DURING SAMPLING EVENTS.

SW-01	10/14/08	12/14/08	4/28/09	7/23/09	4/13/10	7/12/10	10/7/10
Dissolved Metals							
Arsenic	3.2	2.4	2.9 J-	5.1	2.4	3.8	4.1
Manganese	- -	- -	391 J-	150	NA	NA	NA
Total Metals							
Aluminum	170	650	440	13,200	NA	NA	NA
Arsenic	4.8	5.8	5	21.3 J	6.6	20.1	6.5
Copper	- -	5	- -	38	NA	NA	NA
Iron	- -	1,610	- -	16,500	NA	NA	NA
Lead	- -	- -	- -	24	- -	9	- -
Manganese	- -	660	414	313	NA	NA	NA
Mercury	- -	0.0284	- -	0.0649	- -	- -	0.0215
Nickel	- -	- -	- -	72.2 J	NA	NA	NA
Zinc	- -	- -	- -	150	NA	NA	NA
SVOCs							
Bis(2-ethylhexyl) phthalate	- -	1.6	- -	- -	NA	NA	NA
Chrysene	- -	- -	- -	0.014	NA	NA	NA

SW-07	12/17/08	4/28/09
Dissolved Metals		
Arsenic	0.5	0.6 J-
Manganese	229	169 J-
Total Metals		
Aluminum	110	- -
Arsenic	1.7	1.4
Copper	3	- -
Iron	18,000	12,800
Manganese	262	197
VOCs		
Benzene	2.2	3.6

SW-06	10/15/08	12/17/08	4/29/09	7/23/09	4/13/10	7/14/10	10/6/10
Dissolved Metals							
Arsenic	3	- -	4 J-	5	1	3	2
Copper	- -	3	3 J-	6	NA	NA	NA
Manganese	80	132	289 J-	- -	NA	NA	NA
Silver	8	- -	- -	- -	NA	NA	NA
Total Metals							
Aluminum	- -	2,250	370	–	NA	NA	NA
Arsenic	3	3	3	5 J	1.4	4	0.8
Copper	- -	8	4	7	NA	NA	NA
Iron	- -	4,620	1,370	- -	NA	NA	NA
Manganese	90	239	300	- -	NA	NA	NA
Nickel	- -	11	- -	10 J	NA	NA	NA
Silver	7	- -	- -	- -	NA	NA	NA
Pesticides							
4,4'-DDD	- -	0.0019 J	- -	- -	- -	- -	- -

SW-03	10/15/08	12/17/08	4/29/09	7/23/09	4/13/10	07/12/10	10/5/10
Dissolved Metals							
Arsenic	1.1	- -	1.8 J-	1.8	1.3	3.8	1.1
Copper	- -	3	- -	- -	NA	NA	NA
Manganese	203	335	159 J-	180	NA	NA	NA
Nickel	- -	9	- -	- -	NA	NA	NA
Total Metals							
Aluminum	290	100	3,080	140	NA	NA	NA
Arsenic	2.2	- -	3	2.5 J	2	11	1.7
Copper	–	4	10	3	NA	NA	NA
Iron	1,790	- -	7,920	1,360	NA	NA	NA
Lead	- -	- -	3	- -	- -	13	- -
Manganese	230	353	276	195	NA	NA	NA
Mercury	- -	- -	- -	- -	- -	0.071	–
Nickel	- -	9	12.6	- -	NA	NA	NA

SW-05	10/15/08	12/17/08	4/29/09	7/23/09	4/13/10	7/14/10	10/6/10
Dissolved Metals							
Arsenic	- -	- -	1.7 J-	3	0.6	2.5	1.3
Copper	- -	3	- -	4	NA	NA	NA
Manganese	345	227	795 J-	75	NA	NA	NA
Total Metals							
Aluminum	120	400	190	90	NA	NA	NA
Arsenic	1.5	0.8	1.6	4 J	1.2	3.2	1.9
Copper	- -	4	3	4	NA	NA	NA
Iron	1,700	1,080	2,010	720	NA	NA	NA
Manganese	366	243	782	89	NA	NA	NA
Silver	3	- -	- -	- -	NA	NA	NA
SVOCs							
Butyl benzyl phathalate	23	- -	- -	- -	NA	NA	NA

SW-04	10/15/08	12/18/08	4/29/09	7/23/09	4/13/10	7/14/10	10/6/10
Dissolved Metals							
Arsenic	2	- -	2 J-	3	1.4	4.6	1.6
Copper	- -	5	3 J-	3	NA	NA	NA
Manganese	68	246	164 J-	55	NA	NA	NA
Nickel	- -	11	- -	- -	NA	NA	NA
Total Metals							
Aluminum	1,570	4,240	440	1,090	NA	NA	NA
Arsenic	2.8	8	2	4 J	1.4	5.2	1.6
Copper	4	12	4	6	NA	NA	NA
Iron	3,490	7,580	1,020	2,440	NA	NA	NA
Manganese	125	382	176	107	NA	NA	NA
Nickel	- -	17	- -	- -	NA	NA	NA

EXPLANATION

- MONITORING WELL SCREENED IN SOLID WASTE
- MONITORING WELL SCREENED IN LOWER AQUIFER (Qago)
- SURFACE WATER SAMPLE
- SEEP SAMPLE
- PIEZOMETER
- TEST PIT
- SHELBY TUBE
- APPROXIMATE EXTENT OF SOLID WASTE (BASED ON TEST PIT OBSERVATION) (DASHED WHERE INFERRED)

NOTE:

EXPLORATION LOCATIONS IN GRAY WERE NOT ANALYZED OR HAD NO ANALYTICAL RESULTS THAT EXCEEDED THE PCL.

PRELIMINARY CLEANUP LEVELS (PCL)

Metals (µg/L)	
Aluminum	87
Arsenic	0.2
Copper	2.4
Iron	1,000
Lead	2.5
Manganese	50
Mercury	0.02
Nickel	8.2
Silver	1.9
Zinc	81
SVOCs (µg/L)	
Bis(2-ethylhexyl) phthalate	1.2
Chrysene	0.01
Butyl benzyl phthalate	8.32
Pesticides (µg/L)	
4,4'-DDD	0.00125
VOCs (µg/L)	
Benzene	1.2

NOTE: ALUMINUM AND IRON HAD PCLs BUT ARE NOT CONSTITUENTS OF CONCERN.

NOTES:

NA NOT ANALYZED

- - ANALYTE NOT DETECTED AT A CONCENTRATION GREATER THAN PCLs

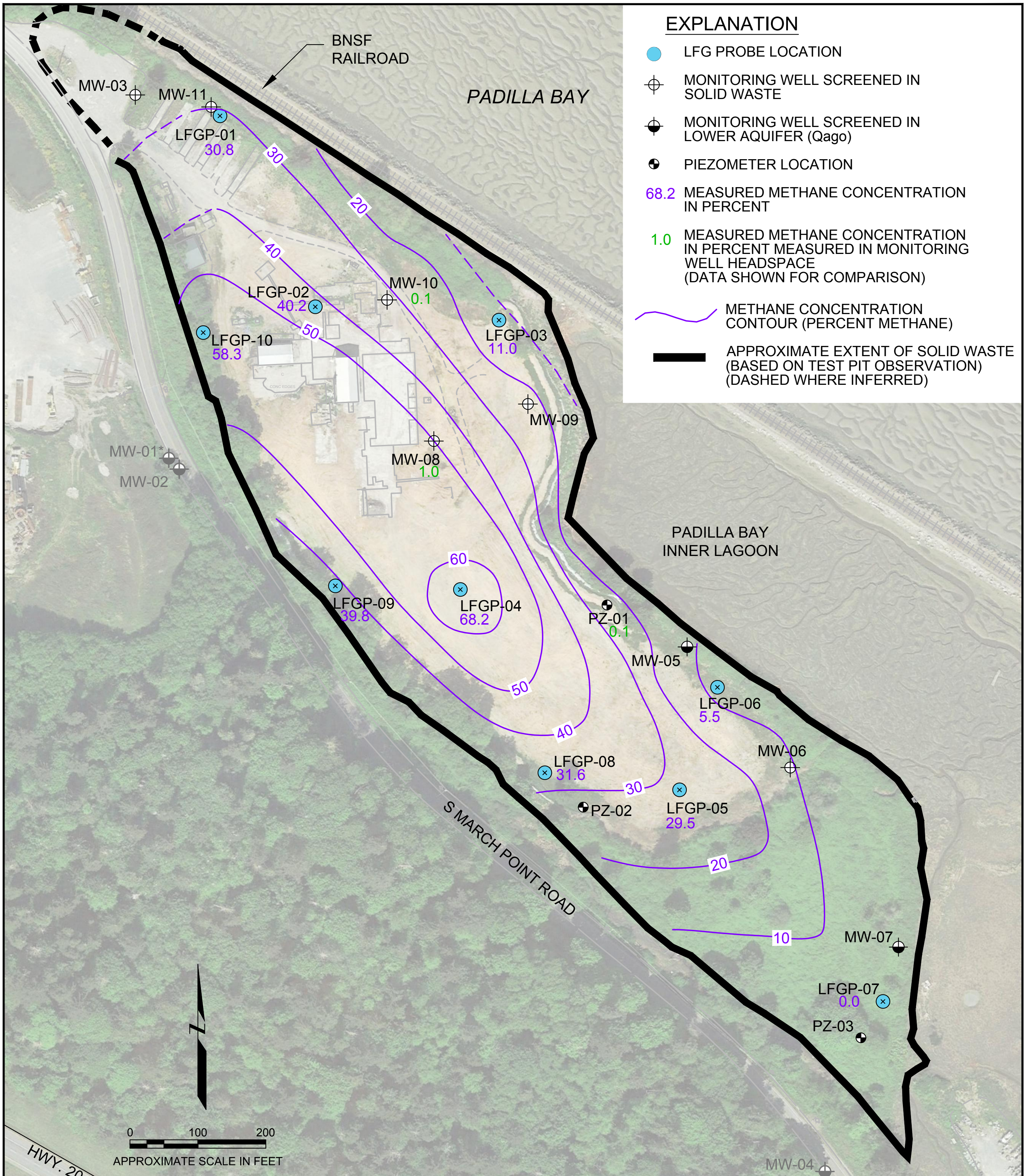
J VALUE SHOWN IS ESTIMATED CONCENTRATION

J- VALUE SHOWN IS ESTIMATED CONCENTRATION WITH A POSSIBLE LOW BIAS

PHASE I AND PHASE II
SUMMARY OF PCL EXCEEDANCES
IN SURFACE WATER SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 8



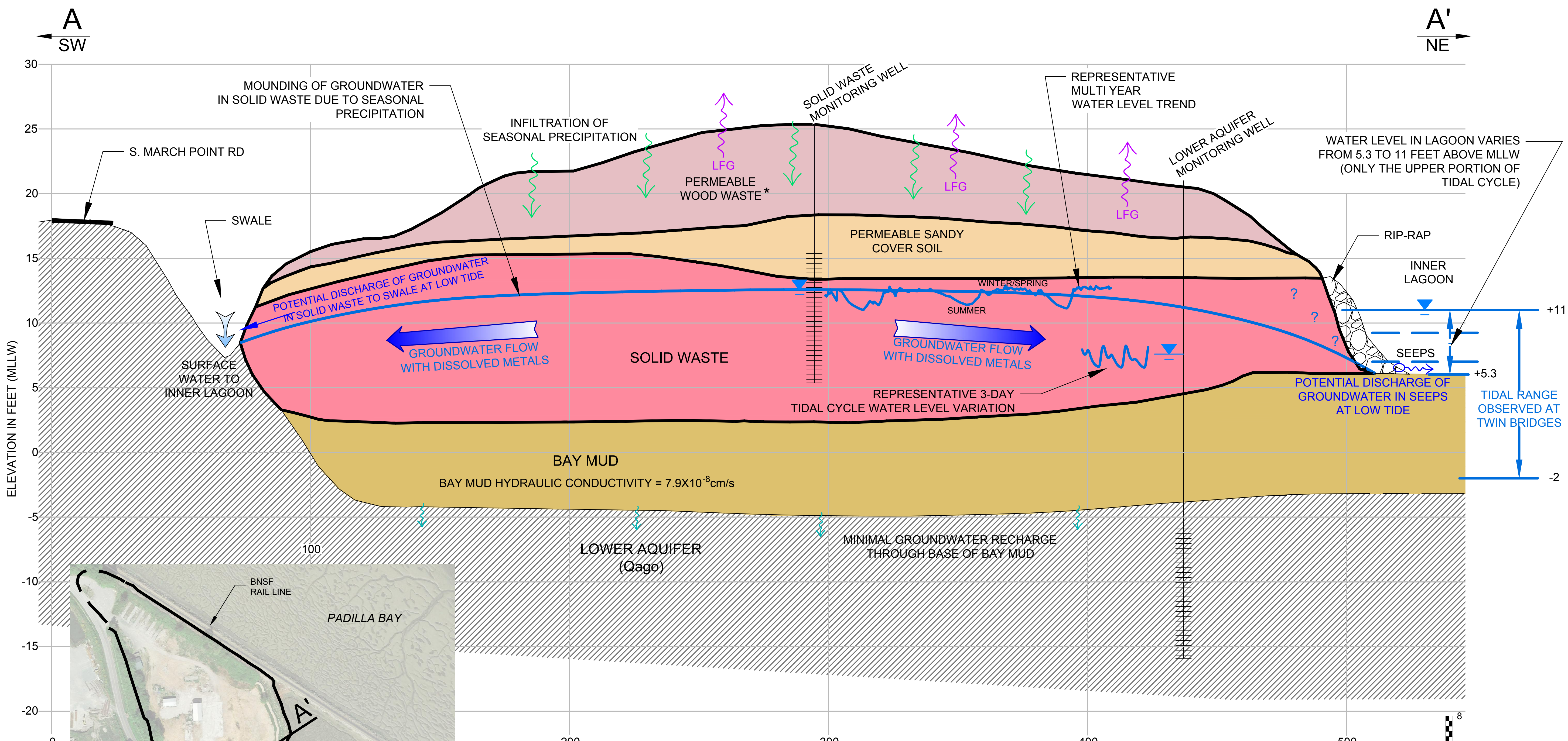
Aerial Photo Courtesy of Google Earth (May, 2015)

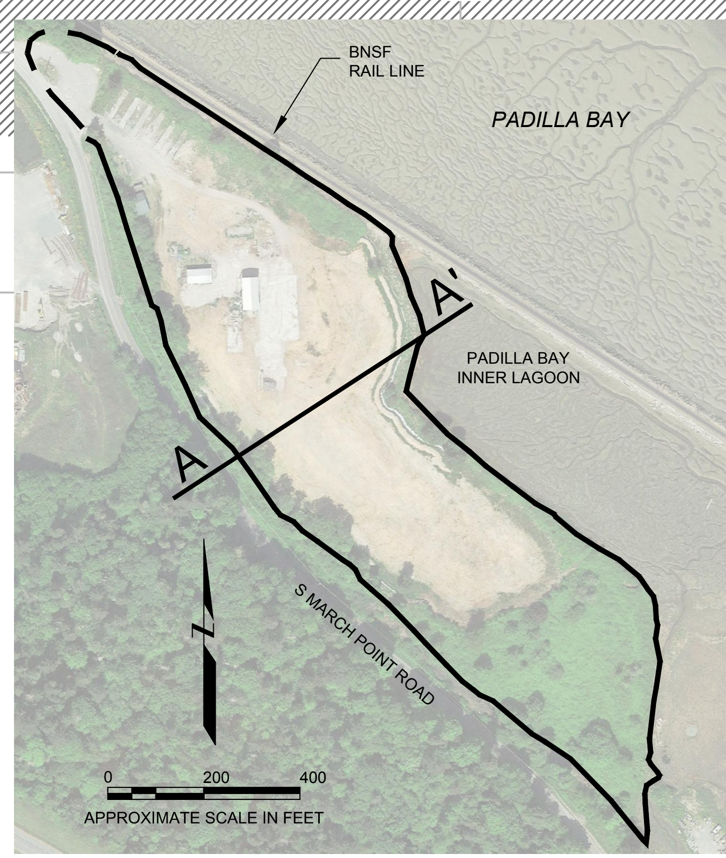
NOTE:
Methane concentrations from groundwater monitoring wells not used to generate contours.

METHANE CONCENTRATIONS, APRIL 2012
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 03/31/17

Figure 9





KEY:

WELL SCREEN INTERVAL

WATER LEVEL (MAY 2010)

* MAJORITY OF THE WOOD WASTE WAS REMOVED IN FALL 2014 BY DNR.

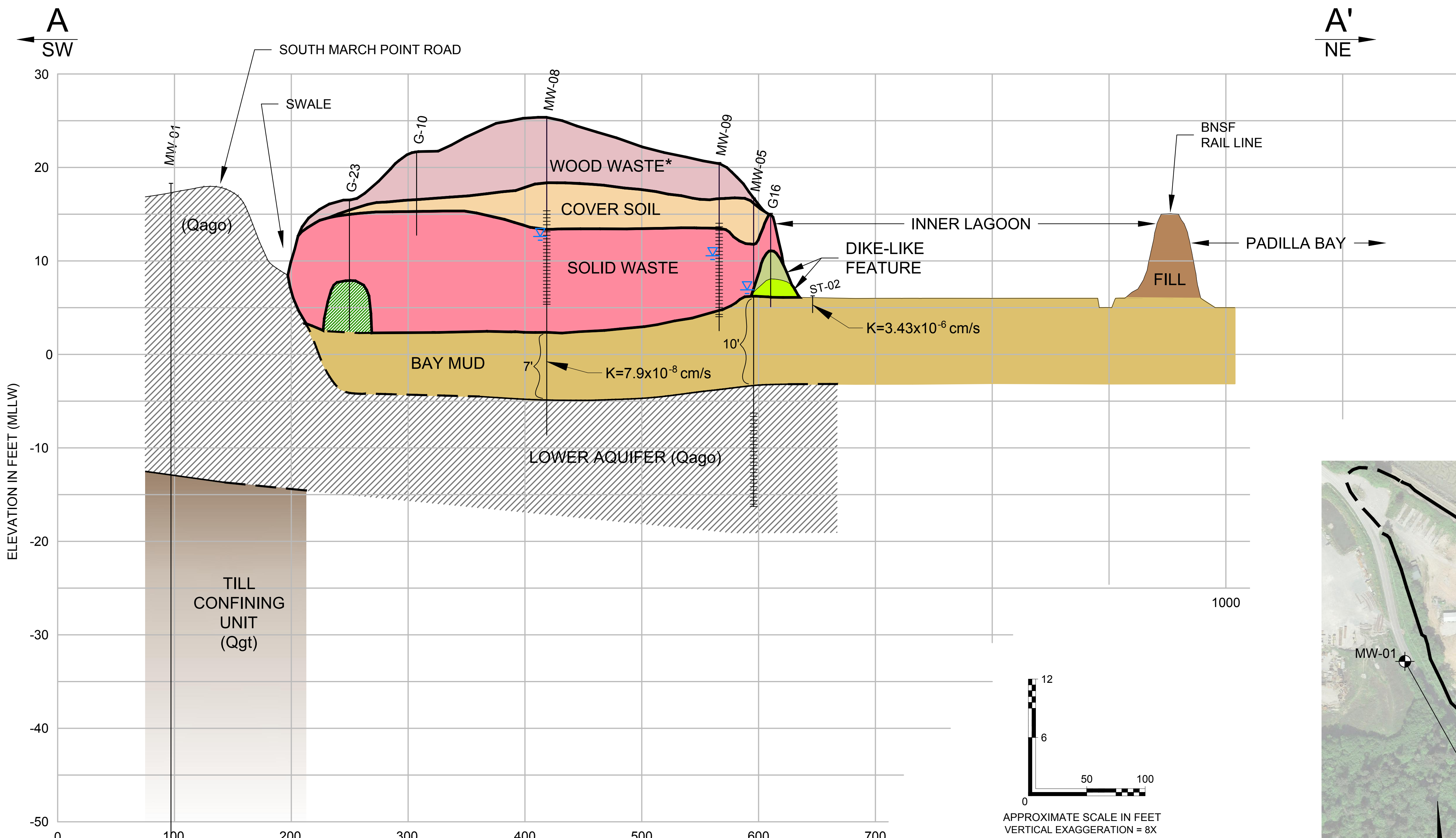
NOTES:

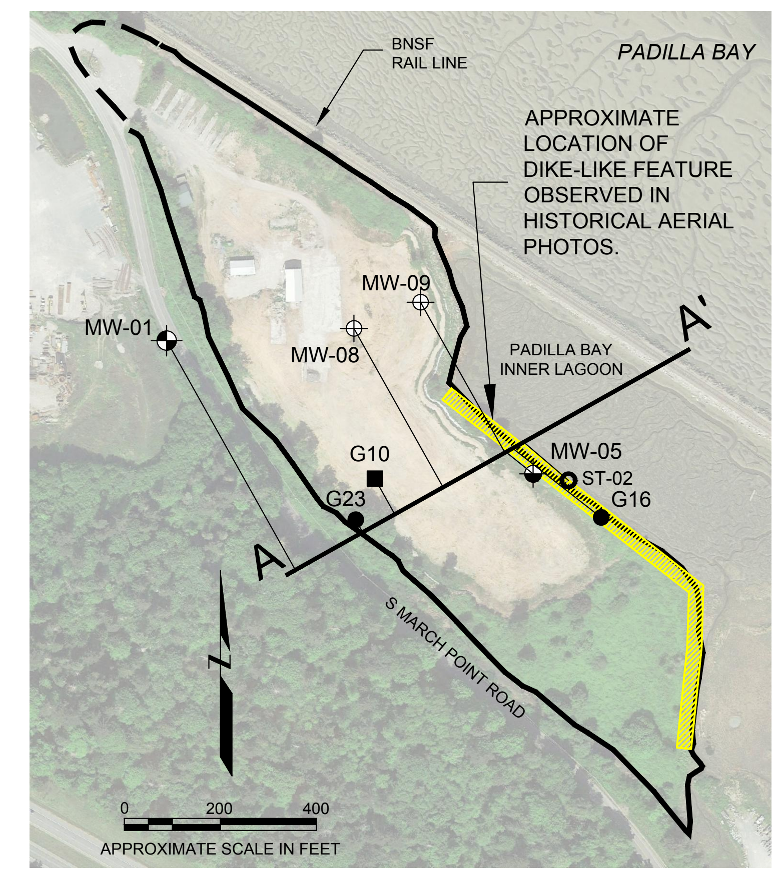
1. Vertical Datum: MLLW (ft)
2. Simplified geologic unit (Qago, Qgt) designations based on Schuster (2000).
3. Hydraulic conductivity calculated using ASTM method D-5084.

CONCEPTUAL SITE MODEL ILLUSTRATION
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 10





KEY:

- WELL SCREEN INTERVAL
- WATER LEVEL (MAY 2010)
- K= HYDRAULIC CONDUCTIVITY CALCULATED USING ASTM METHOD D-5084.
- 7' THICKNESS OF BAY MUD IN FEET
- INFERRED BOUNDARY
- WOOD WASTE*
- COVER SOIL
- SOLID WATER
- LEAN CLAY TO ELASTIC SILT (CL-ML) (BAY MUD)
- POORLY GRADED SAND TO WELL-GRADED SAND WITH GRAVEL (SP-SW) (Qago, RECESSIONAL OUTWASH AQUIFER)
- POORLY GRADED GRAVEL WITH SAND (GP) [POTENTIALLY OLD ROAD BED CONSISTING OF COBBLE ROAD BASE MATERIAL OBSERVED IN 1968 AERIAL PHOTOGRAPH AND GEOPHYSICAL ANOMALY]
- POORLY GRADED SAND (SP) (POTENTIAL DIKE-LIKE FEATURE)
- SILT WITH SAND (ML) (POTENTIAL DIKE-LIKE FEATURE)
- LEAN CLAY (CL) (Qgt, TILL CONFINING UNIT)

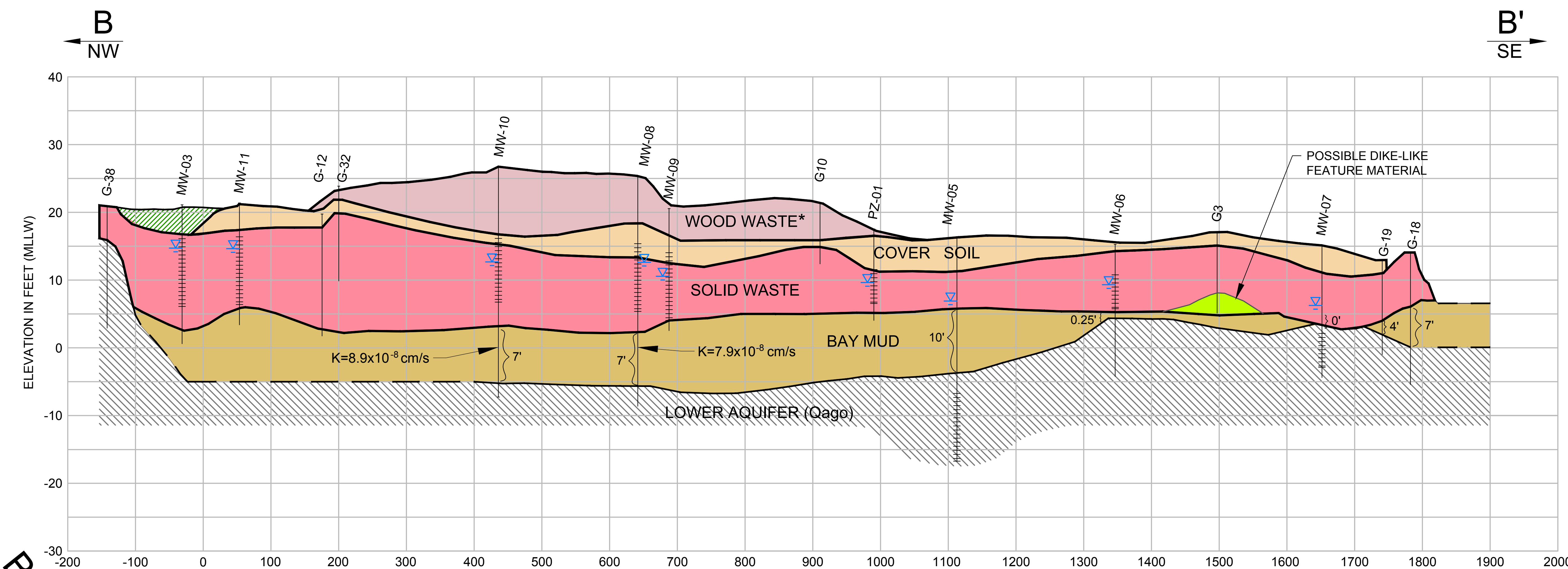
NOTES:
1. Vertical Datum: MLLW (ft)
2. No well installed in MW-01 because no aquifer encountered deeper than the lower aquifer.
3. Simplified geologic unit (Qago, Qgt) designations based on Schuster (2000).

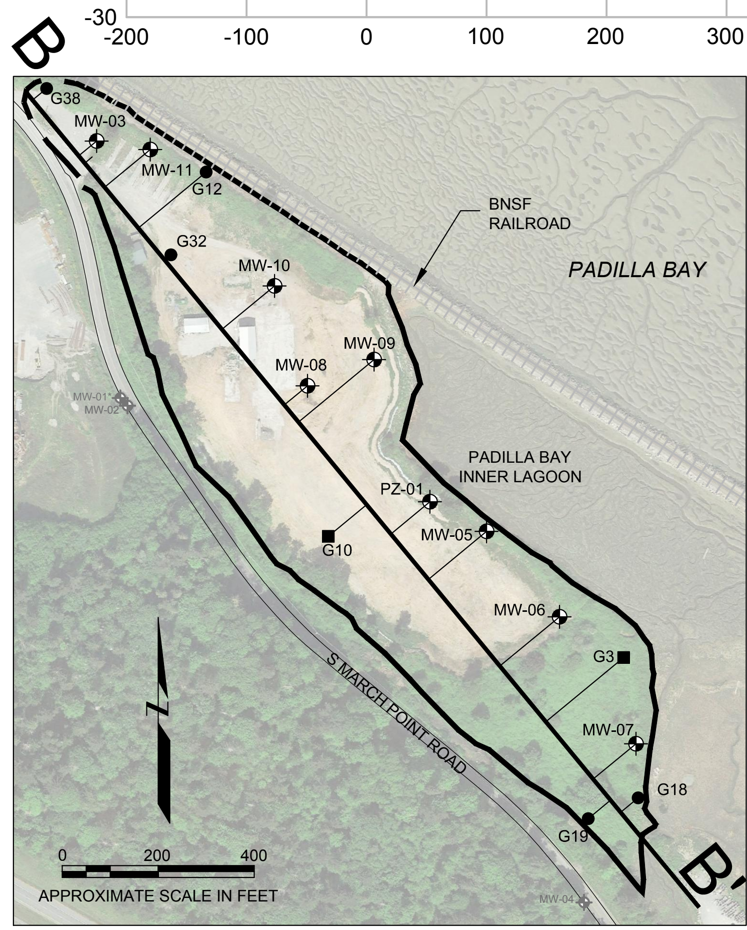
* Majority of the Wood Waste was removed in fall 2014 by DNR.

GEOLOGIC CROSS SECTION A-A'
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

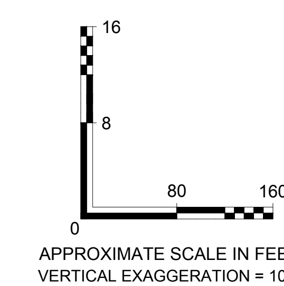
Figure 11





KEY:

┼	WELL SCREEN INTERVAL	— — —	INFERRED BOUNDARY		LEAN CLAY TO ELASTIC SILT (CL-ML) (BAY MUD)
▽	WATER LEVEL (MAY 2010)		WOOD WASTE*		COBBLE/ROAD BASE MATERIAL
K=	HYDRAULIC CONDUCTIVITY CALCULATED USING ASTM METHOD D-5084.		COVER SOIL		POORLY GRADED SAND TO WELL GRADED SAND WITH GRAVEL (SP-SW) (Qago, RECESSIONAL OUTWASH AQUIFER)
7' {	THICKNESS OF BAY MUD IN FEET		SOLID WASTE		WELL-GRADED SAND (SW) (POSSIBLE DIKE-LIKE FEATURE)

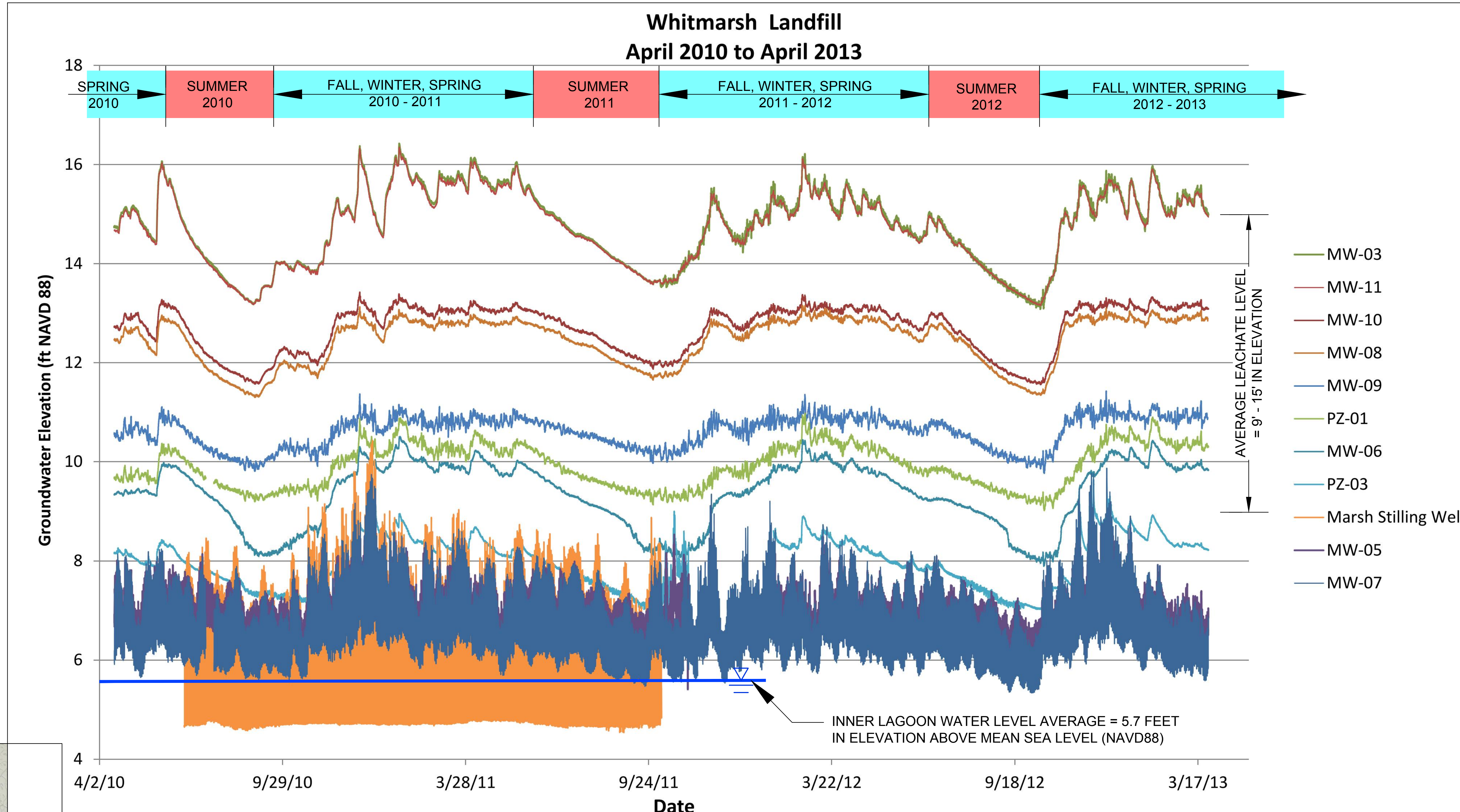


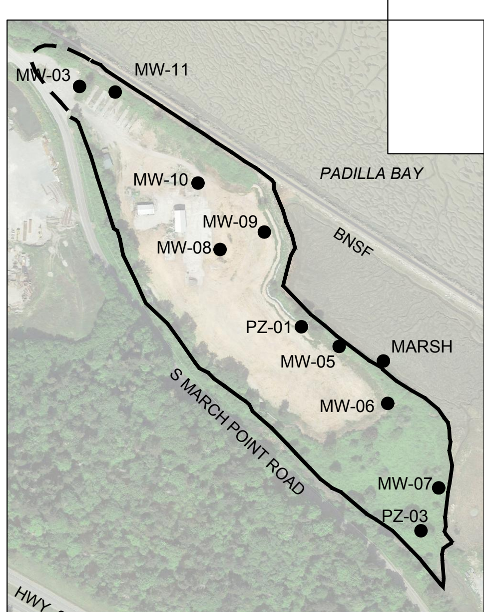
NOTES:
1. Vertical Datum: MLLW (ft)
2. Simplified geologic unit (Qago, Qgt) designations based on Schuster (2000).

GEOLOGIC CROSS SECTION B-B'
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 12





NOTES:

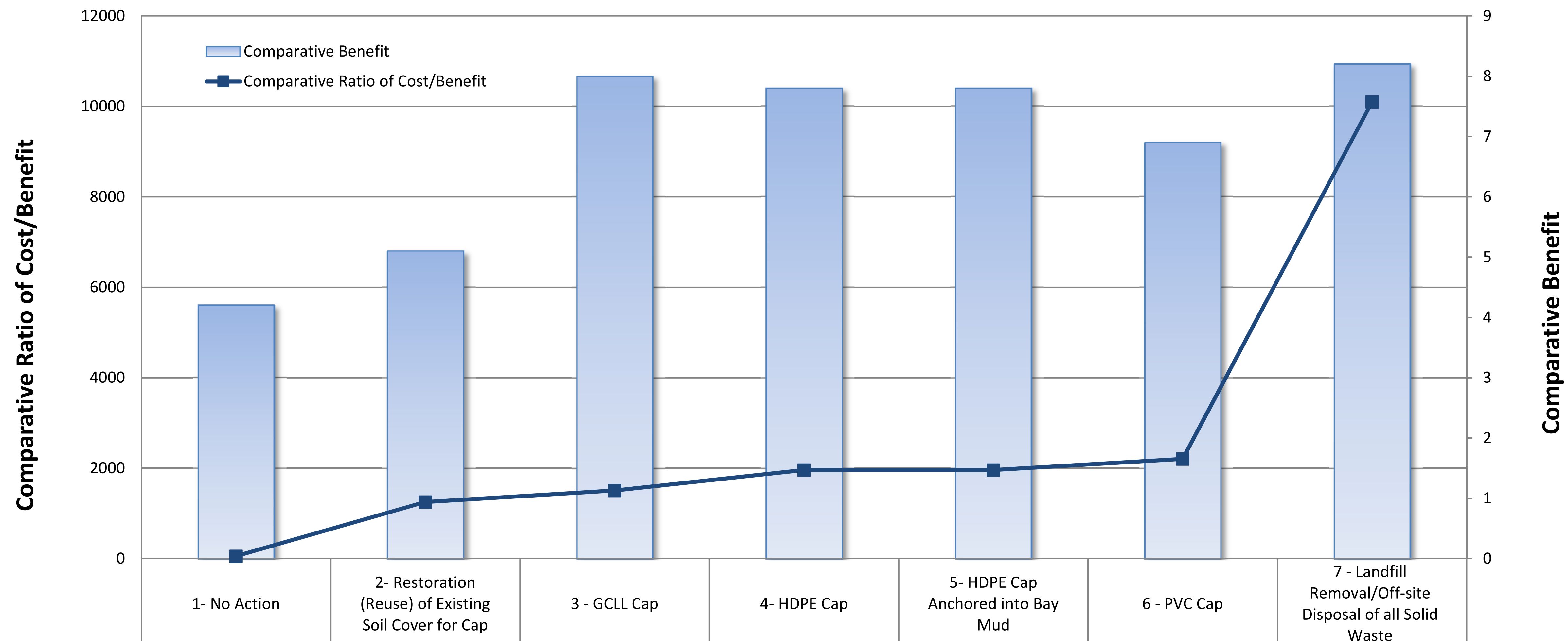
1. PIEZOMETER 2 (PZ-02) IS DRY, AND NOT SHOWN.
2. MARSH STILLING WELL TRANSDUCER MALFUNCTIONED STARTING ON OCT. 7, 2011.
3. READINGS COLLECTED EVERY 15 MINUTES.

SUMMARY HYDROGRAPH
APRIL 2010 TO MARCH 2013
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 13

Disproprionate Cost Analysis Summary: Benefit & CB Ratio (Former Whitmarsh Landfill, Anacortes)



	1- No Action	2- Restoration (Reuse) of Existing Soil Cover for Cap	3 - GCLL Cap	4- HDPE Cap	5- HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal/Off-site Disposal of all Solid Waste
Comparative Benefit	4.2	5.1	8	7.8	7.8	6.9	8.2
Comparative Ratio of Cost/Benefit	55	1254	1505	1958	1960	2206	10102

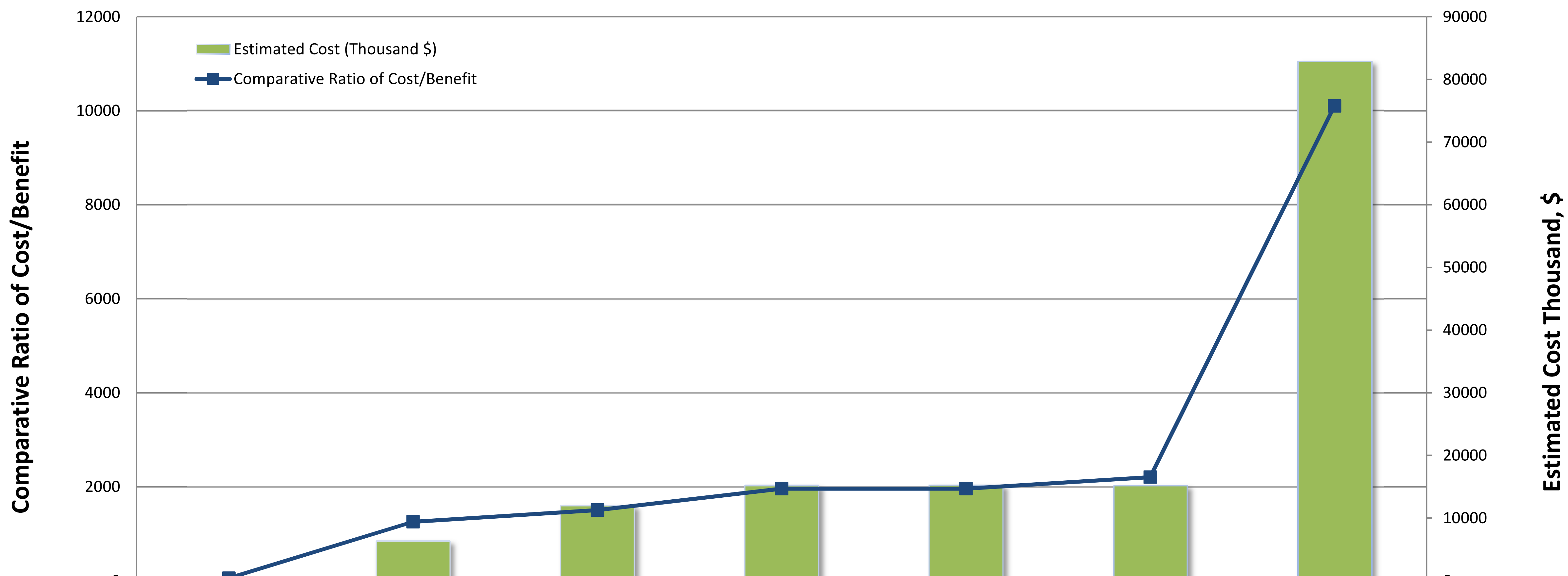
Alternatives

DISPROPORTIONATE COST ANALYSIS SUMMARY: BENEFIT & COST BENEFIT RATIO
Former Whitmarsh Landfill
Anacortes, Washington

Date: 10/01/15

Figure 14

Disproprionate Cost Analysis Summary: Cost & CB Ratio (Former Whitmarsh Landfill, Anacortes)



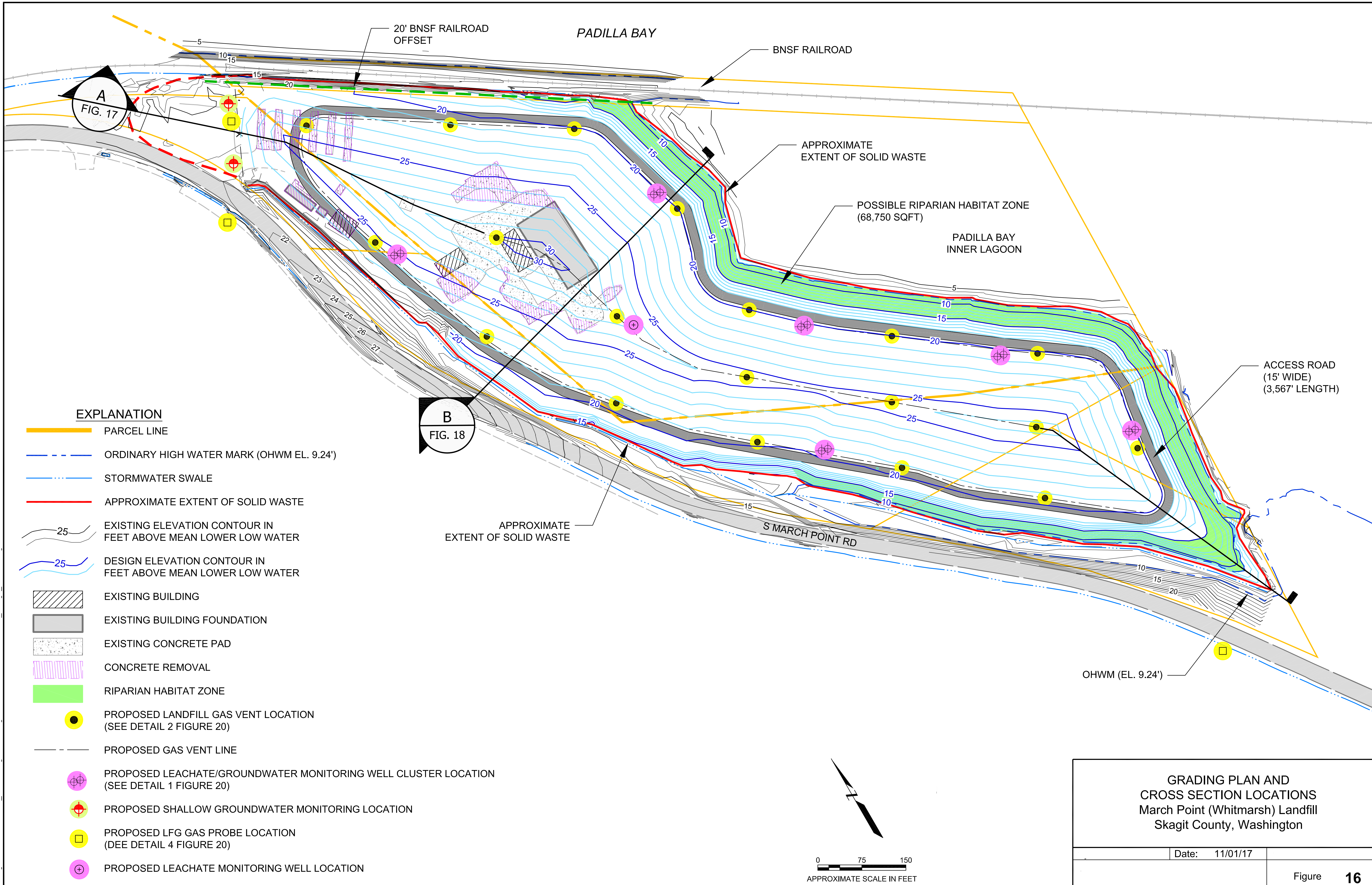
	1- No Action	2- Restoration (Reuse) of Existing Soil Cover for Cap	3 - GCLL Cap	4- HDPE Cap	5- HDPE Cap Anchored into Bay Mud	6 - PVC Cap	7 - Landfill Removal/Off-site Disposal of all Solid Waste
Estimated Cost (Thousand $)	231	6397	12040	15272	15292	15225	82837
Comparative Ratio of Cost/Benefit	55	1254.313725	1505	1957.948718	1960.512821	2206.521739	10102.07317

Alternatives

DISPROPORTIONATE COST ANALYSIS SUMMARY:
COST & COST BENEFIT RATIO
Former Whitmarsh Landfill
Anacortes, Washington

Date: 10/01/15

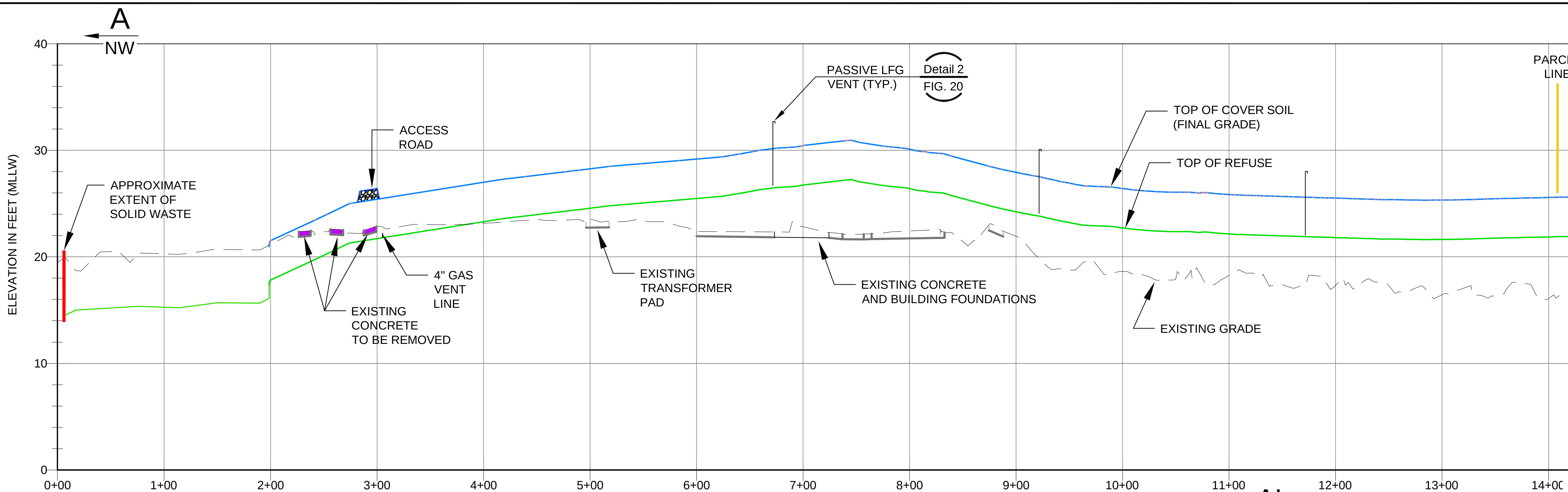
Figure 15

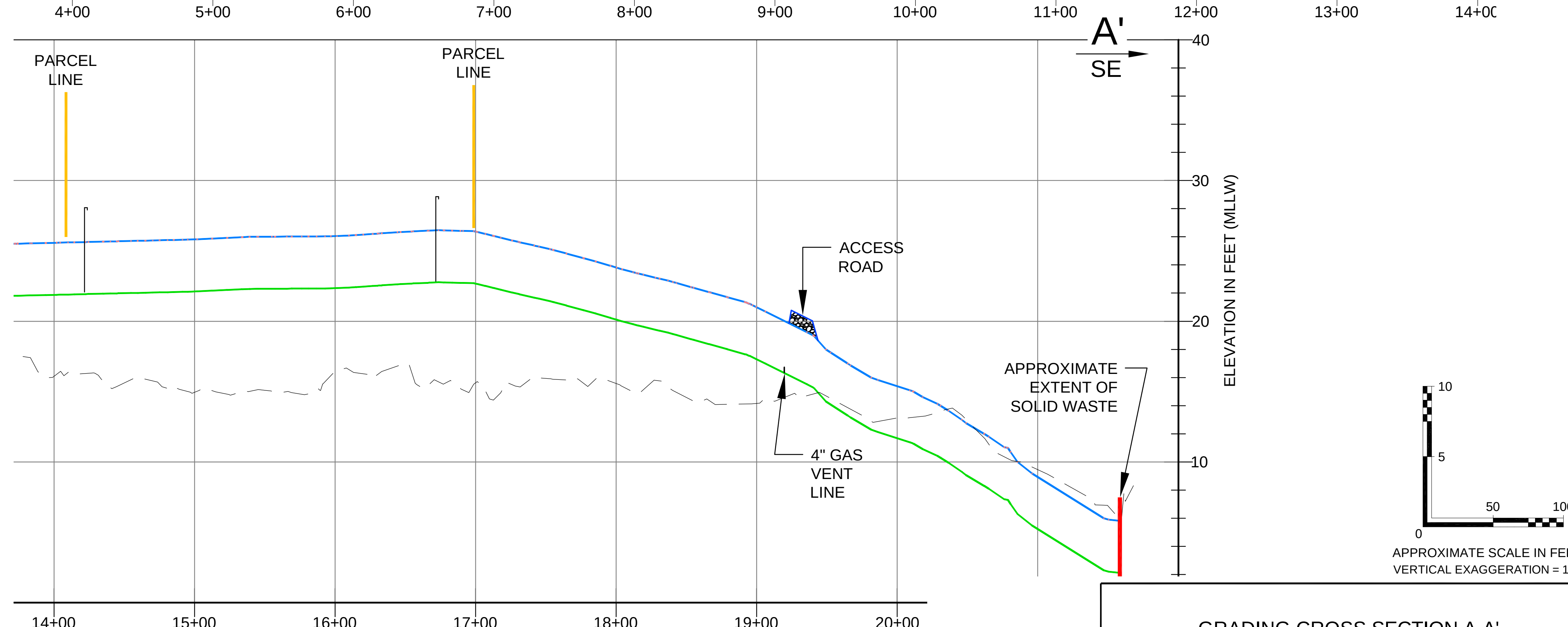


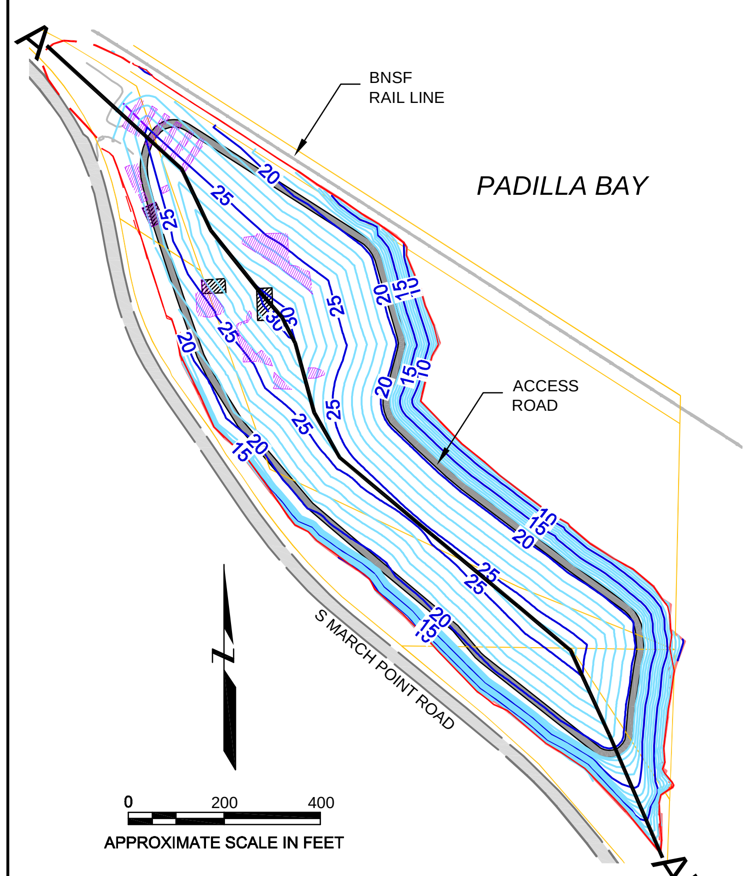
GRADING PLAN AND CROSS SECTION LOCATIONS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 11/01/17

Figure 16



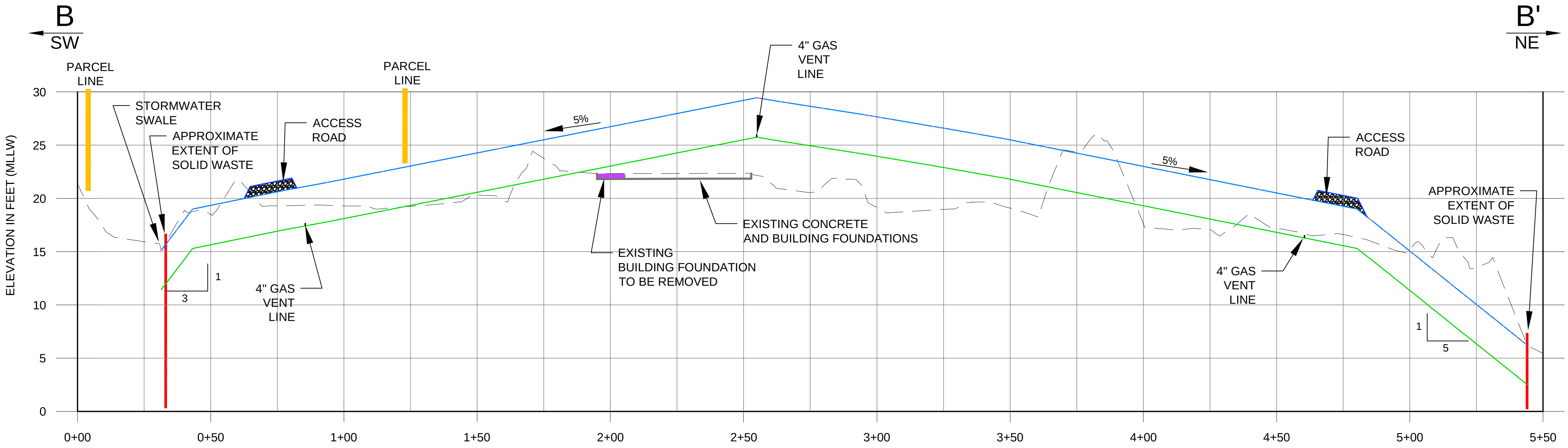


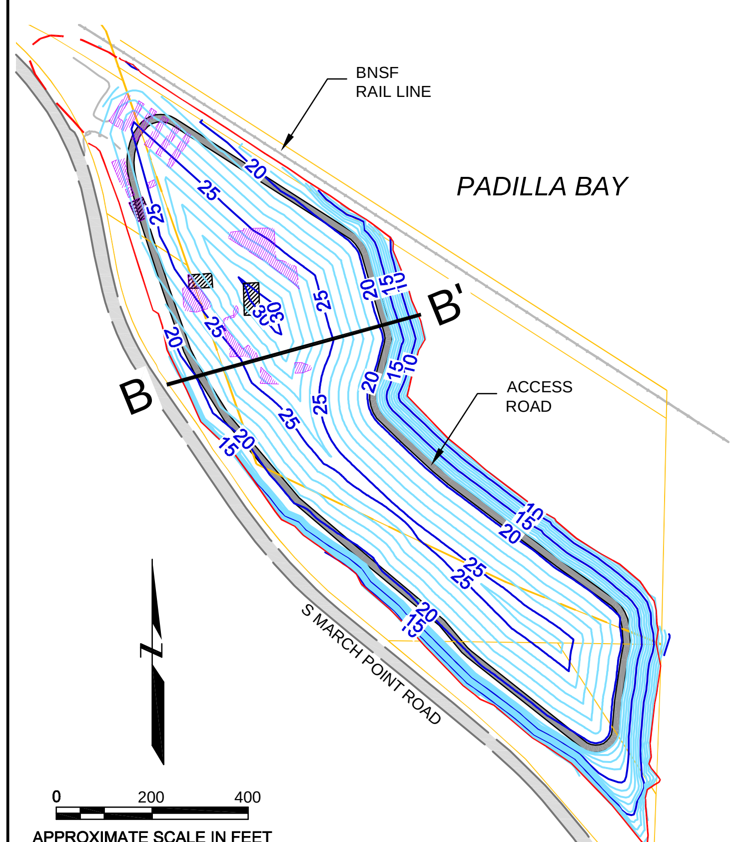


GRADING CROSS SECTION A-A'
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 17





CROSS SECTION EXPLANATION

EXISTING GRADE

TOP OF COVER SOIL

TOP OF REFUSE

CONCRETE REMOVAL

PLAN VIEW EXPLANATION

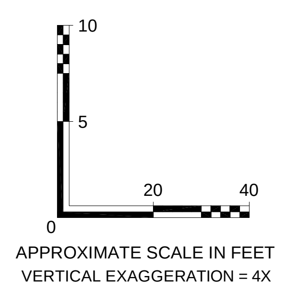
PARCEL LINE

APPROXIMATE EXTENT OF SOLID WASTE

DESIGN ELEVATION CONTOUR IN FEET ABOVE MEAN LOWER LOW WATER

EXISTING BUILDING

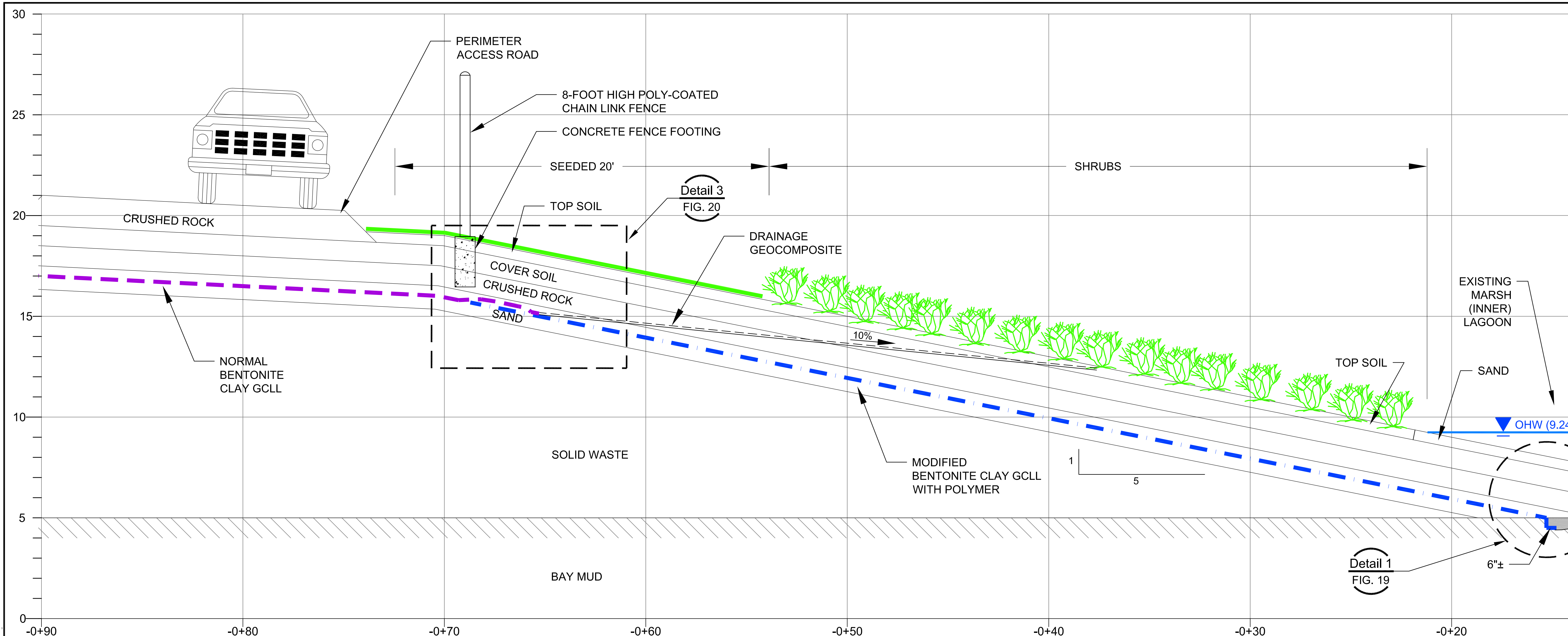
CONCRETE REMOVAL

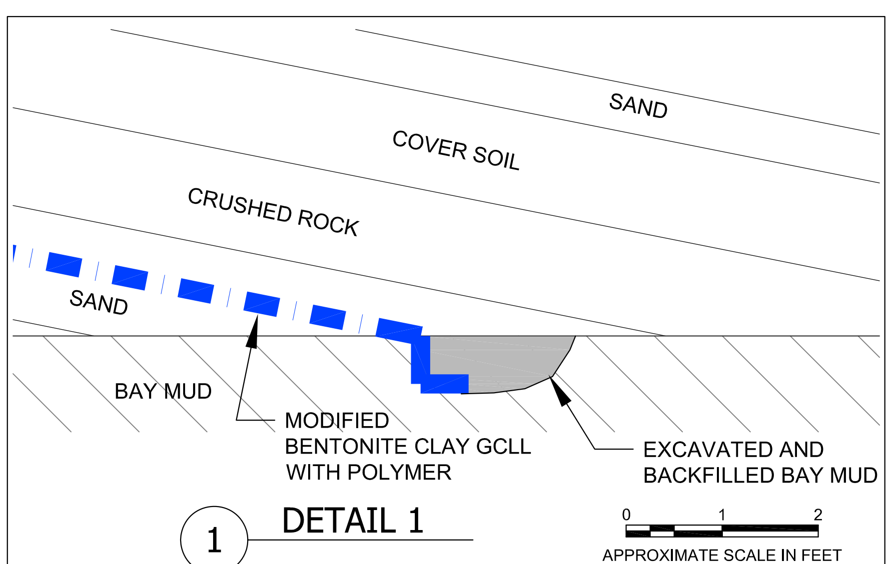


GRADING CROSS SECTION B-B'
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 04/10/17

Figure 18

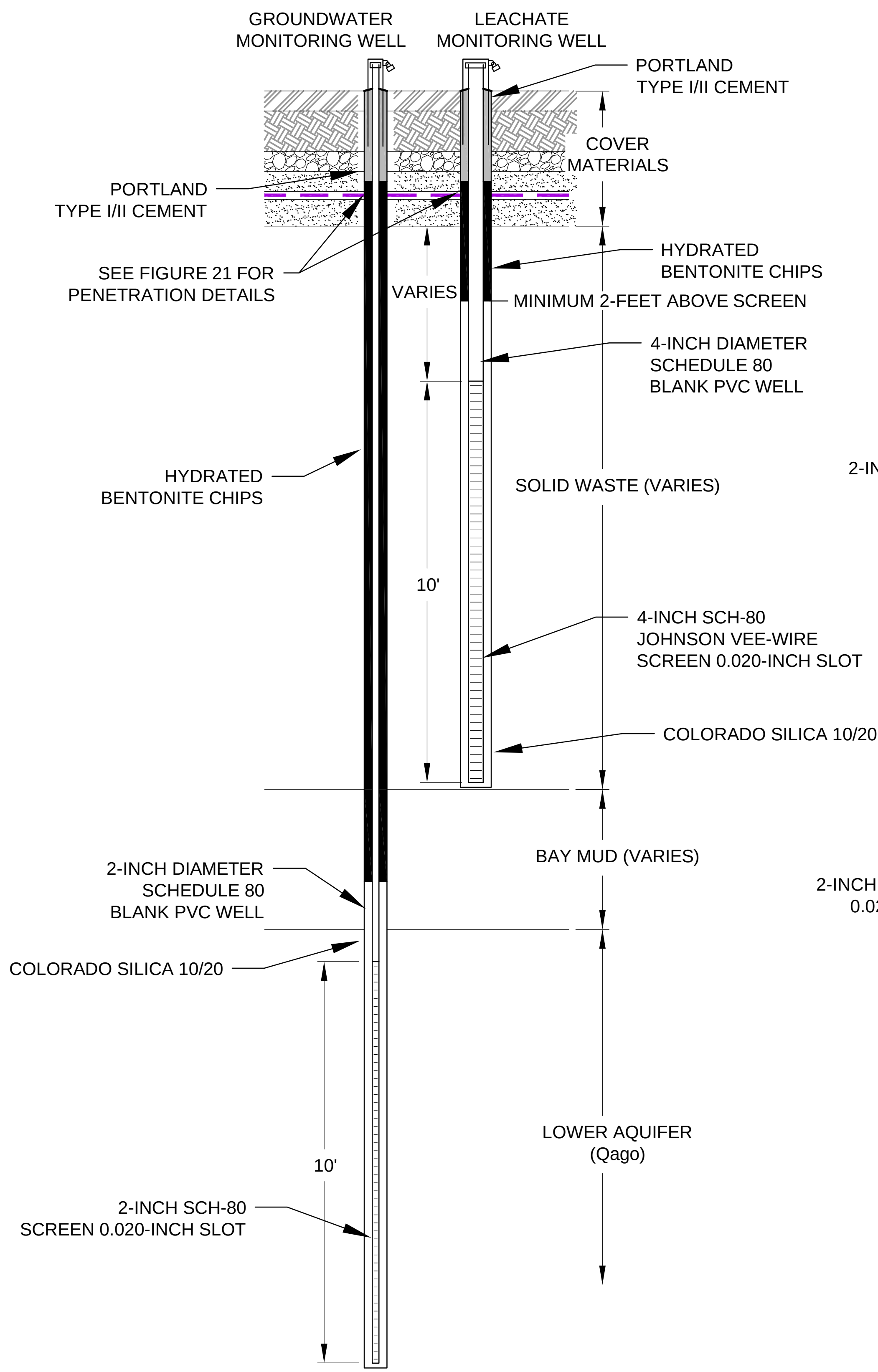




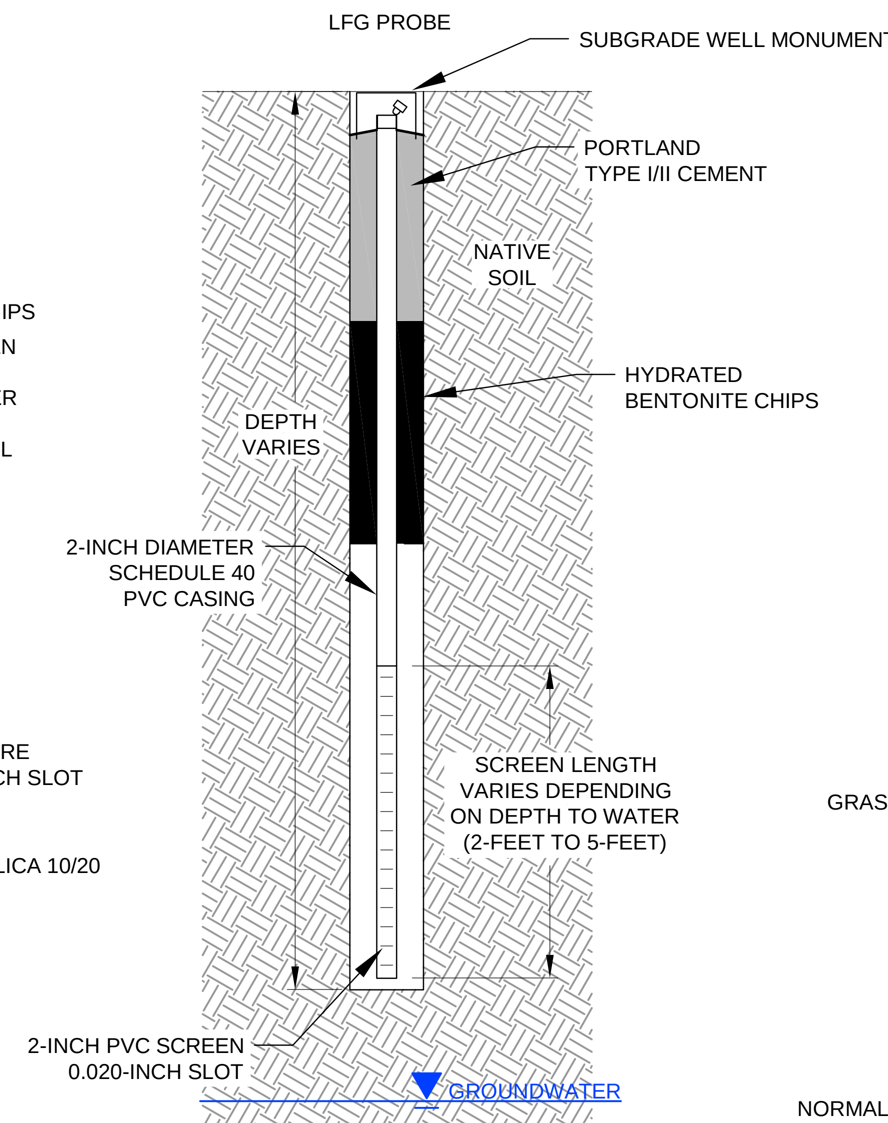
RIPARIAN HABITAT ZONE
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 10/19/17

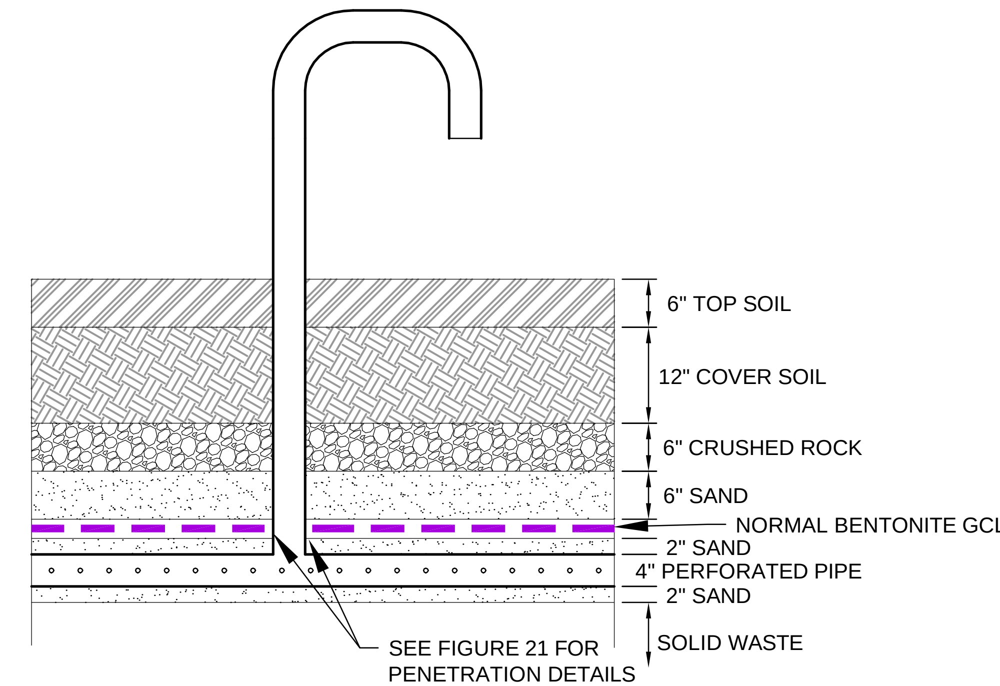
Figure 19



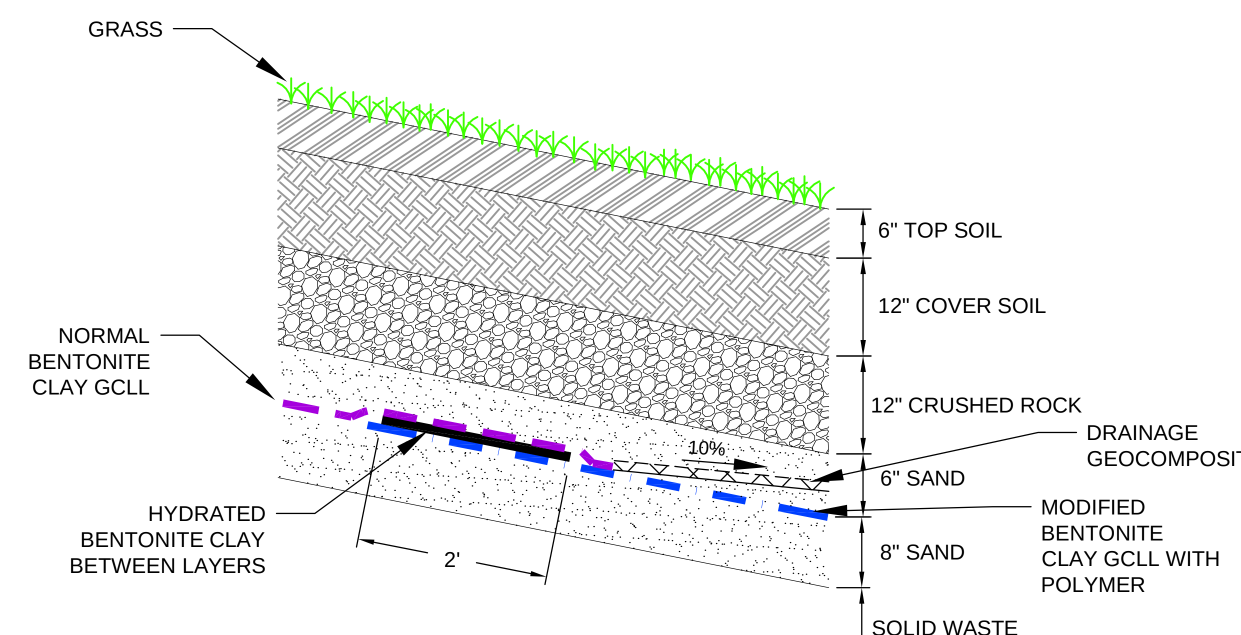
1 LEACHATE/GROUNDWATER MONITORING WELL CLUSTER



4 LFG PROBE DETAIL



2 PASSIVE LANDFILL GAS VENT DETAIL

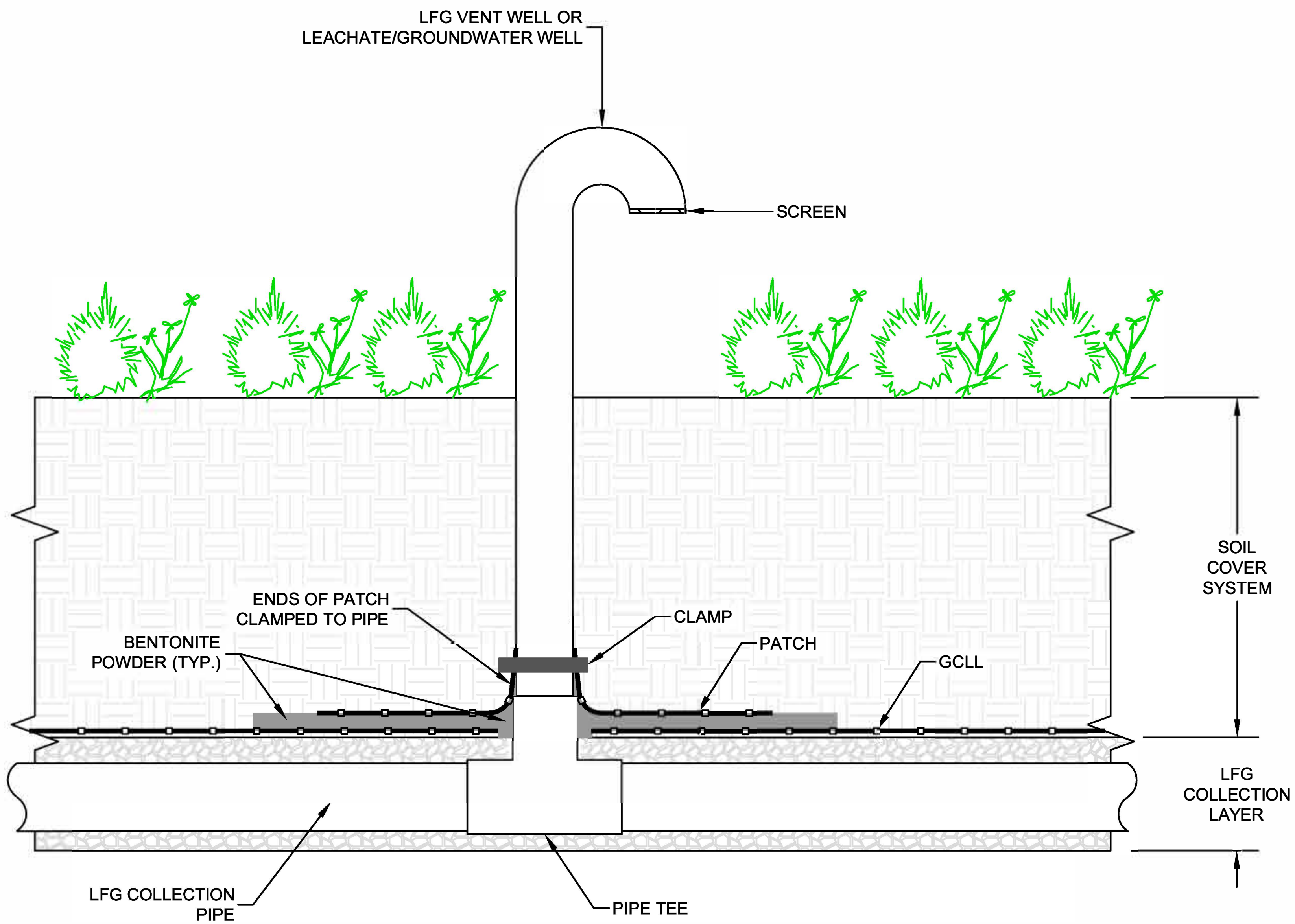


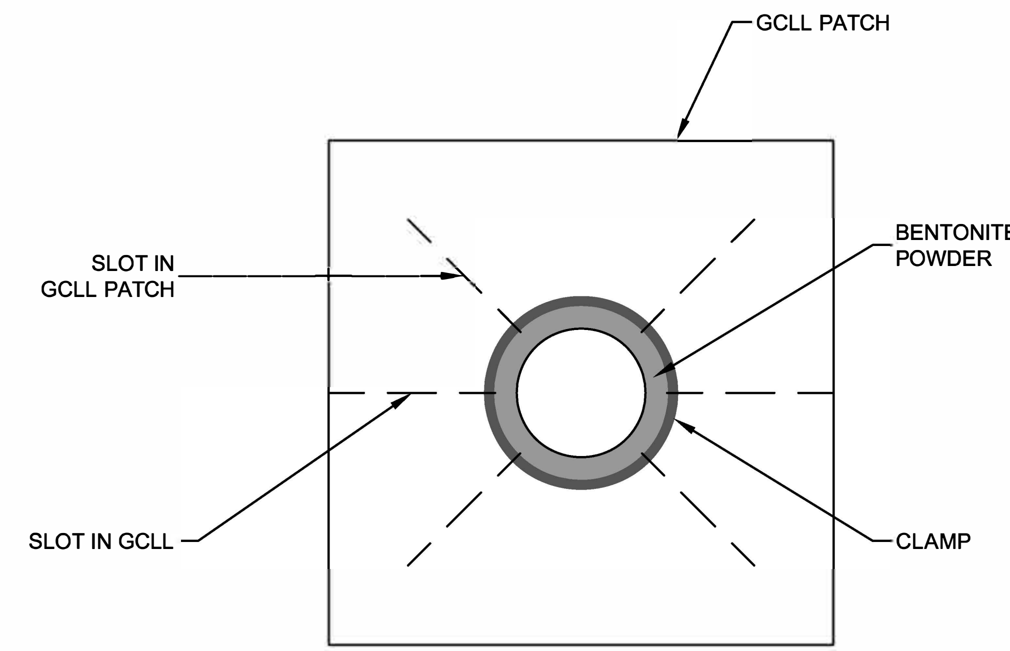
3 GCLL OVERLAP DETAIL

DETAILS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Date: 09/22/17

Figure 20





NOTE:

FORMER WHITMARSH LANDFILL	DATE AUGUST 2017	SCALE N.T.S.
GCLL PENETRATION AND SEAL		FIGURE 21

Appendices

Appendix A. (Maintenance plan)

Appendix B. (Cultural resources procedures for their inadvertent discovery)

Appendix A. Maintenance plan

March Point Landfill Site
Skagit County, WA

Table of Contents

2.0 Introduction

The March Point (aka Whitmarsh) Landfill Site (the Site) is one of the sites on Padilla Bay and the nearby Fidalgo Bay that is being investigated and cleaned up as part of the Puget Sound Initiative. The Site is located on the east side of March Point at 9663 South March Point Road in Anacortes, Washington (Figure 1). The Site is listed on the Washington State Department of Ecology (Ecology) Hazardous Sites List as Facility Site ID 2662.

A Remedial Investigation/Feasibility Study (RI/FS) was prepared by Amec Foster Wheeler (AMEC 2016) on behalf of the participating March Point (aka Whitmarsh) Landfill Potentially Liable Parties (PLP Group) that at this time consists of the Shell Oil Company, Skagit County, Texaco, Inc., and the Washington Department of Natural Resources.

The preferred alternative selected during the RI/FS and accepted by Ecology was Alternative 3, which consists of the following:

- Moving solid waste (35,000 cy) from the edges of the landfill inward, and grading the waste to a mound to make proper/required grading per the minimum functional standards of Washington Administrative Code 173-304.
- Installing a passive landfill gas (LFG) collection system, and placing an engineered cap over the landfill with standard geosynthetic clay laminated liner (GCLL).
- Installing a modified bentonite clay GCLL with polymer extending to the Bay Mud, and constructing a perimeter access road around the landfill. The engineered cap would minimize or eliminate infiltration of groundwater into the landfill, and the GCLL would minimize discharge of groundwater from the landfill to surface waters.
- Treatment of wastewater (1.3 million gallons) generated during construction work.
- Installation of an LFG collection system, which would vent LFG to the atmosphere, as well as groundwater collection/treatment as needed to prevent off-site migration.
- Installation of stormwater control measures.
- Institutional and engineering controls.
- Long-term monitoring of groundwater (quality and levels for hydraulic control purpose), seepage, LFG, and the landfill closure facility.
- Riparian vegetation plantings along the landfill shoreline.

2.0 Maintenance requirements

This document presents the maintenance requirements needed to ensure that the newly planted riparian vegetation at the project site becomes established. The proposed methods, minimum frequency, and duration of maintenance activities (including long-term maintenance) required for the following activities (watering, mulching, weeding, tree removal, dead shrub removal, and debris removal) are covered in this document.

The initial 3-year maintenance requirements have been developed to ensure that newly planted vegetation becomes established and is not out-competed by invasive species or destroyed by herbivores. This maintenance plan and its implementation is a key factor for establishment of the vegetation. The long-term maintenance component of the plan describes the maintenance activities that will be conducted after the initial 3-year maintenance period.

The maintenance plan is comprised of two sections:

- Initial routine maintenance during the 3-year maintenance period; and
- Long-term maintenance that will be conducted for the life of the project after the initial 3-year maintenance period. This includes maintaining vegetation and other habitat attributes, control of invasive vegetation, and undertaking actions to address perturbations with a foreseeable probability of occurrence (e.g., rail accidents, illegal dumping, etc.) excluding "force majeure" events.

2.1 Watering

Supplemental watering will likely be necessary for vegetation in the upland areas for a minimum of 2 years post-construction or until the installed plants develop an adequate root structure. The initial planting for the habitat projects will be conducted in the fall. Plants will need to be watered following installation until rainfall amounts (1 inch weekly total) are sufficient to meet the requirements of the individual plants or until the plants enter dormancy.

Plantings will be inspected weekly until they have entered dormancy or until rainfall amounts consistently reach 1 inch weekly total. During the spring, summer, and fall growing seasons soil moisture monitoring and best professional judgment will be used to determine if supplemental watering is required. Transplanted shrubs and herbaceous ground cover may require up to 1 inch of water (or more) each week during the summer months. Individual woody plants may need 10-gallons-per-inch of stem diameter to meet water requirements. Plants will be watered deeply, slowly, and thoroughly with limited surface water runoff. Watering will occur early in the morning, at night, or in the evening to limit evaporation. Nursery soil transplanted with potted or containerized plants may have different moisture retention characteristics than the surrounding soils.

Watering the surrounding soil is needed to encourage root growth into the surrounding soil. Once supplemental watering is started for the growing season, the watering system will need to be monitored to ensure it is operating correctly and effectively. Depending on the temperature and cumulative rainfall amounts between April and October, soil moisture monitoring and best professional judgment will be needed to determine if supplemental watering is required.

2.2 Mulching

Mulching will occur during initial plant installation to help retain soil moisture by reducing evaporation and erosion, and to provide nutrients to the plants. Supplemental mulching may occur during weeding activities, as necessary. Mulch should be aged plant material comprised of coarse-ground wood byproducts or chips ranging in size from 0.50 inch to 6 inches along the longest dimension. Mulch is typically obtained from mechanical grinding or shredding of harvested trees or portions of trees. Mulch may contain ground or shredded bark fines. Fines content of the mulch should not be greater than 20%.

The mulch may contain a mix of hardwood and softwood species such as hemlock and Douglas fir species. The mulch material should be free of weeds, weed seeds, deleterious materials, resins, tannins, and other materials that are detrimental to plant survival or vigor. Mulch containing bark material or chips from cedar trees is unacceptable.

2.3 Weeding

Weeding around upland riparian shrubs will be important during the summer of the first year to ensure establishment and prevent stress to the plants from competition for resources. The frequency will be determined using best professional judgment; however, weeding will be scheduled to occur at least twice during the spring (ideally May and June), and then once more during the summer months (either August or September). A list of common weed species is provided in the Skagit County Noxious Weed List (Skagit County 2016). If any of the Class “A” Weeds found on the Skagit County Noxious Weed List (see Appendix A) is found colonizing any portion of the site, it will be immediately controlled as required by law. If the invasive plant Spartina spp. (a Class “A” Weed) is found colonizing any portion of the adjacent marsh, it will be controlled consistent with the Swinomish Spartina Control Program. If the invasive Scotch broom (Cytisus scoparius; Class “B” Weed) or the Himalayan blackberry (Rubus armeniacus; Class “C” Weed) is found colonizing any portion of the site, it will be controlled.

A majority of the weeding will be performed using simple hand tools (e.g., rakes, hoes). Chemical treatment (herbicides) will be considered only if physical removal fails. Chemical treatments will only be applied after consultation and coordination with the appropriate local jurisdictions.

2.4 Tree removal

Trees with deep root systems pose a potential threat to the integrity of the GCLL engineered cap and will not be planted or allowed to propagate. Additionally, large trees with shallow, but broad root systems (greater than 6 feet in diameter) also pose a threat to the engineered cap if they blow over. Volunteer tree species that recruit to the site will be thinned as needed to prevent establishment.

2.5 Dead shrub removal

Dead shrubs will only be removed after an accurate assessment of the shrub planting success has been made. Replacement planting may be conducted after submittal of a maintenance report documenting shrub mortality of 30% or greater. If wide-scale replanting is proposed, species recommendations to maintain the desired diversity in the plant communities will be provided to the PLPs and Ecology. Replanting will be conducted in consultation with Ecology.

2.6 Debris removal

Anthropogenic material that potentially impairs habitat functions will be removed from the perimeter of the site on an as-needed basis. Small material will be removed by hand when practical.

2.7 Long-term maintenance

Long-term maintenance will be conducted after the initial 3-year period to ensure that habitat functions of the project are maintained. This includes maintaining vegetation and other habitat attributes, control of invasive vegetation, control and removal of trees, and undertaking actions to address perturbations with a foreseeable probability of occurrence (e.g., rail accidents, illegal dumping, etc.) excluding “force majeure” events. These activities will be conducted on an as-needed basis by facility maintenance or landscaping crews. Facility maintenance or landscaping crews will be instructed in recognizing and dealing with invasive species. Surveys for invasive species should occur in the spring and in late summer. Visual surveys and cleanup of anthropogenic debris should occur a minimum of once per year. Large woody debris that recruits to the sites should be evaluated for stability and scour potential. Unstable logs should be anchored (if needed) to prevent damage to marsh vegetation.

This maintenance plan will not cover “force majeure” events. “Force majeure” in the context of this discussion includes all physical events (e.g., flood flows or seismic events) that exceed the design criteria (developed using accepted professional engineering standards) for the project.

3.0 Maintenance reports

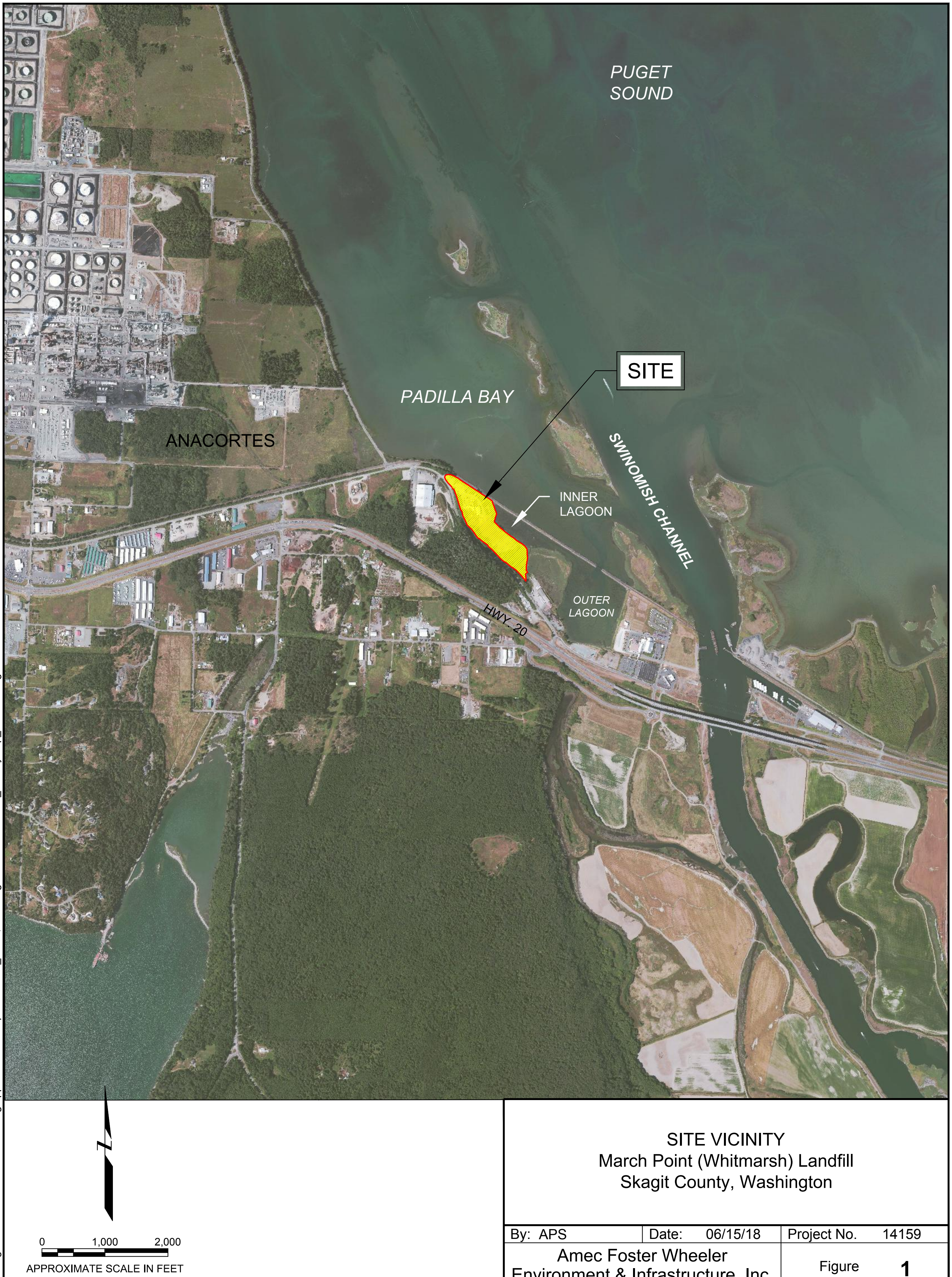
An ecologist will prepare a yearly monitoring reports for submittal to the PLPs and Ecology, which will include a description of maintenance activities that were conducted. After the initial 3-year maintenance period the ongoing long-term maintenance activities and invasive species surveys will be conducted coincident with the landfill maintenance activities (i.e., mowing). If the estimated survival of the planted shrubs drops to 70% of the initial planted density, then a list of recommended replacement shrubs and proposed quantities will be prepared and provided to the PLPs.

4.0 References

AMEC Environment & Infrastructure, Inc. (AMEC). 2016. Remedial Investigation/Feasibility Study Report, March Point (Whitmarsh) Landfill, Skagit County, Washington. Prepared for Whitmarsh Landfill PLP Group, Mount Vernon, Washington, by AMEC, Seattle, Washington.

Skagit County Noxious Weed Control Board (Skagit County). 2016. Skagit County Noxious Weed List. Skagit County Noxious Weed Control Board, Mount Vernon, Washington, http:// www.skagitcounty.net/Departments/NoxiousWeeds/weedlist.htm (accessed August 24, 2016).

Maintenance Plan Figures



SITE VICINITY
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 06/15/18	Project No. 14159
Amec Foster Wheeler Environment & Infrastructure, Inc.		Figure 1

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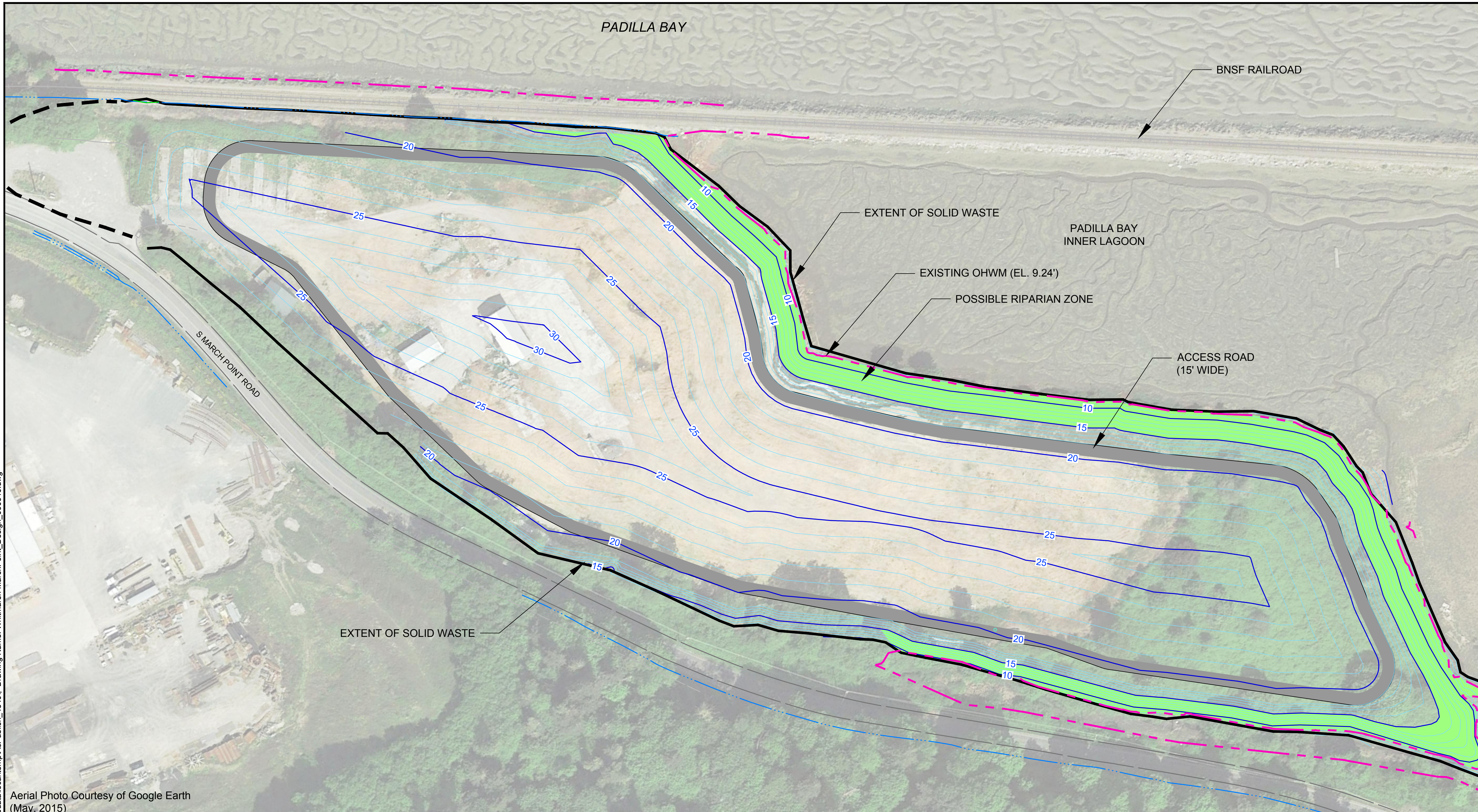

EXPLANATION

RIPARIAN ZONE

ELEVATION CONTOUR IN FEET ABOVE MEAN LOWER LOW WATER

0 60 120

APPROXIMATE SCALE IN FEET

VEGETATION PLAN VIEW
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 01/09/18	Project No. 14159
Amec Foster Wheeler Environment & Infrastructure, Inc.		Figure 2

Plot Date: 01/09/18 - 4:53pm, Plotted by: adam.stenberg
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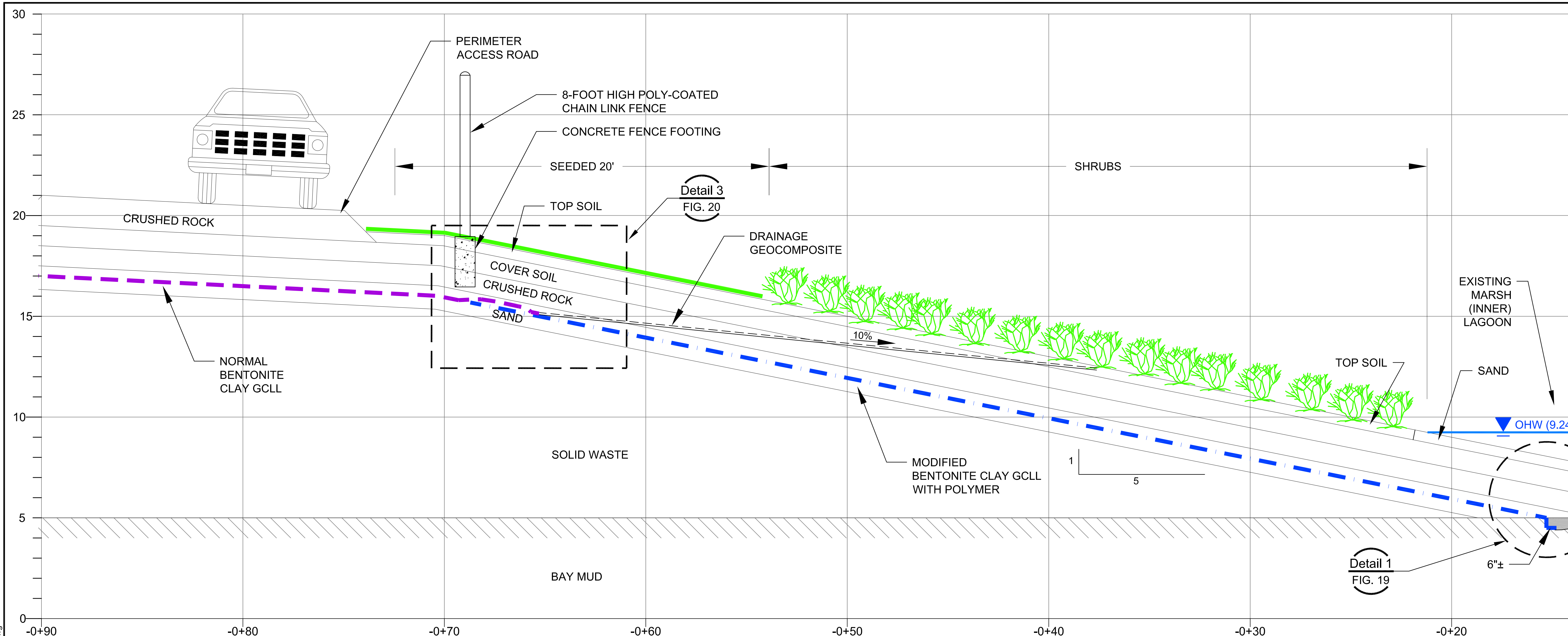

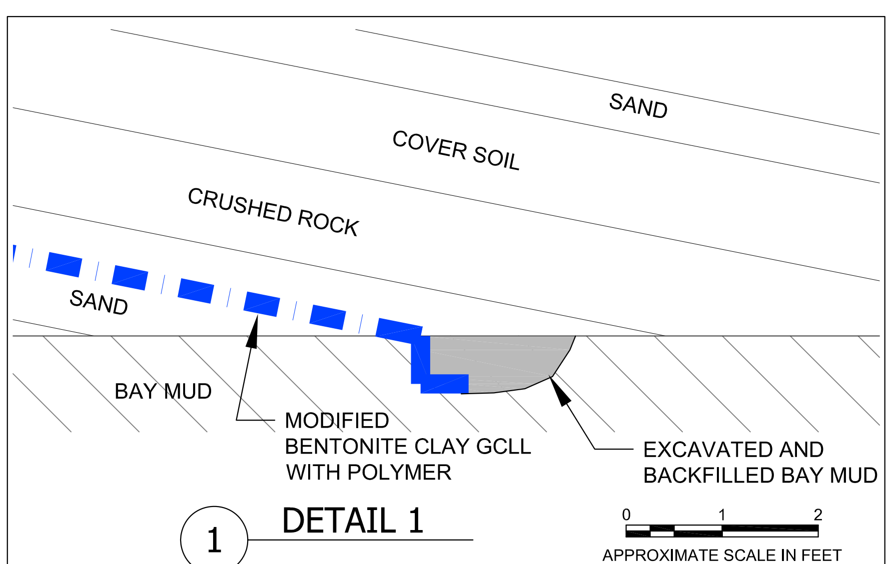

SHORELINE CROSS SECTION
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 06/15/18	Project No. 14159
Amec Foster Wheeler Environment & Infrastructure, Inc.		Figure 3

Plot Date: 06/15/18 - 3:32pm, Plotted by: adam.stenberg
Drawing Path: S:\14159\017_2016-Design\, Drawing Name: Whitmarsh-MarchPoint_Design_010918.dwg

Maintentance Plan Appendix A. Skagit county noxious weed list

Class A Weeds where control is required

common crupina	Crupina vulgaris
cordgrass, common	Spartina anglica
cordgrass, dense-flowered	Spartina densiflora
cordgrass, saltmeadow	Spartina patens
cordgrass, smooth	Spartina alterniflora
dyer's woad	Isatis tinctoria
eggleaf spurge	Euphorbia oblongata
false brome	Brachypodium sylvaticum
floating primrose-willow	Ludwigia peploides
flowering rush	Butomus umbellatus
French broom	Genista monspessulana
garlic mustard	Alliaria petiolata
giant hogweed	Heracleum mantegazzianum
goatsrue	Galega officinalis
hydrilla	Hydrilla verticillata
Johnsongrass	Sorghum halepense
knapweed, bighead	Centaurea macrocephala
knapweed, Vochin	Centaurea nigrescens
kudzu	Pueraria montana var. lobata
meadow clary	Salvia pratensis
oriental clematis	Clematis orientalis
purple starthistle	Centaurea calcitrapa
reed sweetgrass	Glyceria maxima
ricefield bulrush	Schoenoplectus mucronatus
sage, clary	Salvia sclarea
sage, Mediterranean	Salvia aethiopis
silverleaf nightshade	Solanum elaeagnifolium
small-flowered jewelweed	Impatiens parviflora
Spanish broom	Spartium junceum
Syrian beancaper	Zygophyllum fabago
Texas blueweed	Helianthus ciliaris
thistle, Italian	Carduus pycnocephalus
thistle, milk	Silybum marianum
thistle, slenderflower	Carduus tenuiflorus
variable-leaf milfoil	Myriophyllum heterophyllum
wild four-o'clock	Mirabilis nyctaginea

Class B Weeds where control is not required

butterfly bush	Buddleja davidii
common fennel (except bulbing fennel)	Foeniculum vulgare (except F. vulgare var. azoricum)
Eurasian watermilfoil	Myriophyllum spicatum
Hawkweeds (All nonnative species and hybrids of the wall subgenus)	Hieracium, subgenus Hieracium
herb-Robert	Geranium robertianum
knotweed, Bohemian	Polygonum x bohemicum
lesser celandine	Ficaria verna
loosestrife, purple	Lythrum salicaria
loosestrife, wand	Lythrum virgatum
Ravenna grass	Saccharum ravennae
Spurge flax	Thymelaea passerina

Class B-Designated Weeds where control is required

blueweed	Echium vulgare
Brazilian elodea	Egeria densa
bugloss, annual	Anchusa arvensis
bugloss, common	Anchusa officinalis
camelthorn	Alhagi maurorum
common reed (nonnative genotypes only)	Phragmites australis
Dalmatian toadflax	Linaria dalmatica ssp. dalmatica
European coltsfoot	Tussilago farfara
fanwort	Cabomba caroliniana
gorse	Ulex europaeus
grass-leaved arrowhead	Sagittaria graminea
hairy willowherb	Epilobium hirsutum
hawkweed oxtongue	Picris hieracioides
hawkweed, orange	Hieracium aurantiacum
hawkweeds (All nonnative species and hybrids of the meadow subgenus)	Hieracium, subgenus Pilosella
hoary alyssum	Berteroa incana
houndstongue	Cynoglossum officinale
indigobush	Amorpha fruticosa
knapweed, black	Centaurea nigra
knapweed, brown	Centaurea jacea
knapweed, diffuse	Centaurea diffusa
knapweed, meadow	Centaurea x moncktonii
knapweed, Russian	Acroptilon repens
knapweed, spotted	Centaurea stoebe

knotweed, giant	Polygonum sachalinense
knotweed, Himalayan	Polygonum polystachyum
kochia	Kochia scoparia
loosestrife, garden	Lysimachia vulgaris
Malta starthistle	Centaurea melitensis
parrotfeather	Myriophyllum aquaticum
policeman's helmet	Impatiens glandulifera
puncturevine	Tribulus terrestris
rush skeletonweed	Chondrilla juncea
saltcedar	Tamarix ramosissima
shiny geranium	Geranium lucidum
spurge laurel	Daphne laureola
spurge, leafy	Euphorbia esula
spurge, myrtle	Euphorbia myrsinites
sulfur cinquefoil	Potentilla recta
thistle, musk	Carduus nutans
thistle, plumeless	Carduus acanthoides
thistle, Scotch	Onopordum acanthium
velvetleaf	Abutilon theophrasti
water primrose	Ludwigia hexapetala
white bryony	Bryonia alba
wild chervil	Anthriscus sylvestris
yellow archangel	Lamiastrum galeobdolon
yellow floatingheart	Nymphoides peltata
yellow starthistle	Centaurea solstitialis

Class B Weeds selected for control by The Skagit County Noxious Weed Control Board

knotweed, Japanese	Polygonum cuspidatum
poison hemlock	Conium maculatum
Scotch broom	Cytisus scoparius
tansy ragwort	Senecio jacobaea
yellow nutsedge	Cyperus esculentus

Class C Weeds selected for control by The Skagit County Noxious Weed Control Board

common tansy	Tanacetum vulgare
common teasel	Dipsacus fullonum
field bindweed	Convolvulus arvensis
thistle, bull	Cirsium vulgare
thistle, Canada	Cirsium arvense
wild carrot (except where commercially grown)	Daucus carota

Class C Weeds where control is not required

absinth wormwood	Artemisia absinthium
Austrian fieldcress	Rorippa austriaca
babysbreath	Gypsophila paniculata
black henbane	Hyoscyamus niger
blackgrass	Alopecurus myosuroides
buffalobur	Solanum rostratum
cereal rye	Secale cereale
common barberry	Berberis vulgaris
common catsear	Hypochaeris radicata
common groundsel	Senecio vulgaris
common St. Johnswort	Hypericum perforatum
curlyleaf pondweed	Potamogeton crispus
English hawthorn	Crataegus monogyna
English ivy	Hedera helix 'Baltica’, 'Pittsburgh', and 'Star'; H. hibernica 'Hibernica' four cultivars only
Eurasian waterfilfoil hybrid	Myriophyllum spicatum x M. sibiricum
evergreen blackberry	Rubus laciniatus
fragrant waterlily	Nymphaea odorata
hairy whitetop	Lepidium appelianum
Himalayan blackberry	Rubus armeniacus
hoary cress	Lepidium draba
Italian arum	Arum italicum
Japanese eelgrass	Zostera japonica
jointed goatgrass	Aegilops cylindrica
jubata grass	Cortaderia jubata
lawnweed	Soliva sessilis
longspine sandbur	Cenchrus longispinus
nonnative cattail species and hybrids	Typha spp.
old man's beard	Clematis vitalba
oxeye daisy	Leucanthemum vulgare
pampas grass	Cortaderia selloana
perennial sowthistle	Sonchus arvensis ssp. arvensis
reed canarygrass	Phalaris arundinacea
Russian olive	Elaeagnus angustifolia
scentless mayweed	Matricaria perforata
smoothseed alfalfa dodder	Cuscuta approximata
spikeweed	Centromadia pungens.
spiny cocklebur	Xanthium spinosum
spotted jewelweed	Impatiens capensis
Swainsonpea	Sphaerophysa salsula

tree-of-heaven	Ailanthus altissima
ventenata	Ventenata dubia
white cockle	Silene latifolia ssp. alba
yellowflag iris	Iris pseudacorus
yellow toadflax	Linaria vulgaris

Appendix B. Cultural resources and procedures for their inadvertent discovery

March Point Landfill Site
Skagit County, WA

February 2020

1.0 Cultural resources

There are several sites in or near Fidalgo and Padilla Bays, including the March Point (aka Whitmarsh) Landfill Site (the Site), that are high-priority, early action cleanup areas under the Puget Sound Initiative. The Washington State Department of Ecology (Ecology) is working with interested Tribes as the cleanup of contaminated sites and sediments in the vicinity of Fidalgo and Padilla Bays progresses. The Tribes that have been engaged by Ecology under the Puget Sound Initiative at Fidalgo/Padilla Bays have requested to be notified in case of a discovery at the Site include the Swinomish, Samish, and Lummi Tribes. Cultural records indicate that the Samish occupied the shoreline of these areas (Lenz, 2013). However, no archaeological or culturally important sites are known to exist on or immediately adjacent to the Site.

Because the Site was a marine mudflat until a public dump covered the inwater area to create dry land surface, the potential for encountering cultural resources/archaeological materials at the site is believed to be low. No cultural resources/archaeological materials were identified during excavation to support the remedial investigation in 2008. Furthermore, in 2011 AMEC Environment & Infrastructure, Inc. (AMEC) conducted an archaeological survey along the historic western shoreline of Padilla Bay at the edge of the landfill deposit to identify and document any sites that might be affected by remediation activities. The survey resulted in the identification of no new cultural resources. The results of both the 2008 and 2011 efforts are documented in Appendix I of the Remedial Investigation/Feasibility Study Report (AMEC 2017). Appendix I is available upon request.

To update the 2011 survey, the Potentially Liable Parties (PLP) Group performed a records search by accessing the Washington State Department of Archaeology & Historic Preservation's (DAHP) online database of archaeological/historic sites and cultural resources investigations. Ecology followed up and completed an analysis using the WISAARD database. The analysis identified the area near the Site as very high risk. Due to this discovery and Ecology providing capital funding, a Cultural Resources Consultation will be completed by Ecology.

2.0 Site specific procedures for the inadvertent discovery of cultural resources

In preparation, this document includes an Inadvertent Discovery Plan along with a site-specific operating procedure for archeological discoveries as described below.

During implementation of the selected remedy, additional excavation will occur on the exterior fringes of the site at the landfill and Bay Mud interface. Because it is possible that this additional work will encounter cultural resources, field inspectors that are generally aware of the potential types of cultural artifacts that could be encountered will be utilized to oversee the excavation activities.

If potential archaeological resources are identified by the field inspector during implementation of the remedy, work will be stopped immediately and the PLP Group will be notified. The PLP

Group will retain a professional archaeologist to evaluate the potential discovery and determine its cultural significance. If it is determined that the discovery is not culturally significant, work activities will resume.

3.0 Contact list for the inadvertent discovery of cultural resources

Contact information for key personnel for the inadvertent discovery of cultural resources is summarized in the table below:

Dave Haddock (Primary Contact)	Amec Foster Wheeler	Project Manager	(o) 206.342.1700 (c) 425.246.7409
John Long (Alternate Contact)	Amec Foster Wheeler	Assistant Project Manager	(o) 206.342.1779 (c) 206.713.9499
Margo Gillaspy	PLP Group/Skagit County	Project Coordinator	(o) 360.416.1441
Arianne Fernandez	Washington State Department of Ecology	Ecology Project Coordinator	(o) 360.407.7209 (c) 360.704.0173
Donna Podger	Washington State Department of Ecology	Ecology Cultural Resource Specialist (Ecology Project Coordinator Alternate)	(o) 360.407.7016
Rob Whitlam	Washington State Department of Archaeology and Historic Preservation	State Archaeologist	(o) 360.586.3080
Dr. Allyson Brooks	Washington State Department of Archaeology and Historic Preservation	State Historical Preservation Officer	(o) 360.586.3066
James Harrison	Swinomish Indian Tribal Community Historical Preservation Office	Tribal Archeologist	(o) 206.383.7008
Josephine Peters	Swinomish Indian Tribal Community Historical Preservation Office	Cultural Resource Technician	(o) 360.488.3860
Jackie Ferry	Samish Nation	Tribal Historic Preservation Officer and Cultural Director	(o) 360-293-6404
Lena Tso	Lummi Nation Tribal Historic Preservation Office	Coordinator	(o) 360.384.2259
Guy Tasa	Department of Archaeology and Historic Preservation	State Physical Anthropologist	360.586.3534
Juliette Vogel	Department of Archaeology and Historic Preservation	Assistant State Physical Anthropologist	360.586.3075

Anacortes Police Department	Anacortes Police Department		360.293.4684
Hayley L. Thompson	Skagit County Coroner	Skagit County Coroner	360.428.7169

4.0 Inadvertent Discovery Plan

DEPARTMENT OF ECOLOGY
State of Washington

Plan and procedures for the unanticipated discovery of cultural resources and human skeletal remains[2]

PROJECT TITLE: March Point Landfill Site COUNTY WASHINGTON: Skagit

Section, Township, Range: E3, T34, R02

Introduction

The following Inadvertent Discovery Plan (IDP) outlines procedures to perform in the event of discovering archaeological materials or human remains, in accordance with state and federal laws.

Recognizing cultural resources

A cultural resource discovery could be prehistoric or historic. Examples include:

a. An accumulation of shell, burned rocks, or other food related materials.

b. Bones or small pieces of bone.

c. An area of charcoal or very dark stained soil with artifacts.

d. Stone tools or waste flakes (i.e. an arrowhead. or stone chips).

e. Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years.

f. Buried railroad tracks, decking, or other industrial materials. When in doubt, assume the material is a cultural resource.

On-site responsibilities

STEP 1: *Stop work and protect the discovery site*. If any employee, contractor or subcontractor believes that he or she has uncovered a cultural resource at any point in the project, all work must stop immediately. Notify the Project Manager. Leave the surrounding area untouched, and provide a demarcation adequate to provide the total security, protection, and integrity of the discovery (at least 50 feet). The discovery location must be secured at all times by a temporary fence or other onsite security.

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[2] If you need this document in a format for the visually impaired, call Water Quality Reception at Ecology, (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

STEP 2: *Notify the Project Manager* of this project and contact the Ecology Staff Project Manager, or other applicable contacts. The Project Manager will contact the Project Coordinator.

Site Contacts

Project Manager

Dave Haddock

(o)206-342-1700
(c)425-246-7409
dave.haddock@woodplc.com

Ecology Staff Project Manager
Arianne Fernandez

360 - 407 - 7209
Arianne.Fernandez@ecy.wa.gov

Project Coordinator
Margo Gillaspy

(o) 360 - 416 - 1441
margog@co.skagit.wa.us

Assigned alternates

Project Manager (alternate)

John Long

(o)206-342-1779
(c)206-713-9499
john.long3@woodplc.com

Ecology Cultural Resource Specialist (alternate)

Donna Podger

360-407-7016
Donna.Podger@ecy.wa.gov

The Project Manager will make all calls and necessary notifications. **If human remains are encountered**, treat them with dignity and respect at all times. Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed. **Important: Do not call 911 or speak with the media. Do not take pictures unless directed to do so by DAHP. See Section 5.**

STEP 3: Notify Licensed Archaeologist. The Project Manager will notify the on-call Licensed Archaeologist who will be contracted at time of the planned disturbance.

Further contacts and consultation

Project Manager's Responsibilities:

- *Protect Find*: The Project Manager is responsible for taking appropriate steps to protect the discovery site. All work will stop immediately in a surrounding area adequate to provide for the complete security of location, protection, and integrity of the resource. Vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site. Work in the immediate area will not resume until treatment of the discovery has been completed following provisions for treating archaeological/cultural material as set forth in this document.

- *Direct Construction Elsewhere on-Site*: The Project Manager may direct construction away from cultural resources to work in other areas prior to contacting the concerned parties (at least 50 feet).
- *Contact Senior Staff*: The Project Manager must contact the Project Coordinator.

Senior Staff (Project Coordinator or their designee from PLP Group) Responsibilities:

- *Identify Find*: The Senior Staff (Project Coordinator) in concert with the Project Manager (or a delegated Cultural Resource Specialist), will ensure that a qualified professional archaeologist examines the area to determine if there is an archaeological find.
    - If it is determined not to be of archaeological, historical, or human remains, work may proceed with no further delay.
    - If it is determined to be an archaeological find, the Senior Staff or Cultural Resource Specialist will continue with all notifications.
    - If the find may be human remains or funerary objects, the Senior Staff or Cultural Resource Specialist and Project Manager will ensure that a qualified physical anthropologist examines the find. **Important: If it is determined to be human remains, the procedure described in Section 5 will be followed.**
- *Notify DAHP*: The Senior Staff or their designee (or a delegated Cultural Resource Specialist) will contact the involved federal agencies (if any) and the Washington Department of Archaeology and Historic Preservation (DAHP).
- *Notify Tribes*: If the discovery may be of interest to Native American Tribes, the DAHP and Ecology Supervisor or Coordinator will coordinate with the interested and/or affected tribes.

General Contacts

State Agencies:

Washington State
Department of Ecology
Arianne Fernandez
Natural Resource Scientist
360-407-7209
Arianne.fernandez@ecy.wa.gov

Department of Archaeology and Historic Preservation:

Dr. Allyson Brooks
State Historic Preservation Officer
360-586-3066

Rob Whitlam, Ph.D.
Staff Archaeologist
360-586-3050

The DAHP or appropriate Ecology Staff will contact the interested and affected Tribes for a specific project.

Tribes consulted on this project are:

Swinomish tribe
Josephine Peters
Tribal Historical Preservation Officer
(o) 360-488-3860
jpeters@swinomish.nsn.us

Swinomish tribe
James Harrison
Tribal Archeologist
360-488-3860
jharrison@swinomish.nsn.us

Samish nation
Jackie Ferry
Tribal Historic Preservation Officer
and Cultural Director
360-293-6404 ext. 215
jferry@samishtribe.nsn.us

Lummi tribe
Lena Tso
Coordinator
(o) 360-312-2260
(c) 360-510-1503
lenat@lummi-nsn.gov

Further Activities

Archaeological discoveries will be documented as described in Section 6.

- Construction in the discovery area may resume as described in Section 7.

Special procedures for the discovery of human skeletal material

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Do not take photographs by any means, unless you are pre-approved to do so.

If the project occurs on federal lands or receives federal funding (e.g., national forest or park, military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 apply, and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Manager will comply with applicable state and federal laws, and the following procedure:

In all cases you must notify a law enforcement agency or Medical Examiner/Coroner's Office:

In addition to the actions described in Sections 3 and 4, the Project Manager will immediately notify the local law enforcement agency or medical examiner/coroner's office.

The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human, whether the discovery site constitutes a crime scene, and will then notify DAHP.

Contacts

Anacortes Police Department

360-293-4684

Skagit County Coroner

Hayley L. Thompson

360-416-1996 (M-F 9-5)

After Hours Number: 360-428-7169

Coroner@co.skagit.wa.us

*If there is a question whether a discovery is human remains, contact DAHP for assistance.

Guy Tasa
State Physical Anthropologist
(360) 586-3534
Guy.Tasa@dahp.wa.gov

(Or)

Juliette Vogel
Assistant State Physical Anthropologist
(360) 586-3075
Juliette.Vogel@dahp.wa.gov

Participate in Consultation:

Per RCW 27.44.055, RCW 68.50, and RCW 68.60, DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation.

Further Activities:

- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in RCW 27.44.055, RCW 68.50, and RCW 68.60.

- When consultation and documentation activities are complete, construction in the discovery area may resume as described in Section 7.

Documentation of archaeological materials

Archaeological deposits discovered during construction will be assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal

Determination of Eligibility is made.

Project staff will ensure the proper documentation and field assessment will be made of any discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and a contracted consultant (if any).

All prehistoric and historic cultural material discovered during project construction will be recorded by a professional archaeologist on a cultural resource site or isolate form using standard and approved techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for minimal subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

Cultural features, horizons and artifacts detected in buried sediments may require further evaluation using hand-dug test units. Units may be dug in controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Test units will be used only when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. Excavations will be conducted using state-of-the-art techniques for controlling provenience, and the chronology of ownership, custody and location recorded with precision.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of cultural resources investigation will be screened through 1/8-inch mesh, unless soil conditions warrant ¼-inch mesh.

All prehistoric and historic artifacts collected from the surface and from probes and excavation units will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology and the affected tribes.

Within 90 days of concluding fieldwork, a technical report describing any and all monitoring and resultant archaeological excavations will be provided to the Project Manager, who will forward the report for review and delivery to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s).

If assessment activity exposes human remains (burials, isolated teeth, or bones), the process described in Section 5 will be followed.

Proceeding with work

Work outside the discovery location may continue while documentation and assessment of the cultural resources proceed. A professional archaeologist must determine the boundaries of the discovery location. In consultation with Ecology, DAHP and any affected tribes, the Project Manager will determine the appropriate level of documentation and treatment of the resource. If there is a federal nexus, Section 106 consultation and associated federal laws will make the final determinations about treatment and documentation.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Manager, DAHP, any affected tribes, Ecology (and the federal agencies, if any) determine that compliance with state and federal law is complete.

Recipient/project partner responsibility

The Project Recipient/Project Partner is responsible for developing an IDP. The IDP must be immediately available onsite, be implemented to address any discovery, and be available by request by any party. The Project Manager and staff will review the IDP during a project kickoff or pre-construction meeting.

We recommend that you print images in color for accuracy.

APPENDIX A

Cultural Resource Images

Print images in color for accuracy.

Implement the IDP if…

You see chipped stone artifacts.

- Glass-like material
- Angular
- “Unusual” material for area
- “Unusual” shape
- Regularity of flaking
- Variability of size

Implement the IDP if…

You see ground or pecked stone artifacts.

- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

Implement the IDP if…

You see bone or shell artifacts.

- Often pointed if used as a tool
- Often wedge shaped like a “shoe horn”
- Often smooth
- Unusual shape
- Carved

Bone Awls from Oregon and Bone Wedge from California

Implement the IDP if…

You see bone or shell artifacts.

- Often smooth
- Unusual shape
- Perforated
- Variability of size

Tooth Pendant and Bone Pendants from Oregon and Washington

Implement the IDP if…

You see fiber or wood artifacts.

- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare

Artifacts from Mud Bay, Olympia, Washington

Implement the IDP if…

You see historic period artifacts.

Artifacts from Downtown Seattle, Alaskan Way Viaduct (Upper Left and Lower) and Unknown Site (Upper Right)

Implement the IDP if…

You see strange, different or interesting looking dirt, rocks, or

- Human activities leave traces in the ground that may or may not have artifacts associated with them
- “Unusual” accumulations of rock (especially fire-cracked rock)
- “Unusual” shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burnt-looking soils
- Accumulations of shell
- Accumulations of bones or artifacts
- Look for the “unusual” or out of place (e.g., rock piles or accumulations in areas with few rock)

Unknown Sites

Implement the IDP if…

You see strange, different or interesting looking dirt, rocks, or

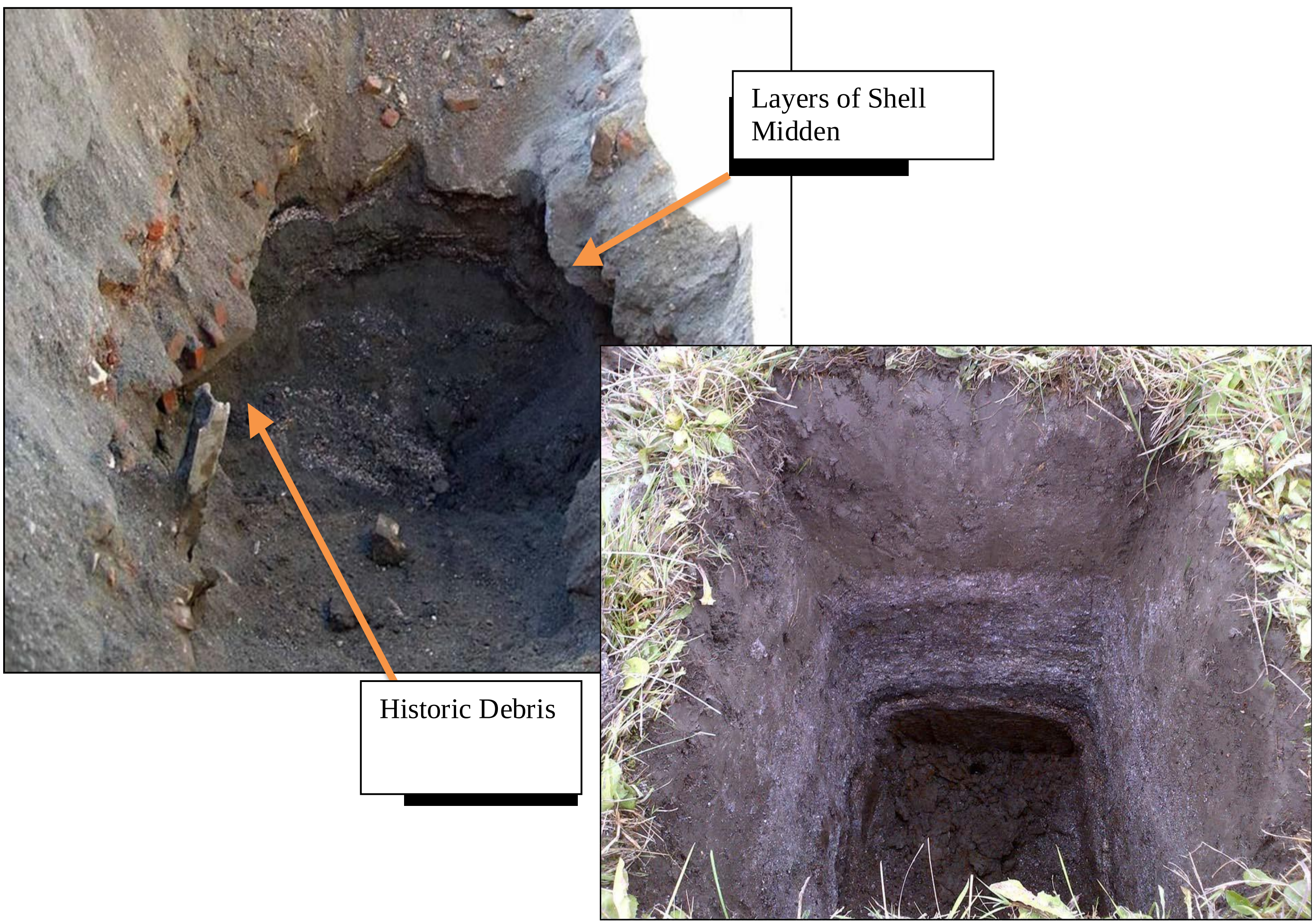
- “Unusual” accumulations of rock (especially fire-cracked rock)
- “Unusual” shaped accumulations of rock (e.g., similar to a fire ring)
- Look for the “unusual” or out of place (e.g., rock piles or accumulations in areas with few rock)

Site on Muckleshoot Indian Reservation, near WSDOT ROW along SR 164

Implement the IDP if…

You see strange, different or interesting looking dirt, rocks, or

- Often have a layered or “layer cake” appearance
- Often associated with black or blackish soil
- Often have very crushed and compacted shells



Site located within WSDOT ROW near Anacortes Ferry Terminal

Implement the IDP if…

You see historic foundations or buried structure

45KI924, In WSDOT ROW for SR 99 Tunnel

References

Lenz, Brett, 2013, Cultural Resource Assessment for the Port of Anacortes Wyman's Property Habitat Mitigation (Pier 1 Mitigation Project), Skagit County, WA, February 15.

AMEC Environment & Infrastructure, Inc. (AMEC), 2017, Final Remedial Investigation/Feasibility Study Report, March Point (Whitmarsh) Landfill, Skagit County, Washington, February 10.

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), 2017, Results of SEPA update regarding Archaeological Survey at the March Point (Whitmarsh) Landfill, City of Anacortes, Skagit County, Washington, April 3.