Work Plan
Cornwall Avenue Landfill Site
Supplemental RI Groundwater Investigation
Bellingham, Washington

June 15, 2012

Prepared for

Port of Bellingham
Bellingham, Washington

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TABLE OF CONTENTS

FIGURES

TABLE

APPENDICES

ABBREVIATION/ACRONYM LIST

BEP	bis(2-Ethylhexyl)phthalate
BGS	below ground surface
BNSF	Burlington Northern Santa Fe
City	City of Bellingham
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EPA	U.S Environmental Protection Agency
FML	flexible membrane liner
ft	foot
GP	Georgia Pacific West
HASP	Health and Safety Plan
IPA	interim placement area
LCS	laboratory control sample
MLLW	mean lower low water
MTCA	Model Toxics Control Act
NTU	nephelometric turbidity units
PCBs	polychlorinated biphenyls
Port	Port of Bellingham
QA/QC	quality assurance/quality control
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
Site	Cornwall Avenue Landfill Site
SMS	sediment management standards
SVOCs	semivolatile organic compounds
VOCs	volatile organic compounds

1.0 INTRODUCTION

In 2009, the Port of Bellingham (Port) and the City of Bellingham (City) completed an agency review draft Remedial Investigation/Feasibility Study (RI/FS) for the Cornwall Avenue Landfill Site (Site) in Bellingham, Washington under the terms of Agreed Order No. 1778. The Site is located at the terminus of Cornwall Avenue adjacent to Bellingham Bay (Figure 1). The Site is bounded by Bellingham Bay to the west and south, the R.G. Haley Model Toxics Control Act (MTCA) site (a former wood treating facility; FSID 2870) to the north, and Burlington Northern Santa Fe Railway Company (BNSF) tracks to the east, as shown on Figure 2.

In a May 24, 2012 letter, the Washington State Department of Ecology (Ecology) requested additional groundwater characterization data for the Site. This document presents the Supplemental RI Groundwater Investigation Work Plan (Plan) to address Ecology's request for additional groundwater quality data. This Plan includes the applicable elements of a sampling and analysis plan and specifies sampling procedures and analytical methodology to accurately characterize groundwater quality, consistent with the requirements of WAC 173-340-820.

2.0 ADDITIONAL GROUNDWATER INVESTIGATION

The goal of this additional groundwater investigation is to better characterize groundwater at the Site in proximity to its point of discharge to Bellingham Bay. This section presents the procedures for implementing the investigation, which will include installation and development of six pairs of groundwater monitoring wells, and conducting two monitoring events to collect and analyze groundwater at the newly installed wells. The proposed locations for additional groundwater monitoring wells and current Site features are shown on Figure 2. Field activities will be conducted in accordance with the Health and Safety Plan (HASP) for this investigation, which is included in Appendix A.

2.1 GROUNDWATER MONITORING WELL INSTALLATION AND DEVELOPMENT

Groundwater monitoring wells will be installed along the western perimeter of the Site near the Bellingham Bay shoreline, as shown on Figure 2. Due to the presence of the perimeter berm constructed along the shoreline as part of the recent interim action, it will not be possible to locate the wells immediately adjacent to the shoreline. Consequently, the wells will not monitor groundwater quality at the point of groundwater discharge to surface water, so the analytical results should represent "worst case" groundwater quality conditions relative to a conditional point of compliance located at the groundwater/surface water interface.

The wells will be constructed by a licensed drilling contractor using a direct-push probe rig, unless subsurface obstructions are encountered that prohibit well installation by this method. Landau Associates field personnel will oversee the drilling and well installation activities, and maintain a detailed record of well construction.

Well construction will be in accordance with Washington State Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC). Prior to initiation of drilling, or any other invasive subsurface activity, the locations of each proposed exploration will be checked in the field to locate aboveground utilities or physical limitations that would prevent drilling at the proposed location. In addition, a public utility locate service will be contacted to locate underground utilities. Because previous utility locate activities have not identified any utilities near the Site shoreline, a private utility locate will not be conducted. The final planned location for each borehole will be based on the findings of the field check.

The wells will be constructed with ¾-inch or 1-inch-diameter, flush-threaded, Schedule 40 polyvinyl chloride (PVC) pipe and 5 or 10 ft screens with 0.020-inch machine-slotted casing. The filter packs will consist of pre-washed, pre-sized number 20/40 silica sand. Pre-packed filter screens will be

utilized in order to better-ensure that a proper filter completely surrounds the well screen. The pre-packed filter screens will consist of an outer layer of stainless steel mesh that affixes a sandpack of relatively uniform thickness completely around the screen.

Two wells will be constructed at each of the monitoring locations shown on Figure 2; one shallow well to monitor groundwater near the soil/groundwater interface, and one deeper well to monitor groundwater at the base of the landfill refuse. Based on review of the hydrogeologic data presented in the RI/FS (Landau Associates 2009), the shallow groundwater wells will likely be placed less than 15 ft BGS to screen in proximity to the water table. The vertical location of the screen will be decided in the field based on conditions observed during drilling and an estimation of the likely groundwater fluctuation caused by tidal influences. Tidal influence on groundwater at the proposed monitoring locations is expected to result in fluctuation of the groundwater level, so a 10 ft well screen will be used for the shallow wells. These shallow wells may be constructed of 1-inch diameter PVC if subsurface conditions allow. For the deeper wells, the boreholes will be advanced to the interface between the landfill refuse and the underlying Nooksack Deposits or Chuckanut Formation, based on review of the soil samples collected during installation. The depth of the landfill is anticipated to be about 30 ft BGS. For the deeper wells, a 5 ft screen will be installed within the landfill refuse, above the interface with native materials. We anticipate each of the deeper wells to be constructed with ¾-inch diameter PVC.

A bentonite seal will be placed in the boring annulus above the filter pack material to the ground surface. Shallow and deep wells will each be completed with an individual locking above-ground protective monument. After well installation, the well location and top of casing elevation will be surveyed. Other groundwater monitoring wells at the Site will be re-surveyed at this time, because the top of casing elevation for other wells may have changed due to normal subsidence of the landfill or wood debris fill.

The new groundwater monitoring wells will be developed to remove particulates and improve the hydraulic connection with groundwater to obtain representative water quality samples and groundwater elevations. The wells will be developed at least 24 hours after completion to avoid compromising the surface seal. Development will be achieved by repeatedly surging the screen and purging the well. During development, the purged groundwater will be monitored for changes in pH, conductivity, temperature, and turbidity. At least ten well casing volumes will be purged from the well. The wells will be developed until the turbidity of the purged groundwater decreases to below 5 nephelometric turbidity units (NTUs), if practicable. If turbidity is not reduced to below 5 NTUs after purging at least ten well casing volumes, development will continue until the groundwater parameters are relatively stable.

2.2 GROUNDWATER MONITORING FIELD PROCEDURES

Groundwater samples will be collected from the newly installed monitoring wells during two groundwater monitoring events. The second monitoring event will occur at least 8 weeks after the first round of monitoring. We anticipate conducting the first event during July 2012, and the second event in September 2012. Laboratory analyses will be conducted with standard turnaround times.

Groundwater samples will be collected during a low tide tidal cycle at or below 0 ft mean lower low water (MLLW) to obtain groundwater samples that minimize the amount of marine water mixing with groundwater. Prior to conducting groundwater sampling, groundwater elevations and specific conductance will be monitored at wells MW-11S, MW-13S, and MW-15S during a similar tidal cycle in order to identify the best timing within the cycle to collect a representative groundwater sample. We anticipate that representative groundwater samples from shallow wells will be collected within 2 hours of low tide on both falling and rising tides and will allow sufficient time to collect all groundwater samples within a 2-day sampling event. We do not anticipate the tidal cycles will have a significant effect on the results of groundwater samples collected from the deeper wells since they will be screened near the saltwater/freshwater interface or mixing zone so shallow wells will be sampled closest to the optimum time in the tidal cycle.

Groundwater samples will be collected using U.S Environmental Protection Agency (EPA) low-flow sampling procedures (Puls and Barcelona 1996). Groundwater will be drawn from the wells using a peristaltic pump and dedicated sample tubing, and pumped directly into sample containers obtained from the analytical laboratory performing the analysis. Container type, number, volume, preservatives, and maximum sample holding times to extraction and/or analysis will be completed as specified by the respective EPA- or state-approved analytical methods.

The following bullets provide a summary of the procedures to be followed during sample collection:

- Immediately following removal of each well monument cover, the well head will be observed for damage, leakage, and staining. Additionally, immediately following removal of the well head cap, any odors will be recorded and the condition of the well opening will be observed. Any damage, leakage, or staining to the well head or well opening will be recorded.
- Prior to sampling, each well will be purged using a peristaltic pump and dedicated purge and sample collection tubing. Purging will begin with a low pumping rate. The rate will be slowly adjusted upward, while minimizing aquifer drawdown (with a target drawdown of less than 0.33 ft) during purging. Pumping flow rate will be recorded in the Groundwater Sample Collection Form presented in Appendix B.
- Field parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity, will be continuously monitored during purging using a flow cell. Purging of the well will be considered to be complete when all field parameters become stable for three successive readings. The successive readings should be approximately +/- 0.1 pH units for pH, +/- 3

percent for conductivity, and +/- 10 percent for dissolved oxygen and turbidity to be considered stable.

- Purge data will be recorded in a Groundwater Sample Collection form including purge volume; time of commencement and termination of purging; any observations regarding color, turbidity, or other factors that may have been important in evaluation of sample quality; and field measurements of pH, specific conductance, temperature, dissolved oxygen, and turbidity.
- Following the stabilization of field parameters, the flow cell will be disconnected and groundwater samples will be collected. Groundwater samples will be collected into the appropriate sample containers. Clean gloves will be worn when collecting each sample.
- Sample data will be recorded on a Groundwater Sample Collection form, including sample number and time collected; the observed physical characteristics of the sample (e.g., color, turbidity, etc.); and field parameters (pH, specific conductance, temperature, and turbidity).
- Any problems or significant observations will be noted in the "comments" section of the Groundwater Sample Collection form.

2.3 LABORATORY ANALYSES

This additional groundwater investigation is designed to characterize groundwater for the primary constituents of concern based on previous investigations, additional contaminants of interest that can be associated with leachate from municipal solid waste or wood waste, and indicator parameters to evaluate oxidation and reduction conditions. Samples will be analyzed for dissolved metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), herbicides, pesticides, tannins and lignins, total petroleum hydrocarbon identification (TPH-HCID), conventional parameters, and typical field parameters. Table 1 presents a summary of the analytical testing and includes the laboratory test methods, container and preservative requirements, maximum sample holding times, and analytical reporting limit goals. Groundwater samples will be filtered in the field for heavy metals analyses and will be centrifuged by the laboratory prior to analysis for SVOCs in order to separate solids from the water that could interfere with the analysis. Centrifuging will be conducted in accordance with Method EPA-823-B-01-002 (modified).

Based on relevant historical data and the results of the first monitoring event, the Port, in consultation with Ecology, may modify the list of groundwater analyses for the second event to focus the scope of investigation.

2.4 FIELD QUALITY CONTROL PROCEDURES

Quality Control (QC) checks for sample collection will be accomplished by a combination of chain-of-custody protocols, laboratory quality assurance as prescribed by the analytical methods, and collection of field QC samples. QC samples are discussed below.

2.4.1 FIELD DUPLICATES

A field duplicate sample provides for the evaluation of precision both in the field and at the laboratory by comparing the analytical results of two samples taken from the same location (i.e., the primary and duplicate samples). The two samples are typically aliquots of the same sample that are prepared and analyzed identically. For groundwater sampling, it is typical to fill the original sample containers, then immediately afterwards, fill the duplicate containers. Since the sample aliquots are extracted at separate times, the technique may be described as replicate sampling. For the purposes of this Plan, we refer to the sample as a duplicate. One field duplicate groundwater sample will be collected during each groundwater sampling event.

2.4.2 RINSATE BLANKS

A rinsate blank is a sample of deionized water passed over decontaminated sampling equipment. A rinsate blank is used to indicate potential contamination from sample instruments used to collect and transfer samples. This water must originate from one common source within the laboratory and should be the same water used by the laboratory performing the analysis.

Because samples will be collected directly from dedicated sample tubing into laboratory prepared containers, no rinsate blanks will be collected for this project.

2.4.3 TRIP BLANKS

Trip blanks are used to determine if any onsite atmospheric contaminants are seeping into the sample vials or if any cross-contamination of samples is occurring during shipment or storage of sample containers. They consist of a VOC vial filled by the laboratory with water demonstrated to be free of contaminants. The trip blanks accompany the empty sample bottles from the laboratory into the field and with the filled bottles back to the laboratory. The trip blanks are never opened in the field. One trip blank will be analyzed for VOCs for each round or sampling.

2.4.4 SAMPLE LABELING, SHIPPING, AND CHAIN-OF-CUSTODY

Sample container labels will be completed before or immediately following sample collection. Container labels will include the following information:

- Project name
- Project number
- Sample ID
- Initials of the person collecting the sample

- Date and time of collection
- Analysis requested.

Groundwater samples collected from monitoring wells will be designated with the well number (e.g., MW-12S) and the date the sample was collected in month day year format (e.g., MW-12S-051512). The samples will be logged in a chain-of-custody form and submitted to an Ecology-accredited laboratory following proper chain-of-custody protocols. The transportation and handling of samples will be accomplished in a manner that protects the integrity of the samples.

2.5 INVESTIGATION DERIVED WASTE

Disposable clothing and equipment will be placed in plastic bags and disposed of as solid waste in an appropriate solid waste facility.

Soil cuttings from well installation and purge water from well developing and groundwater sampling will be collected into separate and appropriately labeled Washington State Department of Transportation-approved 55-gallon drum(s) and stored at the Site. After completion of sampling activities described in this Plan, Landau Associates will arrange for disposal at an appropriately certified disposal facility.

3.0 LABORATORY QUALITY CONTROL SAMPLES

The laboratory conducts internal QC checks by analyzing QC samples to determine if analytical operations are in control, in accordance with their internal QC plan, as approved by Ecology. The laboratory QC checks evaluate the level of confidence in reported results, as well as determining the effect that the sample matrix may have in data being generated. The type and frequency of specific QC samples analyzed will conform to the specified analytical method requirements. QC results that vary from acceptable ranges will result in the implementation of appropriate corrective measures, potential application of qualifiers, and/or an assessment of the impact these corrective measures have on the established data quality objectives. Quality control samples that may be analyzed at the laboratory are discussed below.

3.1 METHOD BLANKS

Method blanks, consisting of aliquots of water or purified solid, are carried through the analytical scheme and serve to measure potential contamination associated with laboratory storage, preparation, or instrumentation (i.e., the level of laboratory background contamination). For most analyses, method blanks are analyzed on a daily basis and at a frequency of 1 per 20 samples if more than 20 samples are analyzed in a given batch.

3.2 LABORATORY CONTROL SAMPLES

Laboratory control samples (LCSs) are aliquots of spiked water or purified solid to which known amounts of an analyte have been added. They are subjected to the sample preparation or extraction procedure and are analyzed as samples. Stock solutions used for LCSs are purchased or prepared independently of the calibration standards. The LCS analysis evaluates the functioning analytical method process and equipment function. Results of the LCS analysis are expressed as percent recovery. LCSs are prepared and analyzed on at least a daily basis, with a greater frequency if a greater number of samples are analyzed on a given day.

3.3 CALIBRATION BLANKS

Calibration blanks are prepared with standards to create an instrument calibration curve. They differ from other standards only by the absence of an analyte and provide the zero-point for the curve.

3.4 SURROGATES

Surrogates are measured amounts of certain compounds added before sample preparation or extraction. Analysts measure the surrogate recovery to determine systematic extraction problems and to assess the accuracy of a chemical measurement by comparing the measured value to the actual spiked value. Surrogates are added to all samples analyzed for organics. Surrogate recoveries are expressed as percent recovery.

3.5 LABORATORY DUPLICATES

A duplicate is a second laboratory sample taken from a submitted sample. The duplicate is then prepared along with the original. It is analyzed and compared to the original sample to assess the precision of the analytical method and the potential variability of the sample matrix. This comparison is reported as the relative percent difference (RPD).

3.6 LABORATORY CONTROL SAMPLE DUPLICATES

In cases where the analyte concentration is consistently below the method detection limit, LCS duplicates are substituted for laboratory duplicate samples. An LCS duplicate is a second analysis of an LCS. The duplicate is prepared along with the original sample. It is analyzed and compared to the original sample to assess the precision of the analytical method and the potential variability of the sample matrix. For this method, both a percent recovery and an RPD are reported. As such, both accuracy and precision for the matrix are measured. LCS duplicates are prepared as needed.

4.0 DATA VALIDATION AND REPORTING

Data validation is a systematic procedure of reviewing a body of data against a set of established criteria to provide a specified level of assurance of validity prior to its intended use. Landau Associates will review the field sampling documentation and the QC as reported by the laboratory as described below.

4.1 SAMPLING PROCEDURE REVIEW

Documentation from the field sampling activities will be reviewed to ensure that the samples were collected consistent with the procedures specified in this SAP, that they are representative of the conditions being measured, and that they fulfill their intended purpose. Field notes will be checked to verify samples have supporting information to verify when, how, and where sampling occurred; who performed the sampling; and that appropriate sample identifiers were used. Chain-of-custody and sample receipt documentation will be reviewed to ensure that chain of custody was unbroken and samples arrived in good condition.

4.2 ANALYTICAL DATA VALIDATION

The laboratory generating analytical data for this project will submit results that are supported by sufficient backup and quality assurance/quality control (QA/QC) data to enable the reviewer to determine the quality of the data. The data evaluation process will include reviewing:

- The overall deliverable package for completeness
- Holding times
- That all samples were analyzed using the specified analytical methods
- Laboratory QC results (e.g., blanks, surrogates, spikes, duplicates) to assess if the data are within the method limits and specifications
- Field quality QC results (e.g., field duplicates, blanks)
- Laboratory qualifiers.

A review of raw data will not be performed. When possible, discrepancies will be resolved through direct correspondence with the laboratory project manager. If the data review reveals significant deviations and problems with the analytical data, Landau Associates may recommend corrective action or a complete validation of the data, including raw data.

5.0 REPORTING

Landau Associates will prepare a brief technical memorandum documenting the implementation of this Plan. The memorandum will include a description of field activities, laboratory analytical results, summary tables of validated data, and a figure showing locations of the new monitoring wells.

* * * * * * * *

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Lawrence D. Beard, P.E.
Principal

Jeremy Davis, P.E., C.H.M.M.
Senior Project Engineer

LDB/JMD/kes

6.0 REFERENCES

Puls, R.W. and M. J. Barcelona. 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. April.

Landau Associates. 2009. *Ecology Review Draft, Cornwall Avenue Landfill Remedial Investigation/Feasibility Study, Bellingham, Washington.* July 24.

Ecology. 2012. Letter: *Updated Ecology Review Comments, RI Portion of Cornwall Avenue Landfill 2009 Draft RI/FS.* From Mark Adams, Site Manager, Washington State Department of Ecology, to Brian Gouran, Port of Bellingham. May 24.

Map from DeLorme Street Atlas USA 2002

0 2000 4000

Approximate Scale in Feet

Port of Bellingham \ Cornwall Avenue Landfill \ Interim Action Plan | V:\001\020\400\440\Additional Groundwater Investigation\Figure 1.dwg (A) "Figure 1" 3/28/2012

LANDAU ASSOCIATES

Cornwall Avenue Landfill Additional Groundwater Investigation Bellingham, Washington	**Vicinity Map**	Figure 1

Bellingham Bay

Approximate Location of Proposed Overwater Walkway Landing Elev=+16.8' MLLW

Top Of Bank

MW-11 S/D

MW-12 S/D

MW-13 S/D

MW-14 S/D

MW-15 S/D

MW-16 S/D

Interim Placement Area #1

Interim Placement Area #2

45'

42'

3:1 Typ

Ditch

Ditch 0.5%

Landfill Boundary

Inner Harbor Line

Existing Stormwater Detention Basin

R.G. Haley Site

Burlington Northern Railway

BNSF Railway Mainline

2" BRASS SURFACE MONS

PC

CITY OF BELLINGHAM MONUMENT 2547 2" BRASS SURFACE MON

Legend

- MW-16 S/D — Proposed Groundwater Monitoring Location and Designation
- Approximate Landward Boundary of Landfill Refuse
- Property Line
- Existing Fence
- 12 — Existing Elevation Contour (ft, MLLW)
- Access Road
- Berm
- Interim Action Area

Source: Reid Middleton 2011; Port of Bellingham 1996; Anchor Environmental 2008

0 100 200

Scale in Feet

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Cornwall Avenue Landfill
Additional Groundwater Investigation
Bellingham, Washington

Additional Groundwater Monitoring Locations

Figure 2

Landau Associates Inc. | V:\001\020\400\440\Additional Groundwater Investigation\Figure 2.dwg (A) "Figure 2" 6/6/2012

TABLE 1
SUMMARY OF GROUNDWATER ANALYTICAL TESTING
SUPPLEMENTAL RI GROUNDWATER INVESTIGATION
CORNWALL AVENUE LANDFILL
BELLINGHAM, WASHINGTON

Analyte	Test Method	Container	Preservation	Holding Time	Reporting Limit Goal
Ammonia	EPA 350.1	500 mL HDPE	Add H2SO4 to pH < 2.0 Store cool at 4°C	28 days	0.035 mg/l
BOD	SM 5210 B	500 mL HDPE	Store cool at 4°C	48 hours	5.0 mg/l
COD	SM 5220-D	500 mL HDPE	Add H2SO4 to pH < 2.0 Store cool at 4°C	28 days	25 mg/l
Total and Free Cyanide	SM 4500-CN / ASTM D4282-02	500 mL HDPE	Add NaOH to pH > 12.0 Store cool at 4°C	14 days	Total = 0.05 mg/l Free = 0.02 mg/l
Dissolved Metals	EPA 6010/200.8	500 mL HDPE	Add HNO_3 Store cool at 4°C	6 months	varies from 0.3 to 24.39 ug/l
Field Parameters	Varies	Flow-through cell	None	Measure Immediately	-
Herbicides	EPA 8150A	1L AG	Store cool at 4°C	7 days to extract; 40 days to analyze	varies from 0.2 to 100 ug/l
Nitrate	EPA 300.0	500 mL HDPE	Store cool at 4°C	48 hours	0.15 mg/l
Nitrite	EPA 300.0	500 mL HDPE	Store cool at 4°C	48 hours	0.14 mg/l
Pesticides	EPA 8081	1L AG	Store cool at 4°C	7 days to extract; 40 days to analyze	varies from 0.05 to 2 ug/l
Sulfate	EPA 300.0	500 mL HDPE	Store cool at 4°C	28 days	0.26 mg/l
Sulfide	EPA 376.1	500 mL HDPE	Add NaOH to pH > 9 Store Cool at 4°C	7 days	0.1 mg/l
SVOCs[1/] PAHs	8270 / 8270 SIM	1L AG	Store cool at 4°C	7 days to extract; 40 days to analyze	varies from 2 to 10 ug/l
Tannins and Lignins	SM 5550 B	500 mL HDPE	Store cool at 4°C	Not specified	0.2 mg/l
TOC	EPA 415.1	500 mL HDPE	Add H2SO4 to pH < 2.0 Store cool at 4°C	28 days	0.5 mg/l
TPH-HCID	NWTPH	1L AG	Store cool at 4°C	7 days	Gas range = 130 ug/l Diesel range = 310 ug/l Oil range = 130 ug/l
VOCs	8270	3 ea 40 mL glass vial	Add HCl to pH < 2.0 Store cool at 4°C	14 days	varies from 0.2 to 20 ug/l

(1) To include phenol, 4-methylphenol, 2,4-dimethylphenol, benzoic acid, benzyl alcohol, and ketones.

Dissolved Metals = Arsenic, Copper, Lead, Mercury, Manganese, and Zinc

Field parameters include: Redox Potential (Eh), pH, conductivity, dissolved oxygen (DO), and temperature

AG = amber glass
HDPE = High Density Polyethylene
M = Modified
mL = milliliter
BOD = Biological oxygen demand
COD = Chemical oxygen demand
SVOC = Semivolatile Organic Compound
VOC = Volatile Organic Compound
WMG = wide mouth glass
TPH-HCID = Total Petroleum Hydrocarbons - Hydrocarbon Identification
NWTPH = Northwest Total Petroleum Hydrocarbon
TOC = Total organic carbon
HCl = Hydrochloric acid preservative
H2SO4 = Sulfuric acid preservative
NaOH = Sodium Hydroxide preservative
HNO3 = Nitric acid preservative
mg/ml = milligrams per liter
ug/l = micrograms per liter

APPENDIX A

Health and Safety Plan

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

WORK LOCATION PERSONNEL PROTECTION AND SAFETY EVALUATION FORM

Attach Pertinent Documents/Data
Fill in Blanks As Appropriate

Job No.:	0001020.400.500		
Prepared by:	Jeremy Davis	Reviewed by:	Christine Kimmel
Date:	May 31, 2012	Date:	May 29, 2012

A. WORK LOCATION DESCRIPTION

1. **Project Name:** Cornwall Avenue Landfill

2. **Location:** Bellingham, WA. The landfill site is located at the terminus of Cornwall Avenue adjacent to Bellingham Bay.

3. **Anticipated Activities:** Installation of 12 groundwater monitoring wells using a direct-push rig; logging geologic conditions; developing the wells; groundwater sampling from the new wells.

4. **Size:** Approximately 16.5 acre (study areas only)

5. **Surrounding Population:** None adjacent. (See 6)

6. **Buildings/Homes/Industry:** The Site is bounded by Bellingham Bay, the R.G. Haley cleanup site (a former wood treating facility), and Burlington Northern Santa Fe Railway Company (BNSF) tracks

7. **Topography:** Level to moderate slopes

8. **Anticipated Weather:** Variable weather, wind, rain, sun; Temperature, 40-75 °F

9. **Unusual Features:** The Site is largely unpaved, with the exception of an area of asphalt pavement in the northeastern portion of the Site. Currently, the most significant above-ground features of the Site are two large piles of low-permeability cover material, capped with an FML in the Interim Placement Areas (IPAs) as well as stormwater drainage and conveyance and shoreline berms.

10. **Site History:** The Site was used as a landfill, or for sawmill operations, or for other industrial purposes since about 1888. The Site came to public attention in 1992 when medical waste was found along the beach. Investigations since that time led to the Draft RI/FS completed in 2009. An interim action was completed at the site to limit surface water infiltration and provide for passive landfill gas ventilation. The additional groundwater investigation performed under this health and safety plan is to provide supplemental data for the Draft RI/FS.

B. HAZARD DESCRIPTION

1. Background Review: ☒ Complete ☐ Partial

If partial, why?

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

Justification:

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

A. ☒ Chemical ☒ Inhalation ☒ Explosive
☒ Biological ☒ Ingestion ☐ O2 Def. ☒ Skin Contact

a. Describe: Airborne particulate matter – could be generated during drilling but is not likely significant due to direct-push installation methods.

b. Landfill refuse – cyanide, ammonia, copper, lead, silver, zinc, polychlorinated biphenyls (PCBs), fecal coliform, and low levels of bis(2-ethylhexyl)phthalate (BEB) have been identified in the refuse on site or in nearby sediment. Additionally, biological hazards are associated with the refuse.

c. Soil or groundwater contaminated with petroleum hydrocarbons from a nearby contaminated site

d. Landfill gas – very low levels of landfill gas likely present in refuse could be encountered in borings

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

Describe:

C. ☐ Radiation

Describe:

4. Nature of Hazards:

☒ Air	Describe: potential for volatile organics constituents to be released from refuse layer in soil, potential explosion hazard related to methane release from landfill.
☒ Soil	Describe: potential for contact with or ingestion of contaminated soil or refuse.
☐ Surface Water	Describe:
☒ Groundwater	Describe: groundwater may be contaminated from the refuse and therefore the contaminants associated with the refuse described in Hazard Description 3 above.
☒ Other	Describe: refuse layer may contain contaminant or biological hazards

5. Chemical Contaminants of Concern ☐ N/A

Contaminant	PEL (ppm)	I.D.L.H. (ppm)	Source/Quantity Characteristics	Route of Exposure	Symptoms of Acute Exposure	Instruments Used to Monitor Contaminant
PCBs	0.001 mg/m3	5 mg/m3	In soil, refuse, and sediment Max concentration=	Inhalation, ingestion	Chloracne, irritation	Observation for visible dust, refuse, or groundwater
Copper	1 mg/m3	100 mg/m3	In groundwater Max concentration=	Inhalation, ingestion	Irritation of eyes and nose, kidney damage	Observation for visible dust, refuse, or groundwater
Lead	0.05 mg/m3	100 mg/m3	In groundwater Max concentration=	Inhalation, ingestion	Insomnia, abdominal pain, kidney disease	Observation for visible dust, refuse, or groundwater
Zinc	NV	NV	In groundwater Max concentration=	Inhalation, ingestion	Irritation to respiratory system; chills, muscle ache, nausea, cough	Observation for visible dust, refuse, or groundwater
Silver	0.01 mg/m3	10 mg/m3	In groundwater Max concentration=	Inhalation, ingestion	Irritation to respiratory system and skin	Observation for visible dust, refuse, or groundwater
Bis(2-ethylhexyl)phthalate	5 mg/m3	10 mg/m3	In sediment Max concentration =	Inhalation, ingestion	Potential endocrine disruptor	Observation for visible dust, refuse, groundwater, or sediment
Landfill gas (methane and trace VOCs)	NV	NV	Generated in refuse	Inhalation	Asphyxiation	CGI/PID
Cyanide (hydrogen cyanide)	5 mg/m3	50 mg/m3	In groundwater Max cyanide concentration=	Inhalation, ingestion	Asphyxiation, confusion, nausea, respiratory problems	Observation for visible dust, refuse, or groundwater
Petroleum Hydrocarbons	300	400	In groundwater at northeastern corner of the Site Max concentration=	Inhalation, ingestion	Headaches, nausea, dizziness	CGI/PID

Notes:

6. Physical Hazards of Concern ☐ N/A

Hazard	Description	Location	Procedures Used to Monitor Hazard
Moving parts of drill rig, falling and flying objects	Drill rigs of all types have many moving parts which can pinch, crush, or come loose from the rig and cause injury.	Near drill rig	Alert observation of surroundings. Minimize time spent near drill rig, no loose clothing. Use of safety glasses, reflective vest, hard hat, and steel toed boots.
Noise	Drill rigs are noisy, particularly direct push probe rigs	Near drill rig	Wear hearing protection whenever drill rig is operating
Explosion	Presence of methane in subsurface	Drill location	Verify drill rig is electrically ground to minimize potential sparks.

7. Work Location Instrument Readings ☐ N/A

Location: _____

Percent O_2: _____ Percent LEL: _____

Radioactivity: _____ PID: _____

FID: _____ Other: _____

Other: _____ Other: _____

Other: _____ Other: _____

Location: _____

Percent O_2: _____ Percent LEL: _____

Radioactivity: _____ PID: _____

FID: _____ Other: _____

Other: _____ Other: _____

Other: _____ Other: _____

Location: _____

Percent O_2: _____ Percent LEL: _____

Radioactivity: _____ PID: _____

FID: _____ Other: _____

Other: _____ Other: _____

Other: _____ Other: _____

Location: _____

Percent O_2: _____ Percent LEL: _____

Radioactivity: _____ PID: _____

FID: _____ Other: _____

Other: _____ Other: _____

Other: _____ Other: _____

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

Describe:

C. PERSONAL PROTECTIVE EQUIPMENT

1. Level of Protection

☐ A ☐ B ☐ C ☒ D

Location/Activity:

☐ A ☐ B ☐ C ☐ D

Location/Activity:

2. Protective Equipment (specify probable quantity required)

Respirator ☐ N/A

- ☐ SCBA, Airline
- ☐ Full-Face Respirator
- ☒ Half-Face Respirator (Cart. organic vapor) (Only if upgrade to Level C)
- ☐ Escape mask
- ☐ None
- ☐ Other:
- ☐ Other:

Clothing ☐ N/A

- ☐ Fully Encapsulating Suit
- ☐ Chemically Resistant Splash Suit
- ☐ Apron, Specify:
- ☐ Tyvek Coverall
- ☐ Saranex Coverall
- X Safety Vest
- ☒ Other: Dedicated field clothing; long sleeves and pants, rain gear, as needed to avoid splash

Head & Eye ☐ N/A

- ☒ Hard Hat
- ☐ Goggles
- ☐ Face Shield
- ☒ Safety Eyeglasses
- ☒ Other: Hearing Protection

Hand Protection ☐ N/A

- ☐ Undergloves; Type:
- ☒ Gloves; Type: Nitrile
- ☒ Overgloves; Type: While handling refuse with potential to cut skin or Nitrile gloves
- ☐ None
- ☐ Other:

Foot Protection ☐ N/A

- ☐ Neoprene Safety Boots with Steel Toe/Shank
- ☐ Disposable Overboots
- ☒ Other: Steel-toed work boots

3. Monitoring Equipment ☐ N/A

☒ CGI ☒ PID

☐ O^2 Meter ☐ FID

☐ Rad Survey ☐ Other

☐ Detector Tubes (optional)

Type:

D. DECONTAMINATION

PERSONAL DECONTAMINATION

☒ Required ☐ Not Required

If required, describe:

Wash hands and face with water and soap before each break. Minimize hand to mouth actions while onsite.

EQUIPMENT DECONTAMINATION

☒ Required ☐ Not Required

If required, describe and list equipment:

Non dedicated sampling equipment will be decontaminated between sampling intervals using a three step process:

- Remove visual contamination and wash with a mixture of Alconox soap and tap water
- Rinse with tap water
- Rinse with deionized water

Down-the-hole drilling equipment will be decontaminated between borings using a high pressure steam cleaner.

E. PERSONNEL

	Name	Work Location Title/Task	Medical Current	Fit Test Current
1.	**Jeremy Davis**	**Field Representative / Logging borings & collecting samples**	**X**	**X**
2.	**Dylan Frasier**	**Field Representative / Logging borings & collecting samples**	**X**	**X**
3.	**Paul Raymaker**	**Field Representative / Logging borings & collecting samples**	**X**	**X**
4.	**Ken Reid**	**Field Representative / Logging borings & collecting samples**	**X**	**X**
5.			☐	☐
6.			☐	☐
7.			☐	☐
8.			☐	☐
9.			☐	☐
10.			☐	☐

Site Safety Coordinator: **Jeremy Davis**

F. ACTIVITIES COVERED UNDER THIS PLAN

Task No.	Description	Preliminary Schedule
1	Direct push installation of groundwater wells, soil sampling, groundwater well development, groundwater sampling.	Summer or Fall 2012

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

Name and Address of Subcontractor: Pacific Northwest
Probe & Drilling
Milton, WA

EVALUATION CRITERIA

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

GENERAL HEALTH AND SAFETY PROGRAM EVALUATION: X Adequate ☐ Inadequate

Additional Comments: Contractor training and safety procedures are maintained in accordance with Basis Agreement with Landau Associates

Evaluation Conducted By: Christine Kimmel Date: May 29, 2012

EMERGENCY FACILITIES AND NUMBERS

Hospital:
St Joseph's Hospital
2901 Squalicum Pkwy
Bellingham, Washington 98225

Directions: Attachment 2

Telephone: Information: **(360) 715-6420**

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

Emergency Routes – Map (Attachment 1)

Emergency Contacts:

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

In the event of an emergency, do the following:

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

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

HEALTH AND SAFETY PLAN
APPROVAL/SIGN OFF FORMAT

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

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Site Safety Coordinator	Signature	Date
Christine Kimmel Landau Health and Safety Manager	Signature	May 29, 2012 Date
Project Manager	Signature	Date

Personnel Health and Safety Briefing Conducted By:

Name	Signature	Date

ATTACHMENT 1

ACTION LEVELS FOR RESPIRATORY PROTECTION

Monitoring Parameter	Reading	Level of Protection
Visible Dust	Elevated above background	Stop work to implement dust suppression; contact Site Safety Coordinator; if dust cannot be suppressed, Level C)
CGI (LEL)	10% LEL sustained	Stop work, evacuate immediate area, stop engines, allow gas to dissipate. Re-monitor before resuming activities
VOCs`	PID reading >10 ppm in breathing zone for more than 15 minutes or >35 ppm for momentary peak.	Evacuate the area or upgrade to Level C - half-face respirator with organic vapor / HEPA cartridge.
VOCs	>10 ppm and <100 ppm	Upgrade to full face respirator
VOCs	>100 ppm	Stop Work, contact H&S Manager

ATTACHMENT 2

MAP AND DIRECTIONS TO HOSPITAL

HOSPITAL

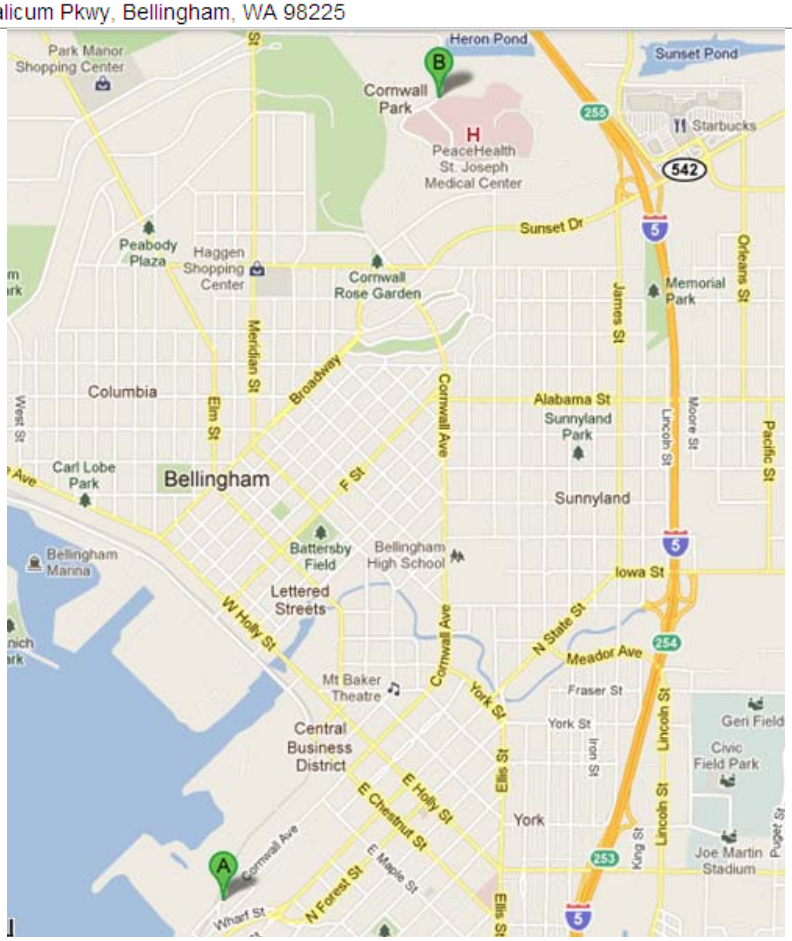
St Joseph's Hospital
2901 Squalicum Pkwy
Bellingham, Washington 98225
Information: (360) 715-6420

DIRECTIONS FROM CORNWALL AVENUE LANDFILL

A Cornwall Ave

1.	Head **northeast** on **Cornwall Ave** toward **E Ivy St** About 6 mins	go 2.0 mi total 2.0 mi
2.	Turn right onto **Plymouth Dr** About 1 min	go 0.4 mi total 2.4 mi
3.	Take the 2nd left onto **Ellis St**	go 456 ft total 2.4 mi
4.	Take the 1st left onto **Squalicum Pkwy** Destination will be on the right About 1 min	go 0.4 mi total 2.9 mi

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



APPENDIX B

Groundwater Sample Collection Form

LANDAU ASSOCIATES

Groundwater Low-Flow Sample Collection Form

Project Name: _____ Project Number: _____

Event: _____ Date/Time: _____

Sample Number: _____ Weather: _____

Landau Representative: _____

WATER LEVEL/WELL/PURGE DATA

Well Condition: Secure (YES or NO) Damged (YES or NO) Describe: _____

DTW Before Purging (ft) _____ Time: _____ GW Meter No.(s) _____

Begin Purge: Date/Time: _____ End Purge: Date/Time: _____ Gallons Purged: _____

Purge water disposed to: ☐ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Other _____

Time	pH	Cond. (uS/cm)	Turbidity (NTU)	D.O. (mg/L)	Temp (°F/°C)	ORP (mV)	DTW (ft)	Interna Purge Volume (mg/L)	Comments/ Observations

SAMPLE COLLECTION DATA

Sample Collected With: ☐ Bailer ☐ Pump/Pump Type _____

Made of: ☐ Stainless Steel ☐ PVC ☐ Teflon ☐ Polyethylene ☐ Other ☐ Dedicated

Decon Procedure: ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water ☐ Dedicated

(By Numerical Order) ☐ Other _____

Sample Description (color, turbidity, odor, sheen, etc.) _____

Replicate	pH	Cond. (uS/cm)	Turbidity (NTU)	D.O. (mg/L)	Temp (°F/°C)	ORP (mV)	DTW (ft)	Comments/Observations
1								
2								
3								
4								
Average:								

QUANTITY	TYPICAL ANALYSIS ALLOWED PER BOTTLE TYPE (Circle applicable or write non-standard analysis below)
	(8260) (8010) (8020) (NWTPH-G) (NWTPH-Gx) (BTEX) WA ☐
	(8270) (PAH) (NWTPH-D) (NWTPH-Dx) (TPH-HCID) (8081) (8141) (Oil & Grease) WA ☐
	(pH) (Conductivity) (TDS) (TSS) (BOD) (Turbidity) (Alkalinity) (HCO3/CO3) (Cl) (SO2) (NO3) (NO2) (F)
	(COD) (TOC) (Total PO4) (Total Kiedahl Nitrogen) (NH3) (NO3/NO2)
	(Cyanide)
	(Total Metals) (As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Tl) (V) (Zn) (Hg) (K) (Na)
	(Dissolved Metals) (As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Tl) (V) (Zn) (Hg) (K) (Na) (Hardness) (Silica
	others

Duplicate Sample No(s): _____

Comments: _____

Signature: _____ Date: _____