FINAL

Appendix A: Sampling and Analysis Plan for the Former Eatonville Landfill

Ecology Facility Site ID No. 85933

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Abbreviations and Acronyms

bgs	below ground surface
CFR	Code of Federal Regulations
COC	chain of custody
COPC	contaminant of potential concern
DPT	direct push technology
DTW	depth to water
DU	decision unit
Ecology	Washington State Department of Ecology
EPH	extractable petroleum hydrocarbon
FM	Field Manager
FS	Feasibility Study
GSI	GSI Water Solutions, Inc.
HASP	Health and Safety Plan
HSA	hollow stem auger
ISM	Incremental Sampling Methodology
LiDAR	light detection and ranging
MTCA	Washington State Model Toxics Control Act
Order	2021 Agreed Order No. 20072
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
RCW	Revised Code of Washington
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RTK-GPS	Real Time Kinematic-Global Positioning System
SAP	Sampling Analysis Plan
Site	Former Eatonville Landfill
SPT	Standard Penetration Testing
SVOC	semi-volatile organic compound
TPH	total petroleum hydrocarbon
USCS	Unified Soil Classification System
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
Weyerhaeuser	Weyerhaeuser Company

SECTION 1: **Introduction**

This Sampling and Analysis Plan (SAP) for the Former Eatonville Landfill (Site)[1] is an appendix to the Remedial Investigation Work Plan (RIWP). This SAP was prepared by GSI Water Solutions, Inc. (GSI) on behalf of Weyerhaeuser Company (Weyerhaeuser) and the Town of Eatonville in Pierce County, Washington, in accordance with the requirements of the 2021 Agreed Order No. 20072 (Order) between the Washington State Department of Ecology (Ecology), the Town of Eatonville, and Weyerhaeuser, pursuant to the Washington State Model Toxics Control Act (MTCA; Revised Code of Washington 70.105D.010) and MTCA regulations (Washington Administrative Code Chapter 173-340).The Eatonville Landfill is shown in Figure 1.

This SAP was developed to comply with a requirement of the Order between Ecology, the Town of Eatonville, and Weyerhaeuser. A primary objective of the Order is to develop a remedial investigation/feasibility study (RI/FS) that will determine what remedial actions are required to comply with current MTCA regulations. Specifically, in Section V.I of the Order it states: "*Ecology has assessed conditions at the Site and as a result of its investigation the property is listed on the database of confirmed or suspected contaminated sites. Ecology's investigation found surface water contaminated with metals, halogenated and non-halogenated organic chemicals. Soil and groundwater impacts are also suspected. Additional remedial investigation activities are necessary to characterize the nature and extent of contamination and to support selection of feasible remedial and closure alternatives*."

The objective of this work is to investigate activities intended to address the Site data gaps outlined below:

- The current conditions of the landfill and landfill cover have not been visually characterized in detail.
- The spatial extent, depth, and variation of waste present in the landfill are unknown. The types of wastes disposed over time are unknown and have not been documented across the full extent of the Site.
- The extent of contamination in soil, wetland sediment, groundwater, and surface water/seeps within and adjacent to the landfill is unknown. The quality of offsite soil/sediment, groundwater and surface water entering/exiting the landfill has not been well characterized.
- The temporal variation in contaminant concentrations, especially in water, is unknown. Samples have been collected in both the dry and wet season, but not in consecutive seasons.
- The groundwater gradient and depth to groundwater, while relatively known at a regional scale, have not been characterized at this Site.
- The geotechnical characteristics of soil and bedrock underlying the landfill are unknown. The potential for future slope instability due to remedial action has not been evaluated.

[1] For the purposes of the Remedial Investigation Work Plan (RIWP), the Site encompasses the real property currently owned by Weyerhaeuser. The final site definition will be developed after completion of the remedial investigation/feasibility study (RI/FS).

SECTION 2: **Health and Safety**

The Field Manager (FM) will function as the safety officer during the fieldwork and ensure that safe practices and operating conditions are maintained during the field investigation. The field crew will comply with Hazardous Waste Operations and Emergency Response regulations under Code of Federal Regulations (CFR) 1910.120. The FM will provide a safety briefing at the beginning of the fieldwork, during sampling events as needed (e.g., when conducting new or different field activities), and to any new personnel involved in the field activities.

GSI prepared a Health and Safety Plan (HASP) (Appendix C of the RIWP) in accordance with Occupational Safety and Health Administration regulations (29 CFR Part 1910). The HASP covers all known field hazards associated with the tasks necessary to complete this SAP. All field personnel will have stop-work authority during the completion of field activities.

SECTION 3: **Scope of Work**

The field scope will be used to characterize contamination, waste, and geotechnical parameters in and around the Site. The field investigation will include a comprehensive visual survey, geotechnical assessment, and sampling/analytical regime to address the data gaps outlined above.

Specifically, the following actions will be completed:

- Visual reconnaissance of the entire Site, where possible
- Aerial survey of the Site using a drone quadcopter (or similar), where visual reconnaissance is not possible
- Multi-media sample collection to evaluate contaminant of potential concern (COPC)
- Field geotechnical assessments and collection of soil samples to support geotechnical assessments
- Placement of wells/piezometers to monitor groundwater upgradient of the upper extents of the landfill and downgradient of the toe of the landfill

Samples will be collected from locations identified in Figure 2. The proposed RI investigation activities include:

- Drilling of soil borings using a direct push rig across the upper, accessible portions of the landfill footprint to delineate horizontal and vertical extents and thicknesses of the waste, as well as characterizing the underlying soil surface in contact with the landfill materials.
- Hand collection of surficial landfill cover soil (less than 6 inches below ground surface [bgs]) using the Interstate Technology and Regulatory Council Incremental Sampling Methodology (ISM) (ITRC, 2020) approach across accessible portions of the landfill footprint to characterize COPC concentrations in surface soil.
- Composite soil sample collection along transects at and beyond the base of the landfill using a hand auger to characterize COPC concentration gradients in shallow soil.
- Well installation using a hollow-stem auger (HSA) drill rig outside the waste prism north (and upgradient) of the upper landfill to support groundwater flow gradient analysis and characterize incoming COPC concentrations in groundwater not anticipated to be impacted by landfill activities (i.e. – background).
- Drill deep boring using a HSA drill rig outside the waste prism in north (and upgradient) of the upper landfill to assess seismic stability, bedrock presence or absence, and confirm subsurface lithology.
- Piezometer installation using a hand auger or other hand methods in the wetland area to support groundwater flow gradient analysis and characterize COPC concentrations in shallow groundwater.
- Map features present in the wetland area to define seeps, springs, standing or pooled and flowing water and directions of discharge. This will include mapping areas of saturated and dry soil/ sediment near the landfill toe.
- Collection of surface water samples in seeps encountered in the suspected waste prism during visual reconnaissance to characterize COPC concentrations.
- Collection of surface water samples in springs and flowing water encountered in or adjacent to the landfill during visual reconnaissance to characterize potential impacts from the landfill, if any.
- Installation of soil gas collection probes and collection of soil gas samples to determine current landfill methane generation concentrations.

- Collection of soil samples for geotechnical analysis during sample collection for other investigation goals to support future FS evaluations and eventual remedial resign. This will, at a minimum, include Standard Penetration Testing (SPT) during well installation with HSA drilling and use of a hand-held vane shear probe in borings across the base of the landfill.

SECTION 4: **Site Reconnaissance**

4.1 Aerial Drone Survey

Prior to any disturbance to the surface of the landfill through investigation activities, a quadcopter drone or similar will be used to perform a video survey of the Site extents. This survey will be performed where open access is achievable (mainly over the waste prism) to determine existing conditions, especially in areas where personnel access is limited due to safety concerns with exposed waste and steep slopes.

The drone will be operated by a certified and licensed operator. Documentation of compliance with Federal Aviation Administration regulations, an operator insurance and safety plan, and instrument specifications and survey methodology will be requested prior to survey.

4.2 Visual Reconnaissance

A pre-loaded base map will be added to ArcGIS Collector, so it can be accessed remotely in the field on a tablet using the Collector application. A Real Time Kinematic-Global Positioning System (RTK-GPS) grade survey system interfaced with a handheld tablet device will be used to provide accurate location information for features of note. This features will be uploaded into a final site base map which will be presented in the RI Report. In addition, the tablet will have the capabilities of collecting photos that can be georeferenced in support of the RI.

Reconnaissance activities will include, at a minimum, locations and types of waste visible, areas with suspected risk for future slope failure, indications of landslides that have occurred in the past, stormwater erosion and rills present within the waste prism footprint, surface water types (e.g. seeps, springs, standing and flowing water extents) encountered, and other features of note. At the edges of visible waste, points will be collected to allow for defining waste boundaries.

SECTION 5: **Sampling and Analysis**

5.1 Positioning and Recording Sampling Locations

Sample locations on Figure 2 have been pre-loaded in the RTK-GPS tablet for all but the landfill cover ISM sample locations. The field team will position over any pre-loaded sample locations and determine if adjustments are required for the actual sampling location due to actual field conditions. If greater than a 5-foot movement is necessary (field determined), the actual sampling location will be updated within the RTK-GPS tablet through recollection of the sampling point. Station accuracy may be affected by satellite positioning and obstructions, such as high steep banks or heavy cloud cover. A photo will be recorded at sampling locations where field staff deems it necessary to visually demonstrate field and sampling conditions.

5.2 Sampling Procedures for Evaluating COPCs

5.2.1 Soil Sampling

5.2.1.1 Drilled Soil Borings (Landfill Area)

Soil borings will be advanced within the area of suspected waste placement that will allow for safe drilling equipment access (SB-01 to SB-15, see Figure 2). Some of the planned boring locations may require adjustment or abandonment due to slope angle or slope stability. Borings will be advanced using a direct-push-technology (DPT) to define the lateral and vertical extent and thickness of waste material in areas where waste is found and to select locations for possible HSA borings. Drilling will proceed through landfill waste material until native soil/bedrock is reached. Drilling will continue 5 feet into the native layer or until refusal. In areas where waste is not present drilling will proceed to a depth of 10 feet below ground surface (bgs). Due to the possibility of borehole collapse or sloughing within the waste prism, a dual-tube drill rod system will be used to avoid uncertainty on characterizing waste extents and characteristics at varying depths. If refusal is reached well above the suspected interface with native materials, the drill rig will move up to 5 feet and make a second attempt. If shallow refusal is encountered upon second attempt, the location will be abandoned and noted in the field documentation. If DPT drilling indicates locations where successful HSA drilling may be possible (no large metal waste or refusal encountered), HSA borings may be drilled to allow for a more comprehensive waste evaluation. This drilling will use split spoon sampling and SPT results within the waste prism and the underlying soil to expand lithological understanding and determine density of waste. The concern with HSA drilled borings is the augers have a potential to become entangled in waste present in the landfill during drilling. Therefore, auger drilling was not chosen as the primary approach to drill through waste.

Continuous DPT material collection by coring of the borings will be performed and soil/waste will be logged in accordance with the Unified Soil Classification System (USCS) (ASTM D2487-17) (ASTM International, 2017) using the field form (see Attachment 1) to characterize the depth, extent, and characteristics of landfill material and the over- and underlying geology. These borings will also be used to determine if leachate is present. Additionally, the core will be field screened, which will consist of visually screening for waste or impacted soil (using olfactory indications, discolorations, leeching, sheen, and other similar factors) and testing suspected material with a photoionization detector (PID). If HSA drilling occurs, split spoons will be collected no less than every five feet and then no less than 18-inches into the native material. Results of field screenings will be added to the field log form.

If any considerable amounts of soil and/or leachate are present within the waste prism borings, samples may be collected and selectively analyzed using the appropriate soil or groundwater analytical suites. SAP Table 1 and the QAPP (Appendix B of the RIWP) identifies analyte suite specifications.

5.2.1.2 Hand-Augured Soil/Sediment Borings (Landfill Toe and Wetland Area)

Shallow soil/wetland sediment samples will be collected in three transects (approximately 50 feet apart moving away from the landfill base) consisting of five composite subsamples each (HA-01A to HA-03E, see Figure 2). The target subsample depth is 0 to 1 foot bgs, but may be adjusted based on field conditions. The first transect will be adjacent to the toe of the landfill and the third transect will be approximately 100 feet from the toe of the landfill. The five subsamples will be collected and homogenized in a decontaminated stainless-steel bowl to form one primary sample per transect.

The surface soil subsamples will be manually collected using a 3- to 4-inch hand auger as mechanical equipment is unable to access the base of the landfill. Each hand auger subsample location will be logged in accordance with the USCS using the field log sheet (see Attachment 1). Areas with considerable waste or vegetation will be noted on the log but will be avoided to ensure a representative soil sample is collected. Excess soil from the soil core will be placed back into the ground at the point of collection.

All materials, including the auger and stainless still spoons, will be decontaminated between each sub-sample collection location. Additional and alternative hand sampling tools will be available during sampling, as backup alternatives if needed.

5.2.1.3 ISM Surface Soil Sampling (Landfill Cover Soil)

The landfill cover soil and borrow pit material (located north of the landfill) will be characterized for COPC (as identified in Table 1) using ISM, a structured composite sampling protocol that reduces data variability, increases sample representativeness, and reduces the chance of missing significant contamination in a volume of soil targeted for sampling (ITRC, 2020). ISM characterizes the average COPC concentrations within a predefined area, called a decision unit (DU). The DU defines the area and depth of sampling upon which risk decisions can be based.

To conduct ISM sampling, numerous samples of soil (each called an increment) are collected and combined in the field and homogenized in a laboratory, and the homogenized sample is then subsampled according to specific protocols. For each DU, 50 minimum increments will be attempted but actual increments will be based on access. At least 30 increments are required for proper ISM protocol. The target depth for each subsample is 0 to 6 inches bgs. The incremental soil samples will be collected using a small-diameter (1- to 2-inch diameter) sampling device (stainless steel push tube), a decontaminated stainless steel trowel or small shovel, or decontaminated 3- to 4-inch hand auger. After collection of each increment, the RTK-GPS tablet will record increment location.

At each incremental location, after removal of surface vegetation, soil from the top 6 inches will be extruded from the sampling device and measured using a scale to achieve a target mass of approximately 100 grams per subsample. The material will then be placed into a large labeled, laboratory pre-cleaned 1-gallon glass sample container. Significant root mass and larger gravel and rocks, when present, should be removed from the top of the core and discarded. However, degraded or fine organic materials are acceptable for collection. The field sampler then will advance to the next incremental location and repeat the process. All increments from a single DU will be placed into a single sample container provided by the laboratory and will be homogenized and processed at the laboratory, as described in Section 8. When processing the ISM samples, the laboratory will use the entire sample volume from each DU (i.e., 30 or more incremental subsamples) to create a composited, homogenized sample. The ISM sample for each DU will be processed following the procedures of using standardized 2-dimensional Japanese Slab-Cake procedures (Gy, 1992).

5.2.2 Groundwater Sampling

At a minimum of four wells will be installed, two north of and upgradient of the landfill area and two in the wetland area. Groundwater samples will be collected to assess water quality, as well as water levels for evaluating groundwater gradient (PZ-01 to PZ-04, see Figure 2). All wells will be installed such that they be can maintained and kept in place for a minimum of two sampling events (one dry season sampling event [September 2021] and one wet season sampling event [January or February 2022]). The upgradient wells will be located along the landfill access road adjacent to the top of the landfill (PZ-01 and PZ-02, see Figure 2) and will be drilled using an HSA drill rig. A 2-inch polyvinyl chloride pre-packed well casing will be installed and screened across the water table and have a minimum 5 foot screen length. Actual screened length will be determined in the field based on geologic logging. The wetland area wells will be drilled by hand auger and set in place by hand (PZ-03 and PZ-04, see Figure 2). A 1.25-inch diameter by 1 or 2 foot long prepacked screen will be installed and depth of augering will determine the well screen length. A clean sand backfill will be placed to a minimum of 1 foot above the screened zone and the remainder of the annular space shall be filled with a bentonite grout or hydrated chips to the ground surface. Flush mount or above grade casings will used on the upper wells but are not needed on the wetland wells. At a minimum, the length of above grade casing will be measured (with a tape measure) from the top of the casing to the ground surface to the 1/100 of a foot. If possible, surveying will be performed to tie the top of the casing to North American Vertical Datum of 1988 elevation. Otherwise, ground surface will be estimated from light detection and ranging (LiDAR) surveys.

For all wells, groundwater will be sampled approximately one day (24 hours) after well installation to allow solids to settle and aim to achieve low turbidity in samples.

5.2.2.1 Hollow Stem Auger Drilled Wells (Upland Area)

Two upgradient borings will be advanced using HSA for the installation of monitoring wells to collect groundwater samples for COPCs, and geotechnical samples and data. These two aforementioned groundwater monitoring wells will be drilled upgradient of the landfill boundary to characterize incoming/background groundwater near the Site. These wells will be drilled and completed using an HSA to a depth of 5 feet beyond competent groundwater. If possible, based on drilling conditions, at least one borehole will be drilled to the anticipated base of the landfill (80 to 100 feet bgs), regardless of initial depth to competent water, to characterize the full lithological extents at the top of the slope and determine if bedrock is present. The borehole will then be grouted back to the depth of well placement using a cement bentonite grout. If HAS drilling is unsuccessful, mud rotary drilling will be evaluated for the deeper boring (or both) and performed at a later date in the fall.

Groundwater will be collected from these wells using a low-flow methodology to minimize introduction of air into the monitoring well column. Parameters collected in the field will be logged on a groundwater sampling field form (see Attachment 1).

First, depth to water (DTW) in feet will be measured using a decontaminated electronic water level meter and recorded. Purge tubing will be inserted into the well and slowly lowered to the center of the screened well zone within the casing. Using a peristaltic pump, the well will be purged at a flow rate of approximately 250 milliliters per minute and DTW will continually be monitored. Field parameters will be collected using a multi-parameter field instrument (YSI) connected via purge tubing to a flow-through cell as outlined in Section 5.2.2.3. These values will be monitored at approximately 5-minute intervals and recorded on the field form.

Purging is considered complete when field parameters have stabilized and water level drawdown is controlled in accordance with U.S. Environmental Protection Agency low-flow purging and sampling procedures (EPA, 2017). If these conditions are not met, purging is considered complete when (1) a minimum of three well volumes has been removed and successive field parameter measurements agree with the stability criteria based on three consecutive measurements taken 5 minutes apart; (2) at least five well volumes have been removed (even if field parameter stabilization criteria cannot be attained); or (3) the well has been pumped dry and allowed to recover sufficiently such that adequate sample volumes can be collected within 24 hours of the initial well purging.

Final field parameters will be collected and purge tubing removed from the flow-through the cell prior to collecting groundwater sample directly from purge tubing. Purge water will be managed as described in Section 7.

5.2.2.2 Hand-Augured Wells (Landfill Toe and Wetland Area)

To install wells in the wetland area, first a temporary well borehole will be created using a decontaminated hand auger, shovel, or post hole digger. Then, a decontaminated temporary push-in well screen (1.25-inch x 14-inch stainless steel piezometer) will be placed in the borehole. Groundwater will be allowed to accumulate in the installed piezometer for at least 24 hours to allow solids to settle. To collect the groundwater sample, a peristaltic pump with dedicated sample tubing will be used to transfer water from the temporary well into sample bottles. If necessary, additional accumulation time will be provided for the temporary well to refill with sufficient water to fill all sampling containers. Prior to sampling, field parameters (such as temperature, dissolved oxygen, oxygen reduction potential, pH, and specific conductivity) and turbidity will be recorded as outlined in Section 5.2.2.3.

5.2.2.3 Field Parameters

A YSI will be used to collect field parameters (pH, dissolved oxygen, temperature, conductivity, and oxygen-reduction potential) from groundwater and surface water samples. The YSI will be calibrated at the beginning of each field day when samples are collected. Calibration specifications will be recorded in the field log book. For each sample location, field parameters will be collected by either submerging the decontaminated YSI directly into water at the sample location or by using the peristaltic pump and a flow-through cell for parameter collection.

5.2.3 Surface Water (Seeps/Springs) Sampling

Samples will be collected from all seeps or springs daylighting within the Site, when identified (anticipated seep sampling area shown on Figure 2). Minimal equipment is anticipated to be required for collecting the samples. Due to the dry weather conditions, sampling seeps may require digging a shallow pit to enable effective sample collection. If sample is obtained by digging a pit to concentrate the water, adequate time will be allowed prior to sample collection to reduce the turbidity/total solids content of the sample.

If seeps are easily accessed, bottles will be filled by hand by decanting from a decontaminated scoop. During sample collection, sample bottle outsides will not be exposed to water being sampled. If digging is required to access seeps, a peristaltic pump will be used to transfer samples into bottles, ideally collecting water from the center of the water column containing low suspended solids/turbidity (as determined by visual observation). Care will be exercised to minimize disturbance to the surrounding soil while collecting samples. Where a bottle cannot easily be placed under the points of flow, a peristatic pump and disposable tubing will be used to collect low-flow samples. As with groundwater samples, a YSI meter will be used to collect field parameters in conjunction with sample collection.

5.2.4 Landfill Gas Monitoring

During drilling activities, landfill gas will be measured from open DPT and HSA borings using a direct read flammable gas meter that indicates gas levels relative to the lower explosive limit for methane. Anaerobic degradation of organic waste at landfills produce methane gas which poses a potential risk because methane is a flammable gas. Because the landfill has been undisturbed for forty (40) years and cover soil has not been effectively maintained, methane concentrations are anticipated to be low. Landfill gas odor can be an indicator methane is being produced.

The presence of landfill gas will be evaluated during the upper landfill DPT drilling and below the upper landfill portion by monitoring soil gas probes. Landfill gas will be monitored from borings and probes in refuse during dry conditions (no measurable precipitation for at least 48 hours) above perched water or the water table. Flammable gas readings will be taken using a flammable gas meter from open push borings after the drill pipe has been removed. Soil gas levels will be recorded in percent of the lower explosive limit and recorded on daily the field log forms.

Landfill gas readings for mid and lower landfill portions will be obtained from hand driven soil gas probes constructed from 1-inch diameter black iron pipe, three (3) feet long, with slots cut into the pipe every six (6) inches. The probes will be hand driven through the landfill cover material into refuse and readings taken from the pipe top immediately after placement.

5.3 Geotechnical Assessment

The Site is assumed to be structurally stable in its present state, as its configuration has not been modified for several decades and no large-scale landslides have occurred. However, to date, no geotechnical evaluations have been conducted to understand the degree of stability or subsurface geological conditions underlying landfill material. Due to the potential for remedial action involving removal of waste, which may modify drainage and disturb underlying soils, a comprehensive geotechnical analysis will be conducted prior to sampling activities. A certified geotechnical drilling contractor will be retained to assess geotechnical conditions and address potential stability concerns that may arise during remedial action.

A geotechnical analysis will be conducted, including field exploration via soil logging, SPT performance, hand exploration methods, geotechnical laboratory testing of collected samples for various parameters, and an engineering analysis and modeling to support the FS evaluations and a future remedial design.

5.3.1 Drilled Exploration Methods

During installation of the upgradient wells, split-spoon sampling will be performed at least every 5 feet with an HSA drill rig to characterize the geotechnical characteristics of the surrounding area. The SPT method will be followed according to ASTM D 1586 (ASTM International, 2018) to determine soil geotechnical properties and collect disturbed soil samples using the SPT split-spoon barrel sampler (1.4-inch inner diameter and 2-inch outer diameter). The sampler will be advanced to a depth of 18 inches using a 140-pound steel hammer falling 30 inches and operated by a semi-automatic trip-hammer, as defined in the ASTM International guidance. Blow counts will be recorded as the number of blows required for each successive 6-inch penetration interval, and the penetration resistance (blows/feet) will be recorded as the number of blows required to drive the final 12 inches of depth. SPT N-values will also be obtained. These values and associated characteristics (hardness, stability, and lithological profiles) will be notated on a field sampling sheet (see Attachment 1).

Split-spoon sampling intervals will be defined in the field by the geotechnical engineer but sampling will be performed at no less than every 5 feet. Samples will be logged for physical properties using a field form in accordance with the USCS, labeled, sealed, and transported to a laboratory for geotechnical testing as defined in the QAPP (Appendix B of the RIWP). If multiple sample types are visually identified within a single SPT drive sample, the samples will be split, labeled, and analyzed independently. If possible, up to three additional HSA drilled soil borings will be advanced through the landfill.

5.3.2 Hand Exploration Methods

The toe of the landfill and the adjacent wetland are inaccessible with mechanized equipment and therefore require the use of hand tools. In this area, geotechnical soil samples will be collected using a hand auger at locations identified by the geotechnical engineer and to depths defined in the field by the geotechnical engineer after evaluation of the soil lithology defined during environmental soil sampling and piezometer installation. Samples will be logged for physical properties using a field form in accordance with the USCS, labeled, sealed, and transported to a laboratory for geotechnical testing as defined in the QAPP (Appendix B of the RIWP).

A hand-held vane shear probe will be used at the base of the landfill in locations determined by the geotechnical engineer to determine the value of undrained soil shear strength. This test is expected to be performed in moist soil, at a depth of 1 to 3 feet bgs. A hand auger may be used to advance the hole to a depth of approximately 6 inches bgs prior to use of the probe. The vane shear (attached to a metal rod) will be pushed to the testing depth by hand, and the mechanism will be rotated at a slow, constant rate (6 to 12 degrees of rotation per minute) using a torque wrench. Once maximum torque has been reached, the shear vane will be rotated quickly to calculate remolded shear strength.

SECTION 6: **Sample Handling, Documentation, and Transport**

Samples will be traceable from the time of collection through laboratory and data analysis. To ensure that the samples collected are traceable, the procedures described in this section will be followed.

6.1 Field Logbook and Forms

The field activities and observations will be noted in a field logbook and/or applicable field forms (see Attachment 1). The following records will be documented:

- Sample information, including station ID, latitude and longitude, date/time of collection, type of sample, and description (recorded in a field form, Attachment 1)
- Names of visitors, their association, and purpose of visit (recorded in the logbook)
- Any changes that occur at the Site (e.g., personnel, responsibilities, deviations from this SAP) and the reasons for such changes (recorded in the logbook)

Field logbook and field form entries will be written clearly with enough detail so that participants can reconstruct events later, if necessary. Field logbooks will be bound, with consecutively numbered pages, and removal of any pages is prohibited. Unbiased, accurate language will be used and entries will be made while activities are in progress or as soon afterward as possible. Field logbook corrections will be made by drawing a single line through the original entry allowing the original entry to be legible. Corrections will be initialed and the corrected entry will be written alongside the original. When field activities are complete, the field logbook will be retained in the project file at GSI's Portland, Oregon, office.

Field forms will be completed for data that are not described in the field logbook and kept in the project file at GSI's Portland, Oregon, office. Attachment 1 contains the field form template.

Photographs will be taken of each sample location, temporary wells, and at other notable features.

6.2 Sample Containers, Preservation, and Holding Times

Samples will be placed directly in the appropriate sample containers (see the QAPP [Appendix B of the RIWP]). Sample containers and preservatives, as well as coolers and packing material, will be supplied by the laboratory. Commercially available, pre-cleaned jars will be used and the laboratory will maintain a record of certification from the suppliers. Sample containers will be labeled clearly at the time of sampling. Labels will include the project name, sample ID, analysis to be performed, date, and time of sample collection. The QAPP (Appendix B of the RIWP) provides additional requirements.

6.3 Sample Identification and Labeling

During sample collection, a unique code will be assigned to each sample as part of the data record in accordance with the QAPP (Appendix B of the RIWP) naming conventions.

6.4 Chain-Of-Custody Procedures

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A chain-of-custody (COC) record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC form will be included in contract laboratory reports and attached to a data report. When transferring sample custody, the COC form will be signed, dated, and the time of transfer will be noted.

The original COC form will be transported with the samples to the selected contract laboratories. Upon receipt, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the COC form. The custodian will enter the sample number into a laboratory tracking system by project code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples in an appropriate secure area.

The laboratories will maintain COC procedures internally and when samples are shipped to subcontracted laboratories or during shipment between laboratories branches.

6.5 Sample Packaging and Shipping

The laboratory will supply sample coolers and packing materials for each sampling event. Upon completion of the final sample inventory, samples will be packed in coolers. Glass jars will be packed to prevent breakage and separated in the shipping container by bubble wrap or other shock-absorbent material. Ice in sealed plastic bags will be placed in the cooler to maintain a temperature of approximately 4 degrees Celsius.

When the cooler is full, the COC form will be placed in a re-sealable plastic bag and taped onto the inside lid of the cooler. A temperature blank will be added to each cooler. Coolers will be transported to the laboratory at the completion of the field event. The QAPP (Appendix B of the RIWP) provides additional requirements.

SECTION 7: **Investigation-Derived Waste Management**

With the exception of HSA drilled soil cuttings, any excess soil or water obtained in this investigation will be returned to the ground where it originated. Cuttings will be drummed and a representative sample(s) will be collected to determine if disposal off-site is required. If determined to be non-hazardous, cuttings will be left on-site; if determined to be hazardous, cuttings will be disposed of at the nearest hazardous waste landfill.

All disposable materials used in sample collection and processing, such as paper towels, gloves, and pump tubing will be placed in heavyweight garbage bags or other appropriate containers and disposed of at a waste collection facility or the GSI office. Disposable supplies will be placed in a normal refuse container for disposal at a solid waste landfill.

SECTION 8: **Equipment Decontamination Procedures**

Equipment that comes in direct contact with samples, such as auger bits, spoons, and stainless-steel samplers, will be decontaminated at the beginning of the sampling event, between use at each location, and at the end of the sampling event. The following procedure will be used:

- Wash with a brush and Liquinox or other phosphate-free detergent.
- Rinse with tap water.
- Rinse with deionized water.
- Collect equipment blank sample as outlined in the QAPP (Appendix B of the RIWP).
- When dry, cover decontaminated equipment with aluminum foil for temporary storage and/or transport, if applicable.

To minimize sample contamination, personnel will replace their gloves after handling each sample, as appropriate.

SECTION 9: **Laboratory Analysis**

This section summarizes the chemical analyses that will be performed on the samples. Laboratory quality control (QC) and data validation protocols will be followed to ensure that (1) data quality and representation are in accordance with method requirements, and (2) data usability is appropriately assessed for project objectives that are provided in the quality management documents of the laboratories. The QAPP (Appendix B of the RIWP) provides detailed information on the analyses and quality assurance (QA)/QC protocol.

9.1 Analytical Schedule

Geotechnical samples will be analyzed for shear strength properties and soil index properties, which may include in-situ dry density, moisture content, Atterberg limits, grain-size distribution, fines content, 1D consolidation, and cyclic direct simple shear.

Soil/sediment, surface water, and groundwater samples will be analyzed for semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) including volatile and extractable petroleum hydrocarbons (VPH/EPH), and metals (arsenic, barium, beryllium, cadmium, chromium [III and IV], cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc).

Table 1 provides details about the sampling locations and analytical suite. The QAPP (Appendix B of the RIWP) provides information about the containers, preservation, holding times, and analytical methodologies to be used.

SECTION 10: **Data Management**

Data management protocols for both field data and electronic data will be implemented to provide consistent, accurate, and defensible documentation of data quality. The QAPP (Appendix B of the RIWP) provides detailed information on data management and QA/QC protocol.

10.1 Field Documentation

As described in Section 6.1, field activities and observations will be documented in field logbooks and field forms during implementation of the sampling activities. COC forms, which document sample possession and handling from the time of collection through relinquishment to the primary contract laboratory, will be maintained as part of the field records. Attachment 1 contains the field form templates for soil, water, and air samples.

The field records will be kept in the project file as a permanent record of the sampling or field measurement activities. All field records will be copied, scanned, and/or entered into an electronic spreadsheet to create an electronic record for the project file. QA reviews by the Project Manager will check for electronic/hard copy consistencies and identify anomalous values or erroneous entries.

SECTION 11: **Reporting and Schedule**

The initial phase of work described in this SAP is anticipated to be completed in fall 2021 and the second (wet season) phase (groundwater and surface water sampling only) is anticipated to be completed in spring 2022. The data generated from this work will be summarized in a field report with anticipated delivery approximately 90 days following the second field event.

SECTION 12: **References**

ASTM International. 2018. ASTM D1586 / D1586M-18, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. (West Conshohocken, PA: ASTM International, 2018).

ASTM International. 2017. ASTM D2488-17e1, Standard Practice for Description and Identification of Soils (Visual- Manual Procedures). (West Conshohocken, PA: ASTM International, 2017).

Environmental Protection Agency (EPA). 2017. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. (North Chelmsford, MA: EPA Region 1, 2017).

Eurofins. 2014. Guide to Air Sampling: Canisters and Bags. Published by Eurofins Air Toxics, Inc.

Gy, Pierre. 1992. Sampling of Heterogeneous and Dynamic Material Systems: Theories of Heterogeneity, Sampling, and Homogenizing. Data Handling in Science and Technology, Volume 10.

ITRC. 2020. Incremental Sampling Methodology Update. Published by the Interstate Technology & Regulatory Council.

TABLES

Table 1
Analytical Schedule for Sampling, September 2021

Sample ID	Methodology	Analyses
Soil Samples		
DU-01	ISM with Hand Auger	SVOCs VOCs PCBs PAHs TPH (EPH/VPH) TOC Metals[1]
HA-01A	Hand Auger Composite	
HA-01B	Hand Auger Composite	
HA-01C	Hand Auger Composite	
HA-01D	Hand Auger Composite	
HA-01E	Hand Auger Composite	
HA-02A	Hand Auger Composite	
HA-02B	Hand Auger Composite	
HA-02C	Hand Auger Composite	
HA-02D	Hand Auger Composite	
HA-02E	Hand Auger Composite	
HA-03A	Hand Auger Composite	
HA-03B	Hand Auger Composite	
HA-03C	Hand Auger Composite	
HA-03D	Hand Auger Composite	
HA-03E	Hand Auger Composite	
PZ-01 (Geotechnical)	Hollow Stem Auger	Shear Strength Properties Soil Index Properties
PZ-02 (Geotechnical)	Hollow Stem Auger	
GT-XX (Geotechnical)	Hollow Stem Auger - TBD	
Water Samples		
PZ-01 (Monitoring Well)	Hollow Stem Auger	PAH TPH (EPH/VPH) Metals[1] PBDEs
PZ-02 (Monitoring Well)	Hollow Stem Auger	
PZ-03 (Temporary Well)	Hand Auger	
PZ-04 (Temporary Well)	Hand Auger	
SW-01 (Surface Water)	Collection by Hand	
Conditional Soil/Water Samples		
SB-01	Direct Push	*If borings contain adequate quantity of soil or water, samples will be collected.* SVOCs (soil only) VOCs (soil only) PCBs PAHs TPH (EPH/VPH) TOC Metals[1]
SB-02	Direct Push	
SB-03	Direct Push	
SB-04	Direct Push	
SB-05	Direct Push	
SB-06	Direct Push	
SB-07	Direct Push	
SB-08	Direct Push	
SB-09	Direct Push	
SB-10	Direct Push	
SB-11	Direct Push	
SB-12	Direct Push	
SB-13	Direct Push	
SB-14	Direct Push	
SB-15	Direct Push	
SW-XX (Seep)	Collection by Hand - TBD	*If additional seeps are identified, samples will be collected.* PAH TPH (EPH/VPH) Metals[1] PBDEs

Note

[1] Arsenic, barium, beryllium, cadmium, chromium [III and IV], cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc.

Abbreviations and Acronyms

EPH = extractable petroleum hydrocarbon
ISM = Incremental Sampling Methodology
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TOC = total organic carbon
PBDEs = polybrominated diphenyl ethers
SVOC = semi-volatile organic compound
TPH = total petroleum hydrocarbon
VOC = volatile organic compound
VPH = volatile petroleum hydrocarbons
TBD = to be determined

FIGURES

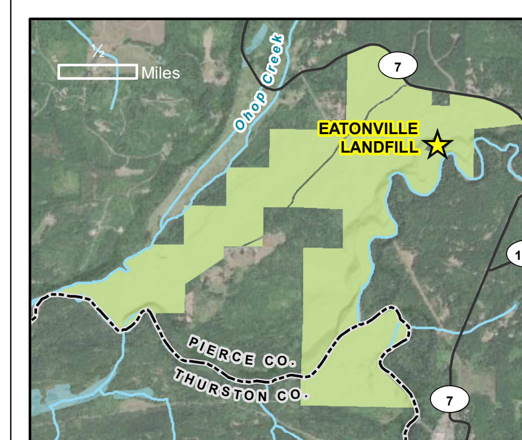
FIGURE 1

Project Area

Eatonville, WA

LEGEND

- Former Eatonville Landfill
- Nisqually State Park
- County Boundary
- Road
- Perennial Watercourse
- Intermittent Watercourse
- Waterbody



N

0 300 600
Feet

Date: July 9, 2021
Data Sources: Bureau Land Management, Environmental Systems Research Institute, United States Geological Survey, Department of Ecology, Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\067_Former_Eatonville_Landfill\QAPP\Figure1_Project_Area.mxd, WKimmon

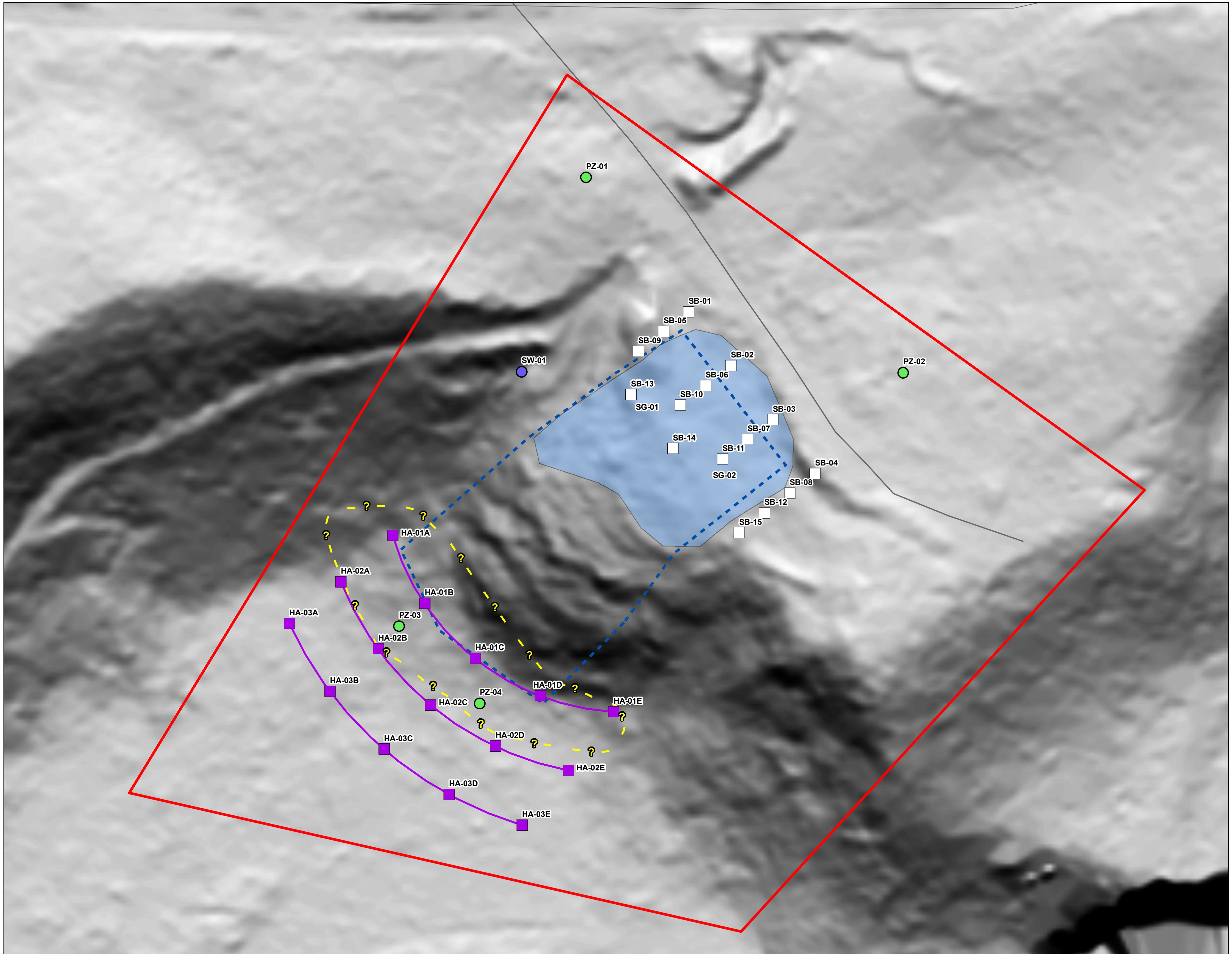


FIGURE 2

Eatonville Landfill Proposed Remedial Investigation Sampling and Analysis Plan

Eatonville, Washington

LEGEND

Approximate boundary of Eatonville Dump Site within the Nisqually State Park

Proposed RI Sampling

- Piezometer/Well
- Surface Water
- Geoprobe Soil Boring / Landfill Gas Probes
- Hand Augered shallow soil (0-6")
- Transect Sampling Line Samples Are Composited Over
- Seep Sampling Area, As Encountered
- Surface Sampling ISM Sampling Decision Unit
- Approximate location of former landfill
- Road
- Watercourse

N

0 25 50 75 100
Feet

Date: August 26, 2021
Data Sources: Bureau Land Management, Environmental Systems Research Institute, United States Geological Survey, Pierce Co.

GSI Water Solutions, Inc.

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ATTACHMENTS

Groundwater Sampling Field Log

Former Eatonville Municipal Landfill Site

Date:

Well ID:

Total Depth: (ft)	(-) DTW: (ft) Time	=	(x) 0.06 - 1.25" (x) 0.16 - 2" (x) 0.65 - 4" gal/feet	= Well Casing Volume	

Field Conditions:

Decontamination: alconox + tap wash; tap rinse; DI rinse

PURGE INFORMATION

☐	Purge Method:
☐	Purge Method:
☐	Refer to calibration log this date, YSI #

Pump Suction Depth (ft BTOC): Purge water disposal:

Type of Flow Through Cell: ☐ 10 oz cup ☐ YSI 556 Flow Through Cell

Comments/Exceptions to SAP:

Time	Purge Volume (gallons)	Temp. (°C)	SC (uS/cm)	DO (mg/L)	pH	ORP (mV)	Purge Rate (mL/min)	DTW (ft BTOC)	Pump Speed/*Clarity/ Color/Remarks (NTU)
Stabilization Criteria		± 0.2	±3% (SC>100) ±5% (SC≤100)	± 0.3	± 0.1	± 10	--	--	± 10% (NTU>5) 3 readings < 5 (NTU<5)
:	Pump On, Water Reaches the Purge Bucket							Initial	
:									
:									
:									
:									
:									
:									
:									
:									
:									
:									
:	Start Sampling								
:	End Sampling								

* **VC**=Very cloudy **Cl**=Cloudy **SC**=Slightly Cloudy **VSC**=Very Slightly Cloudy **AC**=Almost Clear **C**=Clear **CC**=Crystal Clear

Laboratory Analytical Program
Former Eatonville Municipal Landfill Site

Date: / /	Time: :				
Sampling Method (circle one):	A	dedicated purge tube disconnected from flow through cell			
	B	dedicated sampling port			
	C	other:			
Sample I.D. ____________ GW-Well ID-MMYY	Number of sample containers	Volume of each container	Container Type	Pres.	Analytical Method
QAQC: **Sample ID & Time**---> Dups = GW-Dup-X-MMYY MS/MSD = same sample ID					

Sampling Criteria (circle one):	
Collect anytime: stabile parameters over 15 minutes(4 readings) with controlled drawdown	1
After 3 well casing volumes: stabile parameters but uncontrolled/falling water level	2
After 5 well casing volumes: unstabile parameters with or without drawdown control	3
Pump dry: return anytime if there is adequate volume for containers within 24 hours	4

Comments:

Lab: Apex Laboratory, 6700 SW Sandburg St, Tigard, OR 97223; 503.718.2323
Lab PM: Philip Nerenberg, 503.747.6262 (direct) and 503.523.6123 (cell)

Water Solutions, Inc.	Boring ID	Project Number Sheet of
	SOIL BORING LOG	

Project:		Location:
Drilling Contractor:		Drilling Method:
Start Date:	End Date:	Field Personnel:
Sampling Method:		Water Levels:
		Total Depth:

Depth Below Surface (ft)	Sample		Description	Comments
	Sample Interval/ Recovery	Lab Sample Interval	Soil Name, USCS Group Symbol, Color, Moisture, Relative Density/Consistency, Soil Structure, Mineralogy	Air Monitoring/PID Readings, Sheen/Odor, Issues Encountered, Water Levels

GSI Water Solutions, Inc.

Boring ID	Project Number

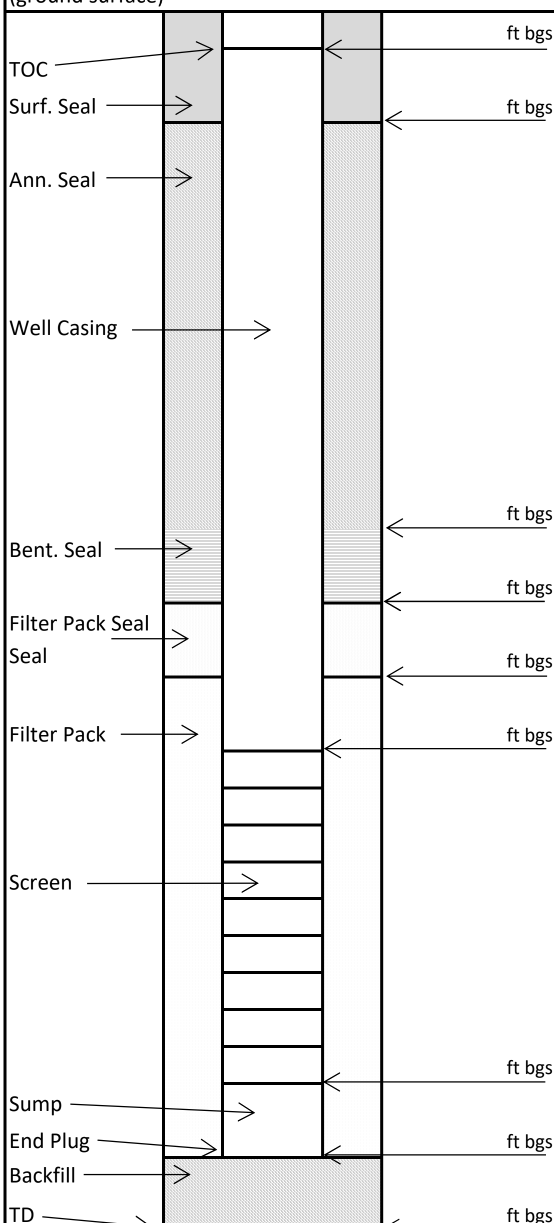
WELL CONSTRUCTION

Project:	Location:	
Drilling Contractor:	Drilling Method:	
Start Date: End Date:	Field Personnel:	
TOC Elev (& datum):	GS Elev (& datum):	
Static Water Levels:	OWRD ID:	Start Card: L

Well Construction Drawing

(below ground completion)

(ground surface)



NOT TO SCALE

bgs = below ground surface

Well Construction Materials

Borehole TD (ft bgs):	Well TD (ft bgs):	
Borehole Diameter:	inches to	ft bgs
Borehole Diameter:	inches to	ft bgs
Monument Type:	Lockable cap: yes / no	
Monument Diam. (in):	Industrial Traffice Rated: yes / no	
Well Casing Type:	Casing Diam. (in):	
Well Casing Interval:	ft bgs to	ft bgs
Screen Type:	Screen Length (ft):	
Screen Slot Size:	Screen Diameter (in):	
Screen Interval :	ft bgs to	ft bgs
Sump Type:	Sump Length:	
End Cap Type:	End Cap Length:	
Centralizer Type:		
Centralizer Locations (ft bgs):		
Backfill Material:		
Backfill Interval:	ft bgs to	ft bgs
Filter Pack Material:	Calc. Quantity:	
Filter Pack Interval:	ft bgs to	ft bgs
Filter Pack Seal Material:	Calc. Quantity:	
Filter Pack Seal Interval:	ft bgs to	ft bgs
Bentonite Seal Material:	Calc. Quantity:	
Bentonite Seal Interval:	ft bgs to	ft bgs
Annular Seal Material:	Calc. Quantity:	
Annular Seal Interval:	ft bgs to	ft bgs
Surface Seal Material:		
Surface Seal Interval:	ft bgs to	ft bgs
Material Type:	Quantity (bags):	

Holeplug: 2"d = 1.6 lb/ft, 4"d = 6.3 lb/ft, 6"d = 14.1 lb/ft; **Grout**: 20% solids = 3.6 ft^3/bag, 25% = 2.8 ft^3/bag
Sand: 2"d = 6.6 lb/ft, 4"d = 17.5 lb/ft, 6"d = 23.7 lb/ft

Notes (i.e., grout emplacement [tremied, poured, tamped], water source):