APPENDIX D

Sampling and Analysis Plan

REPORT

Sampling and Analysis Plan Remedial Investigation/Feasibility Study Work Plan Reserve Silica Reclamation Site

Ecology Facility Site No. 2041/Cleanup Site No 4728

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Table of Contents

1.0 INTRODUCTION 1

2.0 BOREHOLE DRILLING AND GROUNDWATER MONITORING WELL INSTALLATION 1

2.1 Utility Locating 1

2.2 Installation and Development 2

2.3 Monitoring Well Survey 2

3.0 SOIL SAMPLING DURING BOREHOLE INSTALLATIONS 3

3.1 Leaching Testing of Soil Samples 3

4.0 GROUNDWATER AND SURFACE WATER SAMPLING 3

4.1 Calibration Procedures 3

4.2 Water Level Measurements 3

4.3 Monitoring Well Purging and Field Parameters 4

4.4 Sample Collection, Preservation, and Handling 4

4.5 Groundwater and Surface Water Analysis 5

5.0 POND SEDIMENTS AND SEEPAGE AREA SOIL SAMPLING 5

6.0 QUALITY CONTROL SAMPLES 7

6.1 Field Duplicate Samples 8

6.2 Matrix Spike/Matrix Spike Duplicates 8

6.3 Equipment and Field Blank Samples 8

7.0 INVESTIGATION DERIVED WASTE 9

8.0 DECONTAMINATION 9

9.0 REFERENCES 11

TABLES

Table SAP-1: Proposed Remedial Investigation Monitoring Wells Construction Details

Table SAP-2: Groundwater Monitoring Well Sampling Frequency

Table SAP-3: Anticipated Unique Sampling IDs

FIGURES

Figure SAP-1: Proposed RI Boreholes and Monitoring Wells (Overlying 2010 and 2019 Geophysics Surveys)

Figure SAP-2: Typical Monitoring Well Construction

Figure SAP-3: Proposed Decision Units and Sampling Locations

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared by Golder Associates Inc. (Golder) to support the Reserve Silica Reclamation site (Site) Remedial Investigation/Feasibility Study (RI/FS), and is included as Appendix D to the Site RI/FS Work Plan (Work Plan). A full description of the Site background, previous investigations, remedial activities, preliminary conceptual site model (CSM), identified RI/FS data gaps, and planned investigations to fulfill those date gaps are discussed in the Work Plan. This SAP presents the methods and procedures that will be used during RI field investigations. This SAP shall be used in conjunction with the Quality Assurance Project Plan (QAPP), provided in Appendix E to the Work Plan. The purpose of the SAP/QAPP is to ensure that field sample collection, handling and laboratory analysis conducted during the RI/FS generate data of sufficient quality to plan and evaluate remedial actions at the Site.

The primary Site RI data collection activities include the following:

- Borehole drilling and monitoring well installation
- Groundwater and surface water sampling
- Soil and Sediment sampling

Borehole drilling, groundwater monitoring well installation, and sampling will be completed in accordance with the following Golder Technical Guidelines/Procedures (TG/TP):

- TP-1.2-5 Drilling, Sampling and Logging of Soils
- TP-1.2-6 Field Identification of Soils
- TP-1.2-18 Sampling Surface Soil for Chemical Analysis
- TG-1.2-12 Monitoring Well Drilling and Installation
- TG-1.2-20 Collection of Groundwater Quality Samples
- TG-1.2-23 Chain of Custody
- TG-1.4-6a Manual Groundwater Level Measurement

2.0 BOREHOLE DRILLING AND GROUNDWATER MONITORING WELL INSTALLATION

Soil borings and groundwater monitoring wells will be installed at the Site to further define the nature and extent of environmental impacts. This section describes the techniques and materials that will be used to drill and install the additional boreholes and groundwater monitoring wells at the Site. The purpose and justification for the proposed additional RI boreholes and monitoring wells are detailed in the Work Plan. Table SAP-1 summarizes the anticipated drilling and installation details, and Figure SAP-1 shows the approximate locations for the proposed additional boreholes and monitoring wells.

2.1 Utility Locating

A utility locate will be requested from public locating services and from a private locator to identify underground utilities near the proposed monitoring well locations prior to drilling. Underground utilities are not expected to be encountered at the site, but if any utilities are marked near proposed monitoring well locations, Golder will move the proposed boring locations an appropriate distance away from the utilities.

2.2 Installation and Development

Each boring will be drilled with a rotary sonic drill rig operated by a Washington State-licensed drilling subcontractor. The rotary sonic drilling method collects continuous cores. The boreholes will be drilled from ground surface, and soil cuttings will be collected and logged by a Golder geologist in accordance with the Golder technical procedures, which are consistent with ASTM D2487[1] and D2488[2]. On a borehole log, the geologist will generally note depth, lithology (including color, grain size, distribution, shape, strength, and weathering), and water content to provide characterization of underlying stratigraphy to ensure proper depths have been reached for monitoring well installation. The boreholes will be advanced until the target depth or hydrogeologic unit is reached and the borehole is cleared to permit monitoring well construction. During borehole drilling, field pH readings of the soil cuttings may be obtained by mixing soil and distilled water in a clean laboratory-provided container in a 1:1 ratio by weight (e.g., 100 grams of soil and 100 grams of distilled water). The container will be shaken up to agitate the mixture of soil and water, then let sit for approximately 5 minutes. After 5 minutes, liquid from the mixture will be tested with a pH strip to obtain a field pH reading.

Each monitoring well will be constructed of 2-inch diameter polyvinyl chloride (PVC) screens and flush-threaded PVC riser casing. For most locations, drilling will extend approximately 10 to 15 feet into the water table for construction of the monitoring wells. The anticipated screen length will be 10 to 15 feet (0.020-inch slot size). Well depths and screened intervals may be adjusted at the time of installation depending on conditions encountered during drilling. A filter pack consisting of coarse silica sand properly sized for the screen slot size will be placed around the screen interval and will extend approximately 3 feet above the top of the screen. The borehole annulus above the sand pack section will be sealed with bentonitic cement grout or a bentonite clay seal to approximately 2 feet below ground surface (bgs). The upper 2 feet, at a minimum, of the borehole will be sealed with concrete. The surface will be completed with either a flush-mounted steel monument or a stickup casing surrounded by three protective bollards. Figure SAP-2 shows a standard monitoring installation diagram. Well depths and screened intervals may be adjusted at the time of installation depending on conditions encountered during drilling. After a minimum of 24 hours following well installation, each groundwater monitoring well be developed by purging, airlift pumping, or other means to remove fine-grained material entrained in the filter pack.

2.3 Monitoring Well Survey

A Washington State-licensed land surveyor will conduct a geodetic survey of the new monitoring wells. Each monitoring well will be surveyed for horizontal position (x- and y-coordinates) and elevation (z-coordinate) to the same benchmark as the Site. The horizontal location of each monitoring well will be obtained and the elevation of land surface, top of protective monument or stickup, and top of well casing will be measured. Surveys will reference Washington plane coordinate system (RCW 58.20) and the North American Vertical Datum of 1988 (NAVD88).

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[1] ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
[2] ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)

3.0 SOIL SAMPLING DURING BOREHOLE INSTALLATIONS

During the borehole installation of G-AB-1 and P-16, Golder will collect 2 soil samples from each borehole and submit these samples to the laboratory for analyses. Sample collection will be conducted in accordance with Golder TP-1.2-5 “Drilling, Sampling, and Logging Soils". At each location, one soil sample will be collected within the vadose zone and one soil sample will be collected within the saturated zone. It is anticipated the vadose zone sample will be collected at a depth of approximately 10 feet bgs at G-AB-1 and 3 feet bgs at P-16. The saturated zone sample will be collected at the depth where groundwater is encountered during drilling, anticipated to be at a depth of approximately 20 feet bgs at G-AB-1 and 15 feet bgs at P-16.

Each sample will be analyzed for total arsenic, lead, antimony, vanadium, pH, and total organic carbon (TOC)[3].

3.1 Leaching Testing of Soil Samples

Laboratory leach testing will also be performed on soil samples collected from G-AB-1 and P-16. Using EPA Method 1313, leachable concentrations of COPCs at two different pH levels will be determined. Extraction using a pH level that simulates natural rainfall pH (approximate pH of 5.0) will evaluate COPC metals that may leach from the soil samples under natural conditions. Extraction using a pH of 12, similar to the pH of the groundwater in the LDA, will evaluate COPC metals that may leach under high pH conditions. Each extract will be analyzed for total arsenic, lead, antimony, vanadium, and pH.

4.0 GROUNDWATER AND SURFACE WATER SAMPLING

Groundwater samples will be collected from existing Site groundwater monitoring wells and from new monitoring wells installed during the RI. As detailed in the Work Plan, routine sampling of the existing monitoring wells and surface water sampling locations will also be conducted during the RI. The sampling frequency of the existing monitoring wells, the surface water locations, and the proposed monitoring wells is listed in Table SAP-2. Furthermore, as detailed below, and in Section 6.3.2 of the RI Work Plan, semi-annual sampling of P-14 and P-11 will also be completed for two rounds (December 2020 and June 2021), after which the data collected will be used to refine the list of COPCs for future sampling and monitoring. Groundwater and surface water sampling procedures are described in this section.

4.1 Calibration Procedures

Field equipment (e.g., a water quality multimeter) will be calibrated prior to the start of each field day and checked and recalibrated as necessary to maintain accurate readings. Calibration procedures and measurements will be made in accordance with manufacturers’ specifications. Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed and either repaired or replaced. Field staff will record calibration readings on daily calibration logs.

4.2 Water Level Measurements

Static water levels will be measured at each well prior to the start of any purging or other sampling activity during every sampling event. Water level measurements will be conducted in accordance with Golder TG-1.4-6a “Manual Groundwater Level Measurement”. Depth-to-water measurements will be recorded to the nearest 0.01

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[3] Antimony and vanadium were added because their concentrations exceeded the groundwater screening level in samples from P-14 and P-11 on December 11, 2020. TOC is an important parameter when evaluating solute mobility in groundwater.

foot using an electric water level indicator. Measurements will be taken from the surveyed point on each well casing, typically the north side top of the casing, and recorded in the field log.

4.3 Monitoring Well Purging and Field Parameters

Groundwater monitoring wells will be purged prior to sample collection as described in USEPA's groundwater sampling procedure Low Stress (Low Flow) Purging and Sampling (USEPA 2017) and Golder TG-1.2-20 "Collection of Groundwater Quality Samples". Monitoring wells will be purged using either a dedicated bladder pump, a non-dedicated bladder pump, or a peristaltic pump, depending on well construction and depth of water in each well. The purge rate will be 400 milliliters per minute or less. Select water quality parameters will be continuously recorded every 3 to 5 minutes using an in-line multimeter. Parameter stabilization is complete when three consecutive readings are within the following:

- Turbidity: 10% for values greater than 5 nephelometric turbidity units (NTU); preferably three consecutive readings within +/- 1 NTU and below 5 NTU
- Dissolved Oxygen: 10% for values greater than 0.5 milligrams per liter (mg/L); or three consecutive readings below 0.5 mg/L
- Specific Conductance: +/- 3%
- Temperature: +/- 3%
- pH: +/- 0.1 standard units
- Oxidation/Reduction Potential: +/- 10 mV

In addition to the above parameters, purge rate and depth to water will be continuously monitored. Once parameters stabilize, the groundwater sample will be collected.

4.4 Sample Collection, Preservation, and Handling

Following parameter stabilization, groundwater samples will be collected by disconnecting the flow-through cell used to measure field parameters, and pumping groundwater directly into laboratory-provided sample bottles. Surface water samples will be collected using a peristaltic pump and new tubing at each sampling location to pump surface water directly into laboratory-provided sample bottles.

Clean nitrile gloves will be worn while collecting samples from each well to minimize possible cross-contamination. Samples will be collected for total and dissolved metals analyses. Due to the potential high bias of metals concentrations that can be introduced from unfiltered samples, both total and filtered samples will be collected. If the total results are anomalously high and correlated with highly turbid samples, the filtered results will be analyzed for comparison. Dissolved metals samples will be filtered in the field with a 0.45-micron in-line filter. Pre-preserved bottles from the laboratory should not be overfilled to avoid spilling preservative. Due to the elevated pH levels present in some Site sampling locations, additional preservative may be necessary to lower the pH of the preserved sample to required levels. In those cases, a pH strip will be used to verify the sample pH and additional preservative will be added if necessary, to achieve required pH preservation (typically pH less than 2). When measuring the pH of the collected sample, a small amount of water from the sample bottle will be poured over the pH strip, and the pH strip will not be inserted into the sample bottle to avoid potential contaminants from the pH strip from entering the sample bottle. All samples will be labeled with, at a minimum, the sampler's initials, the date, the time, and a unique sample ID. A list of anticipated unique sampling IDs are provided in Table SAP-3. The sample will then be sealed in a plastic bag and placed in a cooler with ice. Coolers will be transported to the laboratory for analysis under Golder chain-of-custody procedures TG 1.2-23 “Chain of Custody”.

4.5 Groundwater and Surface Water Analysis

Groundwater and surface water samples collected at the Site will be analyzed by Analytical Resources, Inc. (ARI), a Washington State-accredited laboratory. Table SAP-2 presents the analytes that will be included in the RI groundwater and surface water monitoring events. The sample containers, volumes, preservation types, hold times and laboratory reporting limits for each analysis are described in the QAPP.

Preliminary testing for an expanded list of contaminants of potential concern (COPCs) is included in the RI groundwater monitoring program as provided in Table SAP-2. Section 6.3.2 of the RI Work Plan discusses the expanded COPC list of analytes. The expanded list includes the following: antimony, arsenic, beryllium, chromium, lead, mercury, nickel, selenium, silver, thallium, vanadium, and 2,3,7,8-substituted Dioxins & Furans.

Analysis of this expanded list of COPCs will initially be conducted on a groundwater sample collected directly from the new RI well P-14, which was installed along the highest apparent conductivity area of the LDA. The groundwater sample from P-14 will evaluate if any of these additional analytes are present in groundwater that is in direct contact with the CKD, and, if detected, if the concentrations exceed preliminary screening levels (PSLs).

Additionally, all of the metals included in the COPC list will also be analyzed in a groundwater sample collected from piezometer P-11, which is located immediately west of the LDA on the west side of the Lower Haul Road. Copper will also be analyzed in the groundwater sample collected from P-11. As further discussed in Section 6.3.2 of the RI Work Plan, P-11 monitors the shallow groundwater migrating from the LDA and after the groundwater has migrated through the fill material beneath the Lower Haul Road where ASARCO slag was observed during previous investigations. ASARCO slag, observed during previous investigation (Aspect 2019), was not encountered in saturated soil beneath the Lower Haul Road.

Both P-14 and P-11 are located along the groundwater flow path that exhibited the apparent highest electrical conductivity signatures during the geophysical testing, as confirmed during the geophysical survey completed in October 2020, which correlates with the Site groundwater that has the relatively higher pH and dissolved metals concentrations. As such, these two sampling points should be representative of the relatively higher impacted groundwater located at the Site. Testing for the expanded list of COPCs will be one of the initial RI sampling tasks completed. P-14 and P-11 will be sampled for two semi-annual monitoring rounds. The data from the two rounds of sampling will be used to refine the list of COPCs. Analytes detected from the expanded list of COPCs exceeding PSLs may be added to analyses proposed for other RI samples. Changes to analysis presented in this SAP would occur in consultation with Ecology and would be documented in an addendum to this SAP.

5.0 POND SEDIMENTS AND SEEPAGE AREA SOIL SAMPLING

Soil and sediment will be sampled using Incremental Sampling Methodology (ISM). ISM sampling will be performed following the procedures detailed in the Interstate Technology and Regulatory Council (ITRC) guidance document “Incremental Sampling Methodology” (ITRC 2020). In addition to the ISM guidance, soil sampling will be conducted in accordance with protocols and procedures specified in Golder Technical Procedure TP-1.2-18 “Sampling Surface Soil for Chemical Analysis”.

The ISM is a structured composite sampling and processing protocol that is designed to reduce data variability and increase the representativeness for a specified volume of a given media being investigated (ITRC 2012). The

ISM allows for multiple random samples of equal sizes from within a single Decision Unit (DU) to be combined, processed, and sub-sampled for analysis. A DU is the smallest volume of a given media for which a decision will be made based on ISM sampling. When properly executed, the ISM can provide reasonable unbiased and reproducible estimates of mean concentrations across the DU. The resulting mean concentration within a/multiple DU(s) can be used to estimate the arithmetic mean at the scale of the DU. The DUs are discussed in Section 6.4 of the RI Work Plan. Locations of the DUs and the increment sampling locations are provided in Figure SAP-3.

Triplicate ISM samples will be completed at each DU, meaning three replicate ISM samples per DU will be collected and shipped to the analytical laboratory for processing and analysis. The collection of three replicate samples allows for the calculation of the relative standard deviation (RSD) and coefficient of variation (CV) between the three samples collected from each DU. The RSD and CV values indicate repeatability in the results (i.e., the results similar), which provides confidence that the results represent the true average concentrations with the DU. If the RSD is greatly different (greater than 35%), or the CV is greatly different (greater than 3) in the majority of sample results, poor correlation is indicated and an alternate sampling strategy may be needed to reduce variability (e.g., a reduction in sampling area, an increase in increments, etc.). To provide conservative estimates of the mean chemical concentrations for comparison to screening levels, 95% upper confidence limits (UCLs) on the mean will be calculated using the triplicate sample results for each DU.

DUs will be established before the field sampling begins, with boundaries and increment locations loaded into a handheld GPS unit. Field staff will navigate to the pre-determined locations and collect a 50-gram increment from the top 4 inches of soil/sediment/precipitates using appropriate tools (e.g., small hand shovel or ISM sampling device). For sediments, the sampling depth (approximately 10 centimeters) is a representative biologically active zone for assessing exposure scenarios for freshwater benthic invertebrates (Ecology 2008). This uppermost soil layer is also representative of potential human exposure by incidental trespass. Additionally, if contaminants were deposited in these areas from the precipitation and dissolution of solids from high pH groundwater, the highest concentrations would be near the surface. The collected increment will be transferred into a sample container that contains all the increments for the DU. The second and third replicate sample from each DU will be collected in a manner identical to the primary sample. The second replicate increment locations will be collected approximately 3 feet west of the first replicate increment locations. The third replicate increment locations will be collected approximately 3 feet south of the first replicate increment locations.

Each ISM sample in DU-1 and DU-3 will be an aggregate of 30 increments. The increments will be collected along a randomly started systematic grid within DU-1 and DU-3. Each ISM sample in DU-2 will be an aggregate of 50 increments collected along a randomly started systematic grid. ISM samples from DU-2 include a greater number of increments because DU-2 area is larger than DU-1 and DU-3. At each increment location, approximately 50 grams of soil will be collected and added to the respective sampling container for the DU sample. The total mass of each ISM sample from DU-1 and DU-3 will equal approximately 1,500 grams (30 increments times 50 grams per increment); and the total mass of each ISM sample from DU-2 will equal approximately 2,500 grams (50 increments times 50 grams per increment). The collection of the maximum soil volume will help to control the fundamental error (FE) associated with the ISM soil sampling (ITRC 2012). It is important to collect the same volume of material from each increment at each increment location. This will be achieved by placing each increment into a measuring container as a volume check prior to placing the increment into the ISM sample container. None of the increments will be saved and available for future analysis; rather, all incremental samples will be placed into one container in the field and homogenized in the laboratory per standard protocols (ITRC 2012). Each ISM sample collected from each of the DUs will be labeled and delivered to the analytical laboratory for further ISM processing and analysis.

If soil cannot be sampled at any increment location due to physical obstructions, a replacement increment location within the DU boundary will be sited 1 foot from the original location in the preference of due North, then due East, due South, then due West. If none of those locations can be sampled, the field team lead will contact the Golder project manager to obtain a random replacement increment sample somewhere else within the DU. All deviations from the planned increment locations will be recorded in a technical memorandum summarizing the sampling activities performed.

Sampling devices may be used within a DU without the need for decontamination but will be decontaminated or replaced between DUs. Between sampling locations within a DU, sampling tools should be visually inspected to confirm that the previous sample has been adequately extracted from the tool and that any remaining residue will not add a significant amount (<1 percent) to the next increment.

Each sample will be analyzed for arsenic, lead, antimony, vanadium, pH, and TOC. TOC is analyzed as it can affect the bioavailability and uptake of contaminants. Soil pH is analyzed to assess the impacted area and the partitioning of naturally occurring metals. If the preliminary screening of COPCs in groundwater indicates additional COPCs are present in water at concentrations that could precipitate and accumulate to concentrations exceeding PSLs, those metals will be added to the soil and sediment characterization samples following consultation with Ecology.

The Infiltration Ponds are an active component of the seepage treatment system and characteristics of the sediments within the Infiltration Ponds are likely to change over time (see Section 6.4 of the RI Work Plan). As such, a limited evaluation of the concentrations of COPCs within the Infiltration Ponds sediments is proposed during the RI. Further evaluation may be conducted in the future when the treatment system is further evaluated as part of the final remedy. The RI evaluation will include the collection of 10 grab samples distributed throughout accessible areas of the ponds. Six of the 10 samples will be collected from the sediments near the area where the seepage water collection pipe discharges to the Infiltration Ponds. This area visually contains the greatest concentration of precipitates and would be expected to contain the highest COPC concentrations if present within the precipitates. The remaining four samples will be distributed throughout the accessible areas of the ponds.

The samples will be collected from the top 10 centimeters (approximately 4-inches) of sediments. The samples will be collected using a stainless-steel hand driven environmental sampling device to extract a core sample for placement directly into sample containers provided by the laboratory. The sampling device will be decontaminated between each sample collected.

The grab samples collected from the Infiltration Pond sediments will be analyzed for arsenic, lead, antimony, vanadium, and TOC. If the preliminary screening of COPCs in groundwater indicates additional COPCs are present in water at concentrations that could precipitate and accumulate to concentrations exceeding PSLs, those metals will be added to the sediment samples following consultation with Ecology.

6.0 QUALITY CONTROL SAMPLES

Quality control (QC) measures will be taken to evaluate laboratory precision, potential equipment cross-contamination, potential matrix interferences, and potential other sources of contamination that could affect sample quality. Field duplicates, equipment blanks, field blanks, and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected as part of the field QC program. Each of these sample types is described in the following sections along with their purpose, collection frequency, and analyses.

6.1 Field Duplicate Samples

Laboratory and field sampling precision of the grab soil samples from G-AB-1 and P-16 will be evaluated by collecting one field duplicate sample. The field duplicate sample will be collected under conditions as nearly identical as possible to the original sample. The field duplicate sample will be distinguished as a duplicate only in the field notes and will be analyzed for total arsenic, lead, antimony, vanadium, pH, and TOC.

Groundwater and surface water sampling will require the collection of one field duplicate per every 10 percent, or fraction thereof, of the total number of samples collected from each media during each sampling event. As such, during groundwater and surface water sampling events at least one groundwater and one surface water duplicate sample will be collected. The field duplicate sample will be collected under conditions as nearly identical as possible to the original sample. The field duplicate sample will be distinguished as a duplicate only in the field notes and will be analyzed for the same constituent list as the original sample.

ISM soil/sediment/precipitate sampling will be completed in triplicate and no duplicates are therefore required. Grab sampling of sediment samples in the Infiltration Ponds will require the collection of one field duplicate sample per every 10 samples. The field duplicate sample will be collected under conditions as nearly identical as possible to the original sample. The field duplicate sample will be distinguished as a duplicate only in the field notes and will be analyzed for the same constituent list as the original sample.

6.2 Matrix Spike/Matrix Spike Duplicates

Potential interferences from the sample matrix (e.g., groundwater and soil) will be evaluated with MS/MSD samples. Triplicate volumes of sample media will be collected at locations specified on the sample matrix. One MS/MSD sample will be obtained for every 5 percent, or fraction thereof, of the total number of samples collected.

MS/MSD samples will be identified with sample names identical to the original field sample but will have “MS/MSD” written on the chain-of-custody next to the analysis requested for the sample. MS/MSD samples will be analyzed for the same constituent groups as the original sample.

6.3 Equipment and Field Blank Samples

The potential for cross contamination from non-dedicated multi-use sampling devices will be evaluated using equipment blank samples. An example of multi-use non-dedicated sampling devices is the environmental soil core sampler that will be used to sample sediments. One equipment blank sample will be collected for each type of non-dedicated sampling equipment to evaluate the effectiveness of the decontamination procedures that are documented in Section 7.0. Equipment blank samples will be prepared by pouring laboratory-supplied deionized analyte-free water over the previously used and decontaminated sampling equipment and capturing the rinsate into appropriate sample bottles for the analyses requested.

Field blanks will be collected during sampling events that use only dedicated sampling equipment. For example, some groundwater and surface water sampling events will occur using only dedicated sampling equipment associated with well of surface sampling location. A field blank evaluates the potential presence of contaminants form the sample containers, preservatives, or dedicated sampling equipment (e.g., peristaltic tubing and 0.45 micron in-line filters). Field blanks will be collected by running laboratory-supplied deionized analyte-free water through new sample tubing and a new in-line filter derived from the same batch used during sample collection. The peristaltic pump can be used to pump the deionized water through the sampling equipment and into the sample container.

The equipment blank and field blank samples will be given a fictitious sample ID following the sampling identification protocols detailed in the QAPP, and the blank samples will be analyzed for the same constituents as the original samples.

7.0 INVESTIGATION DERIVED WASTE

Investigation-derived waste (IDW) will be collected in Department of Transportation (DOT) approved 55-gallon steel drums or other containers approved by the Site Safety Officer. Soils excavated from DU increment locations and liquid decontamination waste will be returned to the excavation. IDW types may include soil cuttings, decontamination water, and purge water. Drums will be clearly labeled and stored on Site until sample analytical results are received. The results of the sample analyses will be used to determine proper disposal requirements for the captured IDW. Due to the long history of surface water and groundwater sampling completed at the Site, it is anticipated that most of the groundwater produced during sampling will not contain contaminants and can be disposed of on-Site. Water samples containing high pH and similar elevated metals currently treated in the on-Site treatment plant, will be treated through the treatment plant.

Used personal protection equipment (PPE) and disposable equipment will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill.

8.0 DECONTAMINATION

Decontamination procedures will be followed for all reusable field equipment (e.g. water-level indicator, non-dedicated bladder pump, environmental core sampler, shovel, etc.) to minimize the potential of cross-contamination between sampling locations and to maintain an accurate representation of analytes of interest at each sampling location. Equipment decontamination will precede sampling the first well or sediment location and follow directly after sampling each location. Decontamination process will include the following steps:

1) For soil/sediment/precipitate sampling equipment, brush all visible soil/sediment/precipitate particles from the sampling device.

2) Wash equipment in a solution of Liquinox™ (or equivalent) and potable tap water.

3) Rinse with potable tap water.

4) Rinse with distilled water.

Drilling equipment decontamination can be conducted using steam pressure washing.

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https://golderassociates.sharepoint.com/sites/119026/project files/6 deliverables/ri fs work plan/_ri work plan to ecology/2021-ri-workplan/2021-07/appendix d sap/152030402-r-rev0-app d-sap_071521.docx

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Tables

Table SAP-1: Proposed Remedial Investigation Boreholes and Monitoring Wells Construction Details

Well ID	Well Description	Estimated Ground Surface Elevation (feet NAVD88)	Anticipated Depth of Borehole (feet bgs)	Anticipated Depth of Groundwater (feet bgs)	Proposed Depth of Well (feet bgs)	Proposed Screened Interval (feet bgs)	Proposed Well Construction Material	Proposed Borehole Diameter (inches)	Casing Diameter (inches)	Target Hydrogeologic Unit
AMW-1	Existing Monitoring Well, Downgradient of Infiltration Ponds	607.64	41.5	18.61	41.5	25-40	PVC	8.5	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash
MW-7A	Downgradient of Infiltration Ponds	607	40	25	40	30-40	PVC	8.5	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash
MW-8A	Downgradient of Infiltration Ponds	595	40	25	40	30-40	PVC	8.5	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash
MW-9A	West of South Pond	697	20	5	20	10-20	PVC	8.5	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash
MW-10A	West of South Pond	688	20	5	20	10-20	PVC	8.5	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash
P-11	Existing Piezometer	739.11	20.5	14.40	20.5	14-19	PVC	8.5	2	Groundwater west of Lower Haul Road
P-14	Existing LDA Piezometer (Installed November 2020)	773.41	70	31.09	50	40-50	PVC	6	2	Perched "Bathtub" Groundwater within LDA
P-15	Immediately east of Lower Haul Road along P-14 to P-11 groundwater flow path	739	25	15	25	20-25	PVC	6	2	Perched Groundwater within LDA flowing west across Lower Haul Road
P-16	Immediately west of Seepage Collection Ditch along groundwater flow path leading to South Pond	706	15	5	15	10-15	PVC	6	2	Shallow Unconfined Aquifer in Recessional Gravel Outwash flowing west to South Pond
G-AB-1	Between P-15 and P-11	739	50	15	-	-	-	6	-	Perched Groundwater flowing west across Lower Haul Road

bgs - below ground surface

LDA - Lower Disposal Area

Notes:

Elevations are provided in NAVD88 Datum

AMW-1 is an existing well that has been surveyed. The depth of groundwater was measured February 27, 2019.

P-11 was installed in November 2010. The depth of groundwater was measured December 11, 2020.

P-14 was installed in November 2020. The depth of groundwater was measured December 11, 2020.

Table SAP-2: Groundwater Monitoring Well Sampling Frequency

Group	Location	Monitoring Frequency	Analytes
LDA Shallow/Alluvial Groundwater	MW-1A	Quarterly Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
	MW-2A	Quarterly Sampling	
	MW-3A	Quarterly Sampling	
	MW-4A	Quarterly Sampling	
	MW-5A	Quarterly Sampling	
	MW-6A	Quarterly Sampling	
LDA – Bedrock Groundwater	MWB-1LDA	Semi-annual groundwater parameters, Annual Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
	MWB-2LDA	Semi-annual groundwater parameters, Annual Sampling	
	MWB-3LDA	Semi-annual groundwater parameters, Annual Sampling	
LDA – Surface Water	South Pond	Quarterly Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
	Still Well	Quarterly Sampling	
	Weir	Quarterly Sampling	
	Infiltration Ponds #1	Quarterly Sampling	
	Interceptor Trench	Quarterly Sampling	Total Dissolved Solids
DSP – Bedrock Groundwater	MWB-2DSP	Semi-annual groundwater parameters	N/A
	MWB-4SDSP	Semi-annual groundwater parameters	
	MWB-1SDSP	Semi-annual groundwater parameters, Annual Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
	MWB-1DDSP	Semi-annual groundwater parameters, Annual Sampling	
	MWB-5DSP	Semi-annual groundwater parameters, Annual Sampling	
	MWB-6DSP	Semi-annual groundwater parameters, Annual Sampling	
	Portal	Semi-annual groundwater parameters, Annual Sampling	
New RI Wells	MW-7A	Quarterly Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
	MW-8A	Quarterly Sampling	
	MW-9A	Quarterly Sampling	
	MW-10A	Quarterly Sampling	
	AMW-1	Quarterly Sampling	
	P-11	Semi-annual Sampling (2 rounds)	Total Antimony, Arsenic, Beryllium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, Vanadium.
	P-14	Quarterly Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids
		Semi-annual Sampling (2 rounds)	Total Antimony, Arsenic, Beryllium, Chromium, Lead, Mercury, Nickel, Selenium, Silver, Thallium, Vanadium. 2,3,7,8-substituted Dioxins & Furans
	P-15	To be determined based on two rounds of semi-annual sampling from P-11 and P-14.	To be determined based on two rounds of semi-annual sampling from P-11 and P-14.
	P-16	To be determined based on two rounds of semi-annual sampling from P-11 and P-14.	To be determined based on two rounds of semi-annual sampling from P-11 and P-14.
Off-site Wells	Baja Well	Semi-annual Sampling	Total Arsenic, Lead, Potassium. Total Dissolved Solids

Notes:

Dissolved metals will also be collected and placed on hold. Dissolved metals will be analyzed if necessary.

If sampling indicates an analyte is consistently not detected above reporting limits, the list of analytes may be reduced as appropriate.

Table SAP-3: Anticipated Unique Sample IDs

Group	Location	Anticipated Sample ID[1]
Grab Soil Samples	G-AB-1 (Vadose Zone)	G-AB-1-DEPTH-DATE
	G-AB-1 (Saturated Zone)	G-AB-1-DEPTH-DATE
	P-16 (Vadose Zone)	P-16-DEPTH-DATE
	P-16 (Saturated Zone)	P-16-DEPTH-DATE
LDA Shallow/Alluvial Groundwater	MW-1A	MW-1A-DATE
	MW-2A	MW-2A-DATE
	MW-3A	MW-3A-DATE
	MW-4A	MW-4A-DATE
	MW-5A	MW-5A-DATE
	MW-6A	MW-6A-DATE
LDA – Bedrock Groundwater	MWB-1LDA	MWB-1LDA-DATE
	MWB-2LDA	MWB-2LDA-DATE
	MWB-3LDA	MWB-3LDA-DATE
LDA – Surface Water	South Pond	South Pond-DATE
	Still Well	Still Well-DATE
	Weir	Weir-DATE
	Infiltration Ponds #1	Infiltration Ponds-DATE
	Interceptor Trench	Interceptor Trench-DATE
DSP – Bedrock Groundwater	MWB-1SDSP	MWB-1SDSP-DATE
	MWB-1DDSP	MWB-1DDSP-DATE
	MWB-2DSP	MWB-2DSP-DATE
	MWB-4SDSP	MWB-4SDSP-DATE
	MWB-5DSP	MWB-5DSP-DATE
	MWB-6DSP	MWB-6DSP-DATE
	Portal	Portal-DATE
New RI Wells	MW-7A	MW-7A-DATE
	MW-8A	MW-8A-DATE
	MW-9A	MW-9A-DATE
	MW-10A	MW-10A-DATE
	AMW-1	AMW-1-DATE
	P-11	P-11-DATE
	P-14	P-14-DATE
	P-15	P-15-DATE
	P-16	P-16-DATE
ISM Soil/Precipitate/Sediment Samples	DU-1	DU-1-ISM1-DATE
		DU-1-ISM2-DATE
		DU-1-ISM3-DATE
	DU-2	DU-2-ISM1-DATE
		DU-2-ISM2-DATE
		DU-2-ISM3-DATE
	DU-3	DU-3-ISM1-DATE
		DU-3-ISM2-DATE
		DU-3-ISM3-DATE
	Infiltration Ponds	Infil-Pond-S-1-DATE
		Infil-Pond-S-2-DATE
		Infil-Pond-S-3-DATE
		Infil-Pond-S-4-DATE
		Infil-Pond-S-5-DATE
		Infil-Pond-S-6-DATE
		Infil-Pond-S-7-DATE

Table SAP-3: Anticipated Unique Sample IDs

Group	Location	Anticipated Sample ID[1]
		Infil-Pond-S-8-DATE
		Infil-Pond-S-9-DATE
		Infil-Pond-S-10-DATE
Quality Assurance/Quality Control Samples	Grab Soil Sample Field Duplicate 1	DUP-1-DATE
	Grab Soil Sample Field Duplicate 2[a]	DUP-2-DATE
	Field Blank 1	MW-89-1-DATE
	Field Blank 2[a]	MW-89-2-DATE
	Equipment Blank 1	MW-99-1-DATE
	Equipment Blank 2[a]	MW-99-2-DATE
	Water Sample Field Duplicate 1	MW-35A-DATE
	Water Sample Field Duplicate 2[a]	MW-45A-DATE
	Infiltration Ponds Sediment Sample Field Duplicate 1	Infil-Pond-S-F1-DATE
	Infiltration Ponds Sediment Sample Field Duplicate 2[a]	Infil-Pond-S-F2-DATE

Notes:

1 - DEPTH refers to the depth the sample was taken. DATE refers to the month and year the sample was taken. For example if sampled in March 2020, the DATE suffix will be -0320.

[a] - if required

Figures

REFERENCE(S)

1. BASE TOPOGRAPHY PROVIDED BY PUGET SOUND LIDAR CONSORTIUM, DATED 2016, IN SHAPEFILE FORMAT.
2. TOPOGRAPHY SHOWN REFERENCES NAD83 WASHINGTON STATE PLANE, NORTH ZONE, US FOOT (HARN) PROJECTION. VERTICAL DATUM: NAVD88.

LEGEND

🟥 — — —	APPROXIMATE 2019 GEOPHYSICS SURVEY EXTENTS
━━━	APPROXIMATE 2010 GEOPHYSICS SURVEY EXTENTS
MW-1A	ALLUVIAL MONITORING WELL
MWB-1DDSP	BEDROCK MONITORING WELL
MWB-2DSP	BEDROCK MONITORING WELL (NOTE 4)
🟩	LDA SURFACE WATER SAMPLING LOCATION
🟩	DSP BEDROCK SAMPLING LOCATION (PORTAL)
▲	INTERCEPTOR TRENCH SAMPLING LOCATION
— x — x —	FENCE LINE
⊕	PROPOSED MONITORING WELL
●	PRIVATE WELL
P-14	LDA MONITORING WELL
P-1	GOLDER PIEZOMETER - NO PROPOSED SAMPLING
G-AB-1	PROPOSED SOIL BORING

CLIENT
HOLCIM

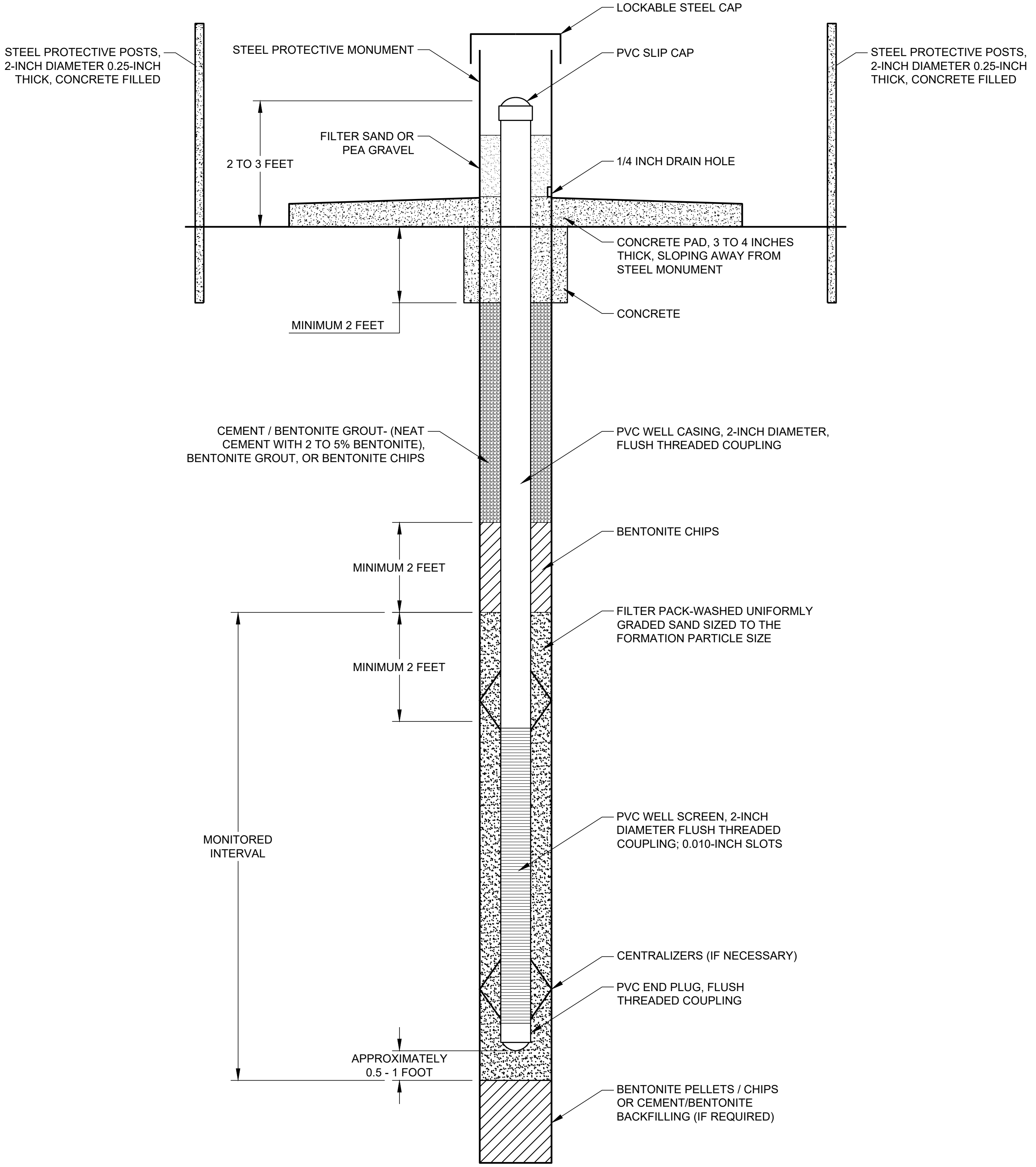
CONSULTANT
GOLDER

YYYY-MM-DD	2021-06-17
DESIGNED	JX
PREPARED	REDMOND
REVIEWED	JX
APPROVED	GZ

PROJECT
RI WORK PLAN 2021
RAVENSDALE, WA

TITLE
PROPOSED RI BOREHOLES AND MONITORING WELLS (OVERLYING 2010 AND 2019 GEOPHYSICS SURVEYS)

PROJECT NO.	PHASE	REV.	FIGURE
152030402	004	0	SAP-1



NOTE

1. MONITORING WELL IS NOT TO SCALE.

CLIENT HOLCIM	PROJECT RI WORK PLAN 2021 RAVENSDALE, WA

CONSULTANT

GOLDER

YYYY-MM-DD	2021-06-17
DESIGNED	JX
PREPARED	REDMOND
REVIEWED	JX
APPROVED	GZ

TITLE

TYPICAL MONITORING WELL INSTALLATION

PROJECT NO.	PHASE	REV.	FIGURE
152030402	004	0	SAP-2

PATH: G:\HOLCIM\Ravensdale\99_PROJECTS\152030402_RI-2019\004_RI_Tasks_2021\02_PRODUCTION\MXD\FIGURES\2021_RI\Rev0\152030402_004_008_F6-4_Rev0_ISM_Proposed_DU_SL.mxd PRINTED ON: 2021-06-17 AT: 12:11:47 PM

LEGEND

●	Sampling Location
▭	Decision Unit
▨	Treatment Tank
▭	South Pond
▭	Site Boundary
▭	Parcel

0 100 200
1 " = 100 FT FEET

REFERENCE(S)
1. GOLDER (DECISION UNITS, SAMPLING LOCATIONS, TREATMENT TANK)
2. ASPECT CONSULTING (SITE BOUNDARY, PARCEL)
3. COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON NORTH FIPS 4601 FT US
4. MAP SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
HOLCIM

PROJECT
RI WORK PLAN 2021
RAVENSDALE, WA

CONSULTANT
GOLDER

YYYY-MM-DD	2021-06-17
DESIGNED	TL
PREPARED	TL
REVIEWED	JX
APPROVED	GZ

TITLE
PROPOSED DECISION UNITS AND SAMPLING LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
152030402	004	0	SAP-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 1 in