SAMPLING AND ANALYSIS PLAN

Groundwater Site Characterization
Eldridge Municipal Landfill RI/FS

Prepared for

City of Bellingham
Public Works – Engineering
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ACRONYMS AND ABBREVIATIONS

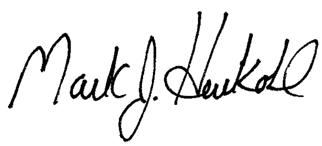
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTC	Bellingham Technical College
City	City of Bellingham, Public Works
COC	chain-of-custody
CVAA	cold vapor atomic absorption
DCAP	draft cleanup action plan
DOT	Department of Transportation
EDR	engineering design report
EPA	United States Environmental Protection Agency
FCR	field change request
FS	feasibility study
GC/MS	gas chromatography/mass spectrometry
GIS	geographic information system
GPS	Global Positioning System
HASP	health and safety plan
Herrenkohl Consulting	Herrenkohl Consulting LLC
HSA	hollow-stem auger
ICP/MS	inductively coupled plasma/mass spectrometry
ICP-OES	inductively coupled plasma – optical emission spectrometry
IDW	investigation-derived waste
MQO	measurement quality objectives
MTCA	Model Toxics Control Act
NAD	North American Datum
NAVD	North American Vertical Datum
NTU	Nephelometric turbidity units
PAHs	polycyclic aromatic hydrocarbons
PCP	pentachlorophenol
PLP	potentially liable person

PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RI	remedial investigation
RL	remediation level
RPD	relative percent difference
SAP	sampling and analysis plan
SPT	standard penetration test
TIC	tentatively identified compounds
USCS	Unified Soil Classification System
WAC	Washington Administrative Code

CERTIFICATION

I, Mark J. Herrenkohl, a licensed engineering geologist in the State of Washington, certify that I have reviewed the geosciences portions of this document.

Signature and Stamp of Geologist:



Name: Mark J. Herrenkohl Date: April 27, 2012

1 INTRODUCTION

This document is the sampling and analysis plan (SAP) for additional environmental site characterization in support of the Eldridge Municipal Landfill remedial investigation/feasibility study (RI/FS) located in Bellingham, Washington (Figure 1). It outlines additional soil and groundwater sampling and testing activities proposed for the Site, activities supplementary to work conducted under the September 30, 2005 Little Squalicum Park RI/FS Work Plans (Integral Consulting 2005), Addendum 2 (Integral Consulting 2006), and the Eldridge Municipal Landfill Interim Action (Herrenkohl Consulting and Wilson Engineering 2011a, b).

This SAP provides specific guidance for field and laboratory methodology and quality assurance procedures that will be followed by Herrenkohl Consulting LLC (Herrenkohl Consulting) and its subcontractors. Herrenkohl Consulting is conducting this work under contract No. 2011-0142 with the City of Bellingham Public Works Department (City), with direction from the Washington State Department of Ecology Toxics Cleanup program (Ecology). The SAP was prepared in accordance with an Agreed Order negotiated between the City and Ecology and signed November 19, 2010 (Document No. DE 8073)[1], and was developed to meet the requirements of an RI/FS as defined by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation [Washington Administrative Code (WAC) 173-340; Ecology 2007].

1.1 PROJECT BACKGROUND[2]

A separate and distinct area of contamination from an old municipal landfill was discovered in Little Squalicum Park (Park) while performing an RI under separate order (Agreed Order No. DE 2016). In the mid- to late-1930s, the City had used a portion of the Park as a "sanitary landfill" for burning and burying local municipal waste hauled by a garbage collection contractor. The landfill was operated for only a few years before operations ceased. The landfill area is located on property owned by Whatcom County (Parcel Number: 38022347 32190000), which is currently leased by the City for management of the Park. The remains of the landfill are located west of the Bellingham Technical College (BTC) campus parking lot and north of Building-U (Figure 1).

The initial boundaries of the landfill were delineated in January 2006 as part of the draft Park RI, through the excavation of reconnaissance test pits in which evidence of municipal garbage was found within various fill materials. The types of municipal garbage observed consisted of glass bottles, metal scraps, ash, ceramics, construction debris, and various indiscernible rusted materials.

Upon completion of the draft Park RI in December 2008, the area of the historical landfill was estimated to be approximately 7,100 ft^2. The draft Park RI documented the presence of low

[1] The Agreed Order was amended July 18, 2011 to include the completion of an Interim Action for the Site.
[2] The section includes excerpts from previously written project documents.

levels of polycyclic aromatic hydrocarbons (PAHs), benzoic acid, phthalates, and pentachlorophenol (PCP) in surface soil samples collected in the landfill area, as well as elevated concentrations of some heavy metals (e.g., lead). Higher levels of metals were detected in subsurface soils.

In November 2009, Ecology listed the landfill area as a separate site and named both the City and County as potentially liable persons (PLPs). Soon after, the City and Ecology began negotiating an Agreed Order for completing an RI/FS and draft cleanup action plan (DCAP) for the Site.

In September 2010, the United States Environmental Protection Agency (EPA) uncovered additional landfill material during excavations in support of the cleanup at the Oeser/Little Squalicum Creek site. In order to allow the EPA work to continue, the City undertook an independent action to investigate, analyze, relocate and secure most of the contaminated soil. Some contaminated soil that was left in-place would be addressed, along with the relocated material, as part of the landfill cleanup. The estimated area of the historical landfill was revised to be approximately 19,000 ft^2 (Figure 1).

The Agreed Order (No. DE 8073) requiring the City to complete an RI/FS report and DCAP for the Site was signed by the City and Ecology on November 19, 2010.

A draft RI/FS report was completed for the Site in February 2011 (Herrenkohl Consulting and Integral Consulting 2011a). After review by Ecology and further discussion between parties, the City agreed to conduct an interim action for the Site in summer 2011.

An amendment to the Agreed Order was negotiated and signed by the City and Ecology on July 18, 2011. The scope of the interim action was described in an interim action work plan (Exhibit B of the Amended Agreed Order) (Herrenkohl Consulting and Integral Consulting 2011b).

The City completed an engineering design report (EDR) on June 24, 2011 for implementing the interim action (Herrenkohl Consulting and Wilson Engineering 2011a). The EDR includes engineering design plans and specifications for the interim action, and ancillary documents (e.g., performance monitoring and contingency plan, wetland restoration plan).

Remedial activities were conducted from August 22 to October 7, 2011 and included the excavation of about 4,290 tons of landfill debris and contaminated soil from the Site and disposal at a Subtitle D landfill located in Roosevelt, Washington. The excavation was stabilized, backfilled with clean soil, and vegetated by hydroseeding. In addition, a 750 ft^2 depressional wetland was created within the project area.

The cleanup of landfill debris and contaminated soil on the Site was confirmed by the collection and testing of soils as described in the performance monitoring and contingency plan (Herrenkohl Consulting and Wilson Engineering 2011a). Based on the testing results and performance evaluation, soils containing PCP and metals above the remediation levels (RLs) were removed from the Site except for locations on steep, unstable slopes and within or adjacent to an existing wetland. The interim action construction activities and performance monitoring was summarized in a construction completion report in December 2011 (Herrenkohl Consulting and Wilson Engineering 2011b).

1.2 PURPOSE

Additional soil and groundwater characterization described in this SAP is required to determine the effectiveness of the interim action and for completion of the Site RI/FS. The groundwater characterization will provide valuable information on whether the interim action was successful and is consistent with the compliance monitoring specified in the Interim Action Work Plan (Exhibit B) of the Amended Agreed Order (Herrenkohl Consulting and Integral Consulting 2011b). The empirical data generated from the groundwater characterization will also be used to further evaluate the groundwater leaching pathway and complete the RI/FS report for the Site.

1.3 DOCUMENT ORGANIZATION

Section 2 of this SAP presents the investigative approach that will be used for sampling the site including soil boring/monitoring well locations, depths, and sample selection for analysis. Sample field methods, sample identification, decontamination procedures, management of investigation-derived wastes, field documentation, and health and safety considerations are described in Section 3. Laboratory methods, quality assurance/quality control (QA/QC) procedures, and data quality review procedures are provided in Section 4. References are presented in Section 5.

Referenced figures and tables are presented at the end of the SAP. Appendix A contains field forms.

2 INVESTIGATION APPROACH

A limited access, track-mounted hollow-stem auger (HSA) will be used to drill soil borings and install groundwater monitoring wells at 4 locations onsite and one upgradient location on adjacent Bellingham Technical College (BTC) property (Figure 2). Selected soil samples from each boring will be analyzed for metals, PAHs, and PCP. Additional soil samples will be archived for possible future analysis, if required. Groundwater monitoring wells will be installed at each location with groundwater samples collected during the wet season (November-June). Groundwater samples will be analyzed for total and dissolved metals, PAHs, PCP, and conventional parameters (e.g., nitrogen compounds). Additional groundwater sampling may be necessary based on the results of the proposed sampling event.

2.1 STATION LOCATIONS

Proposed soil boring/well locations were selected to best characterize groundwater quality at the Site (Figure 2):

- Stations EML-SB-01, EML-SB-02, and EML-SB-03 will be located within the boundary of the interim action, but upgradient of the Birchwood/BTC stormwater channel (designated point-of-compliance);

- Station EML-SB-04 will be located northeast and upgradient of the interim action area; and

- Station EML-SB-05 will be located in the BTC parking lot, upgradient of the interim action area (Herrenkohl Consulting and Wilson Engineering 2011b).

Proposed soil borings/well locations may be adjusted in the field based on location of utilities and other field conditions.

2.2 SOIL BORING DEPTHS

The soil borings will extend to a depth of approximately 10 to 25 feet below ground surface (bgs)[3] to provide information in the upper groundwater zone at the Site. Based on previous investigation within the Park, a silty clay layer likely delineates the lower depth of this shallow, groundwater zone at the Site (Herrenkohl Consulting and Integral Consulting 2011a).

Proposed soil boring depths may be adjusted based on field observations and conditions.

[3] The soil boring depths at locations EML-SB-01 through EML-SB-04 are expected to be 10 to 15 ft bgs. The depth for EML-SB-05 is expected to be from 20 to 25 ft bgs.

2.3 SOIL SAMPLE SELECTION FOR ANALYSIS

The number of soil samples and the depth intervals identified for sample collection will largely be dependent on the boring location and the judgment of the field geologist. However, in general, the following sampling strategy will be used to characterize the vertical subsurface soil at the 5 locations throughout the site:

- At locations where no evidence of contamination is observed based on field observations such as odor, sheen, discoloration, or debris present in the samples, three soil samples will be collected for analysis at the analytical laboratory:
    1. One sample will be collected from a 0.5- to 1 ft interval in the upper 2 ft of soil;
    2. A second sample will be collected from a 1-ft interval between 2 and 6 ft bgs to evaluate contaminant concentrations (such as metals that cannot be screened in the field) above the MTCA conditional point-of-compliance for terrestrial ecological receptors (6 ft bgs); and
    3. A third sample will be collected from a 1-ft interval between 10 to 15 bgs to characterize soil above the MTCA human health point-of-compliance for direct contact (15 ft bgs).

  The first two depth intervals will not be collected at stations EML-SB-01, EML-SB-02, and EML-SB-03 located in the interim action area (uppermost soil layer is imported fill).
- At locations where evidence of contamination is observed based on field observations such as odor, sheen, discoloration, or debris present in the samples, one soil sample will be collected and archived from the zone of contamination (1-ft interval) and another soil sample will be collected from a 1-ft interval below the zone of contamination (based on visual and olfactory observations) to define the vertical extent of contamination. These soil samples may be in addition to the soil sample collected within the upper 2 ft of soil, but may replace the soil samples to be collected at deeper intervals as described above for those explorations where no evidence of contamination is observed.

Soil samples will be analyzed for metals (arsenic, cadmium, copper, lead, mercury, zinc), PAHs, and PCP following methods described in Section 4. A representative portion of each soil sample will also be archived (frozen) for possible future analysis, if necessary.

2.4 GROUNDWATER ANALYSIS

Groundwater samples collected from each well will be analyzed for hardness (calcium, magnesium), nitrogen compounds (ammonia, nitrite, nitrate), metals (arsenic, cadmium, copper, lead, mercury, zinc, iron, manganese), PAHs, and PCP following methods described in Section 4. Both total and dissolved metals will be analyzed for the groundwater samples.

3 FIELD INVESTIGATION METHODS

This section presents the field sampling methods to be used by Herrenkohl Consulting and its subcontractors for the groundwater characterization in support of the Eldridge Municipal Landfill RI/FS.

3.1 SITE PREPARATION

Proposed soil boring/groundwater monitoring wells will be identified in the field with a clearly marked wooden stake. The proposed sampling positions will be located using a backpack Ashtech Global Positioning System (GPS) with an accuracy of approximately ±1 m. Prior to commencing intrusive field activities, a utility location survey will be conducted using the regional One-Call service (1-800-424-5555) to locate and identify all known underground utilities near the study area. In addition, the City's Park Maintenance and Operations Department and BTC will locate any known utilities that are not covered by the One-Call Service including wastewater lines, irrigation systems, stormwater lines, and electrical lines (from the meters out). If underground or overhead utility lines interfere with proposed groundwater monitoring well and sample locations, alternate locations will be identified and marked before sampling begins.

Herrenkohl Consulting and its subcontractors will be given approval by City and BTC personnel to access Park and BTC property for well installation and sampling operations in support of this work. This may include the establishment of sample processing stations and storage of drilling and other field equipment and supplies on site, as needed, during the field investigation.

3.2 HORIZONTAL AND VERTICAL CONTROL METHODS

Once sampling has been completed for the Site, well and sampling stations will be located by a professional land surveyor licensed in the state of Washington using conventional Total Station positioning methods and RTX GPS. Survey control stations established previously within the Site will be utilized to maintain system accuracy. Northing and easting coordinates will be provided in North American Datum 1983 (NAD 83) with recent corrections and an accuracy of 0.1 ft. Using control points established by the professional land surveyor, the elevation of each groundwater monitoring well will be determined by differential leveling. Station elevations will be referenced to the geodetic North American Vertical Datum of 1988 (NAVD 88) with an accuracy of 0.01 ft. Both the top of monitoring well casing elevation and ground surface elevation adjacent to the monitoring well will be measured by the surveyors.

3.3 SOIL INVESTIGATION

Boreholes for collecting soil samples will be drilled using a limited access, track-mounted hollow-stem auger drilling rig. The boreholes will be constructed into permanent groundwater monitoring wells. The borings will extend into the shallow groundwater zone. Based on documentation from previous soil explorations, depth to the groundwater at the Site likely ranges from 10 to 15 ft bgs. All soil borings will be completed by a licensed driller and under the supervision of a geologist licensed in the State of Washington. Soil will be described in accordance with the Unified Soil Classification System (USCS) (ASTM D2487) using the visual-manual procedures for describing soils (ASTM D2488).

3.3.1 Sample Collection Procedures

Soil samples will be collected at 2.5 ft depth intervals throughout the length of each boring. A split-spoon sampling device (2-inch outside-diameter, 18-inch long) will be used to collect the soil samples. The auger will be advanced to the top of the desired sampling depth, the drill equipment removed, and the split spoon will be attached to the drilling rod. A decontaminated split-spoon sampler will be lowered into the borehole and a hydraulic 140-pound hammer will be used to advance the sampler into the undisturbed soil just below the bottom of the hole. The "blow counts" from the standard penetration test (SPT) will be recorded for geotechnical characterization. The sampler will then be removed from the hole and the sample will be visually inspected and prepared for collection. After the sample has been collected, the auger will be advanced to the next depth interval, a decontaminated split-spoon sampler will be attached to the drill rod and this process will be repeated until the total borehole depth has been reached.

After the split-spoon is opened, the soil type will be evaluated by the field geologist and recorded on a Log of Exploration form (Appendix A). The soil column retained in the split-spoon will be screened for visual and olfactory evidence of contamination. Each soil sample will be placed into decontaminated stainless-steel bowls and homogenized until the sample is of uniform color and texture using a decontaminated stainless-steel spoon prior to being placed into pre-labeled laboratory-supplied containers for analysis and/or archive. Samples will be placed in a cooler with ice and chilled to 4°C immediately after collecting the sample. Clean nitrile gloves will be worn when collecting each sample. The samples will be submitted to the analytical laboratory under chain-of-custody protocol.

Field duplicates and blanks (e.g., equipment blank) will not be collected as part of this investigation.

3.3.2 Soil Sample Identification

This section presents the proposed sample identification procedures for soil samples collected as part of the Site characterization.

Soil samples will be assigned an individual sample identification number in the following manner:

EML-SB-## - ##

Where: = Eldridge Municipal Landfill (EML)

Sample Type: SB= Soil Boring

Sample Location: ## = Station Number

Depth Interval: - ## = top and bottom depth increment in feet bgs (using 0.1 ft increments)

3.4 GROUNDWATER INVESTIGATION

The groundwater investigation will consist of installing 5 shallow groundwater monitoring wells, developing the wells, and collecting groundwater samples for analysis as described further below.

3.4.1 Groundwater Well Installation and Construction

Five permanent monitoring wells will be installed within the shallow groundwater zone of the Site. As discussed in Section 3.3, boreholes for groundwater monitoring wells will be advanced using a limited access, track-mounted hollow-stem auger drilling rig. Prefabricated 2-inch-outside diameter wells with flush-threaded couplings will be installed in the borings after the soil samples have been collected and the borings have been advanced to the target depths. The monitoring wells will be constructed with 2-inch diameter, flush-threaded, Schedule 40 polyvinyl chloride (PVC) pipe and 5-ft screens with 0.020-inch machine slotted casing and filter pack material consisting of pre-washed, pre-sized number 10/20 silica sand. The filter pack will be placed from the bottom of the well to approximately 2 ft above the top of the screen. Filter pack material will be placed slowly and carefully to avoid bridging of material. A bentonite seal will be placed above the filter sand pack material to within about 3 ft of ground surface and hydrated with potable water[4]. Grout will be used to backfill the boring to the subgrade for placement of the protective cover. The wells will be completed with a concrete surface seal and flush-mounted protective well monument.

The well names and the identification numbers assigned by Ecology will be marked on the well identification tags supplied by Ecology and will be attached to each well casing following well installation.

Monitoring wells will be constructed by a drilling contractor licensed in the State of Washington in accordance with the Minimum Standards for Construction and Maintenance of Wells (WAC 173-160; Ecology 2006). Oversight of drilling and well installation activities will be supervised by a licensed geologist familiar with environmental sampling and construction of resource protection wells.

[4] A variance may be required from Ecology if the monitoring wells are too shallow to accommodate 2 ft of sand, the bentonite seal, and 3 ft of concrete/grout above the screen.

3.4.2 Monitoring Well Development

Following construction, each monitoring well will be allowed to sit for a minimum of 24 hours to allow the bentonite seal to stabilize. The monitoring wells will be developed after the stabilization period to remove fine-grained formation materials from the well borehole and the filter pack prior to groundwater level measurement and sampling. Development will be achieved by repeatedly surging the well with a surge block and purging the well with a submersible centrifugal pump until the water runs clear. A minimum of 10 well casing volumes will be purged. During development, the purged groundwater will be monitored for the following field parameters:

- pH
- Conductivity
- Temperature
- Turbidity

The wells will be developed until the turbidity of the purged groundwater decreases to 50 Nephelometric turbidity units (NTUs), if practical. If the well dewaters during the initial surging and purging effort, one final well casing volume will be removed after the well has fully recharged, if practical. Well development activities will be recorded on a Well Development form (Appendix A).

3.4.3 Groundwater Sampling

Groundwater samples will be collected once from each of the monitoring wells during the wet season (November to June). Additional groundwater sampling may be necessary based on the results of the proposed sampling event. Collection of groundwater samples will be completed at each monitoring well using the following procedures:

- Immediately following removal of each well monument cover, the well head will be observed for damage, leakage, and staining and the air space will be assessed for any odors emanating from the well. Any damage, leakage, or staining to the well head or well opening and/or any odors will be recorded on the field data sheet.
- Water levels will be monitored by measuring depth-to-water at each of the new wells prior to sample collection for evaluating groundwater elevation at the Site. Water level measurements will be obtained at each monitoring well prior to purging and sample collection. All water levels will be measured from a surveyed reference point on the top of the well casing using an electronic water level indicator and recorded to the nearest 0.01 ft on the field data sheet. Water level measurements will be synoptic, meaning all measurements obtained as close together in time as possible (no more than 30 minutes total).

- Prior to sampling, each well will be purged using a peristalitic pump that is attached to dedicated purge and sample collection Teflon-coated tubing (types of pumps used may vary depending on purge volume and depth to water and may include a centrifugal pump, a peristaltic pump, or an electric submersible pump). During each sampling event, the intake end of the tubing will be slowly and carefully lowered into place at the center or slightly above the center of the well screen interval to minimize excessive mixing of stagnant water in the casing. Purging will begin with a low pumping rate (i.e., 0.1 to 0.5 liters/minute). The rate will be adjusted upward slowly to minimize drawdown (with a target drawdown of less than 0.33 ft) during purging.
- Field parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity, will be continuously monitored during purging using a flow cell meter. The field parameters will be recorded on the field data sheet every 3-5 minutes. Purging of the well will be considered to be complete when all field parameters become stable for three successive readings. The successive readings should be within +/- 0.1 pH units, +/- 3% for conductivity, and +/- 10% for dissolved oxygen and turbidity.
- Purge data will be recorded on a Groundwater Sample Collection form including purge volume and pumping rate (Appendix A); time of commencement and termination of purging; any observations regarding color, odor, 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 meter will be disconnected and groundwater samples will be collected directly from the tubing. 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).
- Groundwater samples will be collected into the appropriate sample containers using a peristaltic pump.
- Groundwater samples slated for dissolved metals analyses will be collected last and field filtered through a 0.45 micron, in-line disposable filter. Dissolved metal samples will be preserved, as specified in Section 4. A note will be made on the sample label, sample collection form, and chain-of-custody (COC) to indicate the sample has been field filtered and preserved, including the type of preservative used.
- Samples will be placed in a cooler with ice and chilled to 4°C immediately after collecting the sample. Clean nitrile gloves will be worn when collecting each sample. The samples will be submitted to the analytical laboratory under chain-of-custody protocol.
- Any problems or significant observations will be noted in the "comments" section of the Groundwater Sample Collection form (Appendix A).

Groundwater samples will be submitted to the laboratory for analysis as described in Section 4. Field duplicates and blanks (e.g., equipment blank) will not be collected as part of this investigation.

3.4.4 Groundwater Sample Identification

This section presents the proposed sample identification procedures for groundwater samples collected as part of the Site characterization.

Groundwater samples will be assigned an individual sample identification number in the following manner:

EML-GW-##

Where: = Eldridge Municipal Landfill (EML)

Sample Type: GW= Groundwater Well

Sample Location: ## = Station Number

3.5 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination of all equipment upon arrival to the Site, between sample locations, and prior to removal from the Site.

Upon arrival onsite, all drilling equipment (i.e., drilling rods and augers) will be cleaned using a high-pressure hot water or steam washer before initial use. Drilling equipment will also be steam cleaned between sampling locations and prior to removal from the Site. All non-disposable sampling components of the soil/sediment drilling equipment (e.g., split spoons), or other equipment used to collect soil/sediment samples that contacts the soils/sediments, will be decontaminated as follows:

- Potable water rinse
- Alconox/Liquinox detergent wash
- Potable water rinse
- Distilled water rinse
- Air dry (or cover with aluminum foil if dust is a concern)

3.6 INVESTIGATION-DERIVED WASTE

The primary waste streams to be generated during this project and the proposed storage/disposal methods are discussed in the following sections. Soil and water Investigation-Derived Wastes (IDW) will be stored in labeled 55-gallon Department of Transportation (DOT)-approved drums at a secure location onsite (location to-be-determined) until proper off-site transport and disposal.

3.6.1 Soil Waste

Soil that is rejected or determined to be in excess of what is required to conduct analytical sampling will be stored in a labeled 55-gallon DOT-approved drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting.

Excess soil from the drilling activities (drill cuttings) will be collected by the driller and contained in labeled 55-gallon DOT-approved drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting.

3.6.2 Liquid Waste

Liquid wastes (i.e., dewatering water and decontamination waters) may be potentially contaminated with metals, PCP, and PAHs. The presence of any chemical constituents in the wastewaters is expected to be diluted; therefore, the wastewaters are not expected to be classified as dangerous or hazardous waste. Although the wastewaters are not likely to contain hazardous waste pursuant to the contained-in policy (i.e., environmental media that contain a listed hazardous waste are to be managed as a hazardous waste), they will be collected in labeled 55-gallon DOT-approved drums for proper off-site disposal. Disposal of material will be the responsibility of the City with oversight and guidance provided by Herrenkohl Consulting.

3.6.3 Personal Protective Equipment/Miscellaneous Debris

Used personal protective equipment (PPE) and miscellaneous spent supplies and waste materials will be generated during sampling activities. The PPE and spent supplies will be cleansed of gross contamination and placed in plastic garbage bags. Interim storage of these materials in plastic bags is acceptable. The bags are to be disposed of at an appropriate solid waste facility dumpster after the completion of each sampling event. Disposal of material will be the responsibility of field personnel.

3.7 FIELD DOCUMENTATION

The primary types of documentation that will be used for this project include site logbook, photo logs, sample log forms, and sample tracking forms. The site logbooks are vital for documenting all onsite activities including names of contractors, time and date of activities, and detailed descriptions as sampling progresses. Photo documentation will be used to provide an accurate account of the material sampled, sample locations, and environmental conditions. Sample log forms are used to summarize field sample data collected for various sample locations. Sample tracking forms include the sample labels, custody seals, and chain-of-custody forms. Sample labels are used to provide essential information and identification for all samples collected during field activities. Custody seals are used on all sample shipment containers to detect any tampering that may have occurred during transport or shipment. The chain-of-custody form is used to track sample custody, which is an important aspect of field investigation activities that documents the proper handling and integrity of the samples. Example field forms are presented in Appendix A.

3.8 HEALTH AND SAFETY CONSIDERATIONS

General health and safety provisions to protect workers from potential hazards during field activities described in this SAP are presented in the Site HASP (Herrenkohl Consulting 2011). Ecology does not approve health and safety plans.

The HASP applies to the employees of Herrenkohl Consulting and its subcontractors while conducting the following field activities at the site:

- Hollow-stem auger soil borings
- Groundwater monitoring well installation
- Groundwater sampling
- Surveying.

A copy of the HASP will be with the field crew during field activities. All individuals performing fieldwork must read, understand, and comply with this plan before undertaking field activities. Once the information has been read and understood, the individual must sign the Acknowledgment Form provided, which becomes part of the project file.

The HASP may be modified at any time based on the judgment of the site safety and health officer in consultation with the project manager. Any modification will be presented to the onsite team during a safety briefing and will be recorded in the field logbook.

4 LABORATORY METHODS

Soil and groundwater monitoring samples will be analyzed for nitrogen compounds (groundwater only), metals, pentachlorophenol, and PAHs as described in the following sections. The laboratory will provide standard turnaround of sample results. Detailed analyte lists and recommended reporting limits are provided in Table 1. Laboratory quality assurance/quality control requirements (QA/QC) are summarized in Section 4.4 followed by data quality review procedures in Section 4.5.

4.1 NITROGEN COMPOUNDS

The nitrogen compounds ammonia, nitrite, and nitrate will be analyzed in the groundwater samples. Ammonia will be analyzed by colorimetry using EPA Method 350.1. Nitrite and nitrate will be analyzed by ion chromatography using EPA Method 300.0.

4.2 METALS

Soil samples will be analyzed for arsenic, cadmium, copper, lead, and zinc by inductively coupled plasma/mass spectrometry (ICP/MS) using EPA Method 200.8. Soil samples will also be analyzed for mercury by cold vapor atomic absorption (CVAA) using EPA Method SW 7471A (Table 1). Strong acid digestion with nitric acid and hydrogen peroxide will be used to prepare soil samples for analysis (EPA Method SW 3050B).

Two methods will be used to analyze groundwater samples for total and dissolved metals. Digestion with nitric and hydrochloric acids will be used to prepare samples for analysis of metals other than mercury using EPA Method SW 3005. Analysis for arsenic, cadmium, copper, lead, zinc, iron, manganese, calcium and magnesium will be completed by ICP/MS (EPA Method 200.8). Mercury samples will be digested with aqua regia, oxidized using potassium permanganate, and analyzed by CVAA (EPA Method 7470A). The laboratory instruments will be set to report the MDL as well as the reporting limit. During data validation, concentrations observed between the MDL and the reporting limit will be identified and qualified as estimated values.

4.3 PENTACHLOROPHENOL AND PAHS

Soil samples will be analyzed for PCP and PAHs[5] by gas chromatography/mass spectrometry (GC/MS) using EPA Method SW 8270D low-level selected ion monitoring (SIM) analysis

[5] PAHs will be measured using low-level SIM analysis and include naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene(s) (total), benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene.

(Table 1). Sonication by EPA Method SW 3550C will be used to prepare soil samples for analysis.

Continuous liquid-liquid extraction will be used to extract PAHs and PCP from groundwater samples (EPA Method SW 3510C). PAHs and PCP will be analyzed by GC/MS using Method SW 8270D and SIM analysis. The laboratory instruments will be set to report the MDL as well as the reporting limit. During data validation, concentrations observed between the MDL and the reporting limit will be identified and qualified as estimated values. Any suspended material in the groundwater samples will be allowed to settle prior to collecting an aliquot for analysis.

Tentatively identified compounds (TICs) will not be reported for this study.

4.4 CORRECTIVE ACTIONS

Corrective actions may be initiated in response to deviations from this SAP or laboratory protocols. If deviations from this SAP or unexpected conditions are encountered in the field, the field manager will immediately institute the necessary corrective actions (with City and Ecology notification and approval), complete a field change request (FCR) form (refer to Appendix A), and conduct an evaluation to ensure that the correct procedures continue to be followed. In circumstances where sampling conditions are unexpected, the appropriate sampling actions consistent with project objectives will be conducted. The procedural change will be noted in the field log and a corrective action report will be completed for the project files.

At the laboratory, any deviations from the SAP or laboratory protocols will be addressed by the laboratory's project manager and QA officer. The laboratory's project manager is responsible for maintaining records of QC issues related to laboratory work and for notifying the project QA manager of the QC issues. The project QA manager will be responsible for evaluating all reported non-conformances, conferring with the project manager, and verifying that the corrective action is implemented as developed and scheduled by the laboratory's project manager or QA officer. Corrective action records generated at the laboratory will be included with the data package and discussed in the case narrative.

4.5 QUALITY ASSURANCE AND QUALITY CONTROL

Extensive and detailed requirements for laboratory QC procedures are provided in the method protocols that will be used for this study. Every method protocol includes descriptions of QC procedures, and many incorporate additional QC requirements by reference to separate QC sections. QC requirements include control limits and, in many cases, requirements for corrective action. QC procedures will be completed by the laboratories, as required in each method protocol and as indicated in this plan.

The frequency of analysis for laboratory control samples, matrix spike samples, matrix spike duplicates or laboratory duplicates, and method blanks will be one for every 20 samples or one per extraction batch, whichever is more frequent. Surrogate spikes and internal standards will be added to every field sample and QC sample, as required by the method. Calibration procedures will be completed at the frequency specified in each method description. As required for EPA SW-846 methods (USEPA 2010), performance-based control limits have been established by each laboratory. These and all other control limits specified in the method descriptions will be used by the laboratories to establish the acceptability of the data or the need for reanalysis of the samples.

4.6 DATA QUALITY REVIEW PROCEDURES

Field and laboratory data for this project will undergo a formal verification and validation process. All entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Data verification and validation for metals, PCP, and PAHs will be completed according to methods described in the guidelines for inorganic and organic data review (USEPA 2004, 2008).

Data quality review will include evaluations of the following:

- Chain-of-custody methods
- Holding times
- Laboratory method blanks
- Surrogate recoveries
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes and blank spike duplicates
- Laboratory duplicates
- Completeness
- Overall assessment of data quality.

Data will be qualified as estimated if results for laboratory control samples, matrix spike samples, and matrix spike or laboratory duplicates do not meet measurement quality objectives. Data will also be qualified as estimated as applicable if control limits for other QC samples or procedures do not meet performance-based control limits established periodically by the laboratory.

Data will be rejected if control limits for acceptance of data are not met (USEPA 2004, 2008).

5 REFERENCES

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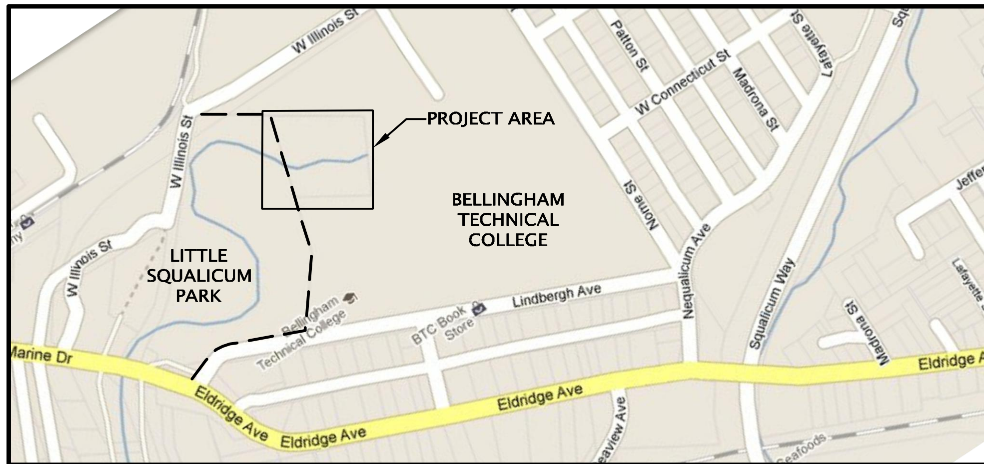
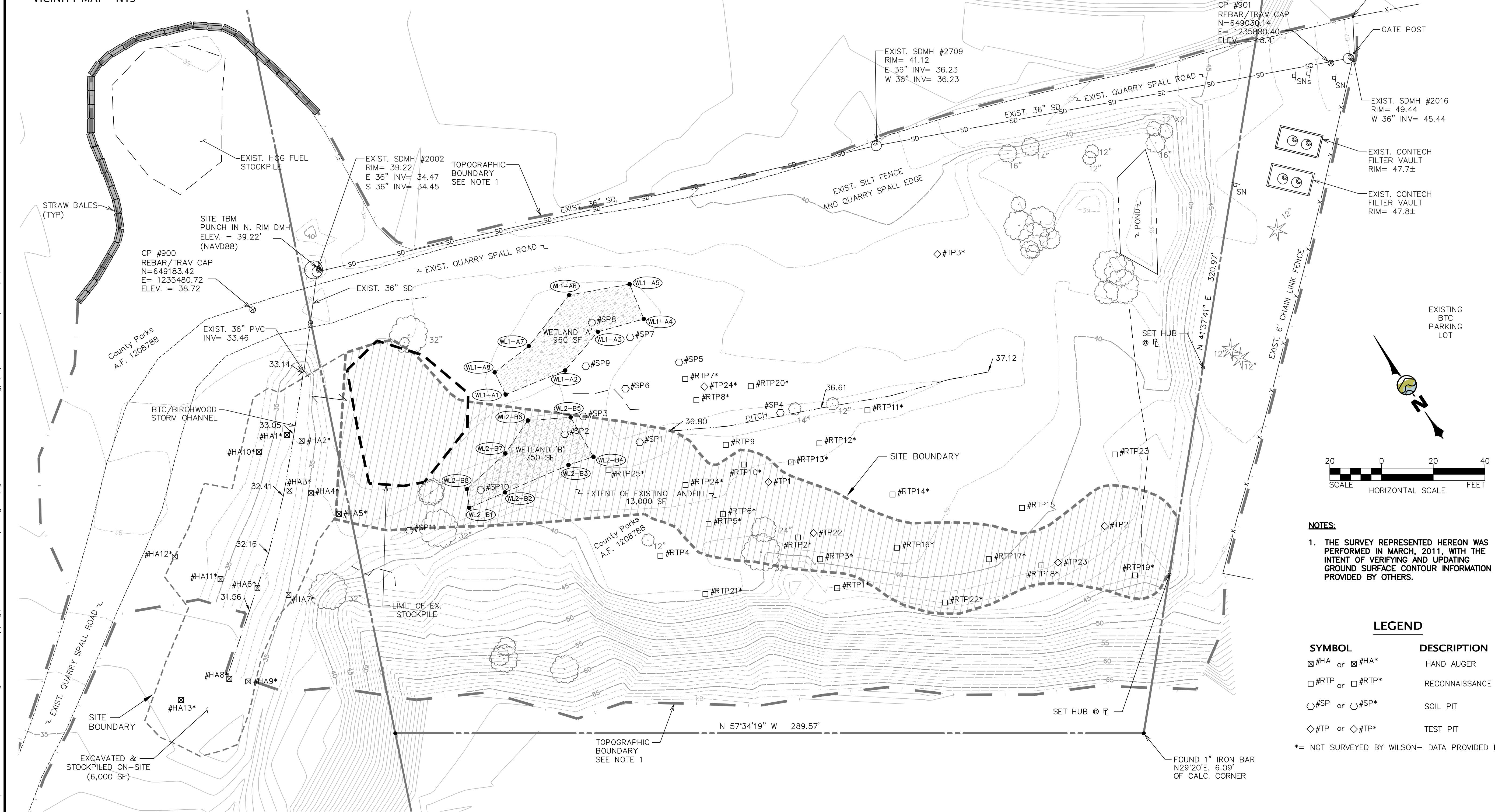
Table 1. Recommended Sampling Preparation Methods, Cleanup Methods, Analytical Methods, and Detection Limits for Soil and Groundwater Samples

Chemical	Recommended Sample Preparation Methods (Soil/Groundwater)	Recommended Analytical Methods (Soil/Groundwater)	Recommended Reporting Limit (Soil)	Recommended Reporting Limit (Groundwater)[6]
Arsenic	SW 3050B/SW 3005	EPA 200.8	0.2 mg/kg	0.2 ug/L
Cadmium	SW 3050B/SW 3005	EPA 200.8	0.2 mg/kg	0.1 ug/L
Copper	SW 3050B/SW 3005	EPA 200.8	0.5 mg/kg	0.5 ug/L
Lead	SW 3050B/SW 3005	EPA 200.8	1.0 mg/kg	0.1 ug/L
Zinc	SW 3050B/SW 3005	EPA 200.8	4.0 mg/kg	4.0 ug/L
Mercury	SW 3050B/SW 7470A	SW 7471A/SW 7470	0.025 mg/kg	0.01 ug/L
Ammonia	SM4500-NH3	EPA 350.1	--	0.10 ug/L
Nitrite, Nitrate	EPA 300.0	EPA 300.0	--	0.10 ug/L
Iron	SW 3005	EPA 200.8	--	20 ug/L
Manganese	SW 3005	EPA 200.8	--	0.5 ug/L
Calcium	SW 3005	EPA 200.8	--	50 ug/L
Magnesium	SW 3005	EPA 200.8	--	20 ug/L
Pentachlorophenol	SW 3550C/SW 3510C	SW 8270D	0.100 mg/kg	0.20 ug/L
PAHs[7]	SW 3550C/SW 3510C	SW 8270D SIM	0.020 mg/kg	0.010 ug/L

[6] For metals in groundwater, the laboratory instruments will be set to report the MDL as well as the reporting limit.
[7] For SVOCs in soils and groundwater, the laboratory instruments will be set to report the MDL as well as the reporting limit.



VICINITY MAP – NTS



NOTES:

1. THE SURVEY REPRESENTED HEREON WAS PERFORMED IN MARCH, 2011, WITH THE INTENT OF VERIFYING AND UPDATING GROUND SURFACE CONTOUR INFORMATION PROVIDED BY OTHERS.

LEGEND

SYMBOL	DESCRIPTION
⊠#HA or ⊠#HA*	HAND AUGER
□#RTP or □#RTP*	RECONNAISSANCE TEST PIT
○#SP or ○#SP*	SOIL PIT
◇#TP or ◇#TP*	TEST PIT

*= NOT SURVEYED BY WILSON– DATA PROVIDED BY OTHERS

NO.	REVISIONS	BY	DATE

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Wilson
SURVEY/ENGINEERING
ELIZABETH ANNE STERLING
STATE OF WASHINGTON
PROFESSIONAL
REGISTERED

DESIGNED BY EAS
DRAWN BY JCS
CHECKED BY

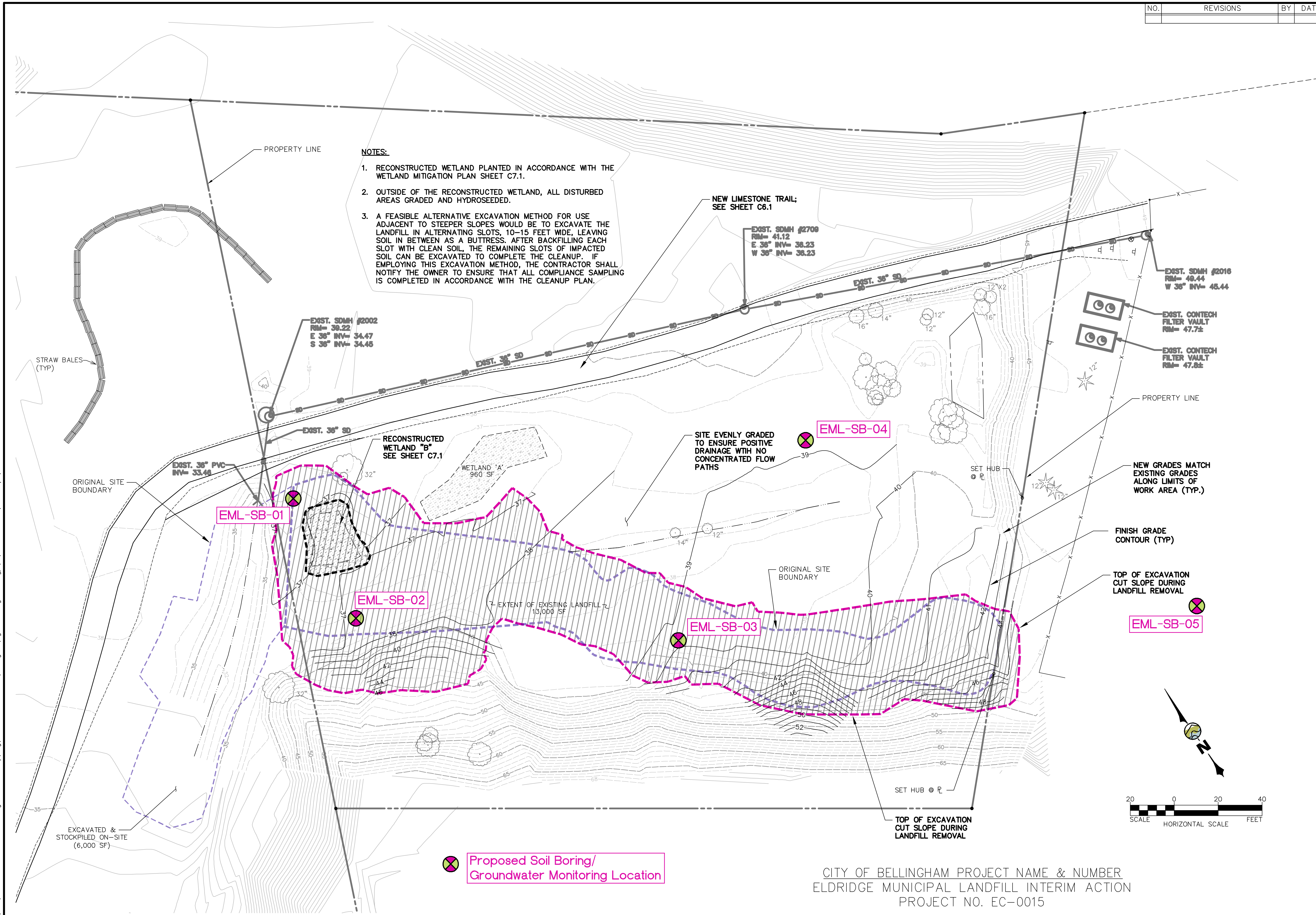
CITY OF BELLINGHAM

BELLINGHAM WASHINGTON

ELDRIDGE MUNICIPAL LANDFILL RI/FS

EXISTING CONDITIONS (BEFORE INTERIM ACTION)

DATE 04-27-2012
SCALE AS SHOWN
JOB NUMBER 2011-020
SHEET FIG 1 OF 2



CITY OF BELLINGHAM PROJECT NAME & NUMBER
ELDRIDGE MUNICIPAL LANDFILL INTERIM ACTION
PROJECT NO. EC–0015

NO.	REVISIONS	BY	DATE

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Wilson
SURVEY/ENGINEERING

DESIGNED BY EAS
DRAWN BY JCS/BAH
CHECKED BY

CITY OF BELLINGHAM
BELLINGHAM WASHINGTON
ELDRIDGE MUNICIPAL LANDFILL RI/FS
PROPOSED SOIL BORING/
GROUNDWATER MONITORING LOCATIONS

DATE 04-27-2012
SCALE AS SHOWN
JOB NUMBER 2011-020
SHEET FIG 2 OF 2

W:\2011\2011-020 Herrenkohl - COB Eldridge Landfill Cleanup\Dwg\HERRENKOHL EXHIBITS\SAP Figures\Fig2 Monitoring Wells.dwg, 4/27/2012 8:35:06 AM, AcroPlot.pc3, RDN

APPENDIX A
FIELD FORMS

HERRENKOHL CONSULTING LLC

321 Summerland Road
Bellingham, WA 98229

(360) 319-0721 FAX (360) 647-6980

BOREHOLE NUMBER ____
PROJECT ____
LOCATION ____
PROJECT NUMBER ____
LOGGED BY ____
DATE AND TIME ____

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)			USCS group name, moisture content and plasticity, color, minor and MAJOR constituents with grain size range, odor, sheen, texture, weathering, cementation, geologic interpretation, etc.
							1--		
							2--		
							3--		
							4--		
							5--		
							6--		
							7--		
							8--		
							9--		

DRILLING CONTRACTOR ____
DRILLING METHOD ____
SAMPLING EQUIPMENT ____
COORDINATES ____

SURFACE ELEVATION ____
DATUM ____

LOCATION SKETCH

N

Not to scale

EQUIPMENT CALIBRATION AND MAINTENANCE FORM (TYPICAL)

INSTRUMENT (NAME / MODEL NO. / SERIAL NO.): ______________________________

MANUFACTURER: ______________________________ DATE PURCHASED or LEASED: ______________________________

CALIBRATION LOGSHEET

Calibration Date	Initial Settings	Standard(s) Used	Procedure	Adjustments Made	Final Settings	Signature of Operator	Comments

MAINTENANCE LOGSHEET

Maintenance Date	Reason for Maintenance	Maintenance Performed	Signature of Operator	Comments

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: ____ Project No.: ______________________
Client: ____ Request No.: FCR-______________

To: ____________________________________ Date: _________________________________

Field Change Request Title: ____

Description:

____
____
____

Reason for Change:

____
____
____

Recommended Disposition:

____
____

____________________________	____________________________	____________________
Field Operations Lead (or designee)	Signature	Date

Disposition:

____
____

____________________________	____________________________	____________________
Project Manager	Signature	Date

Approval:

____________________________	____________________________	____________________
Project Manager	Signature	Date

Distribution:

Client Project Manager	QA Officer
Herrenkohl Consulting Project Manager	Project File
Field Operations Lead	Other:

(Additional Field Forms will be provided in the field)