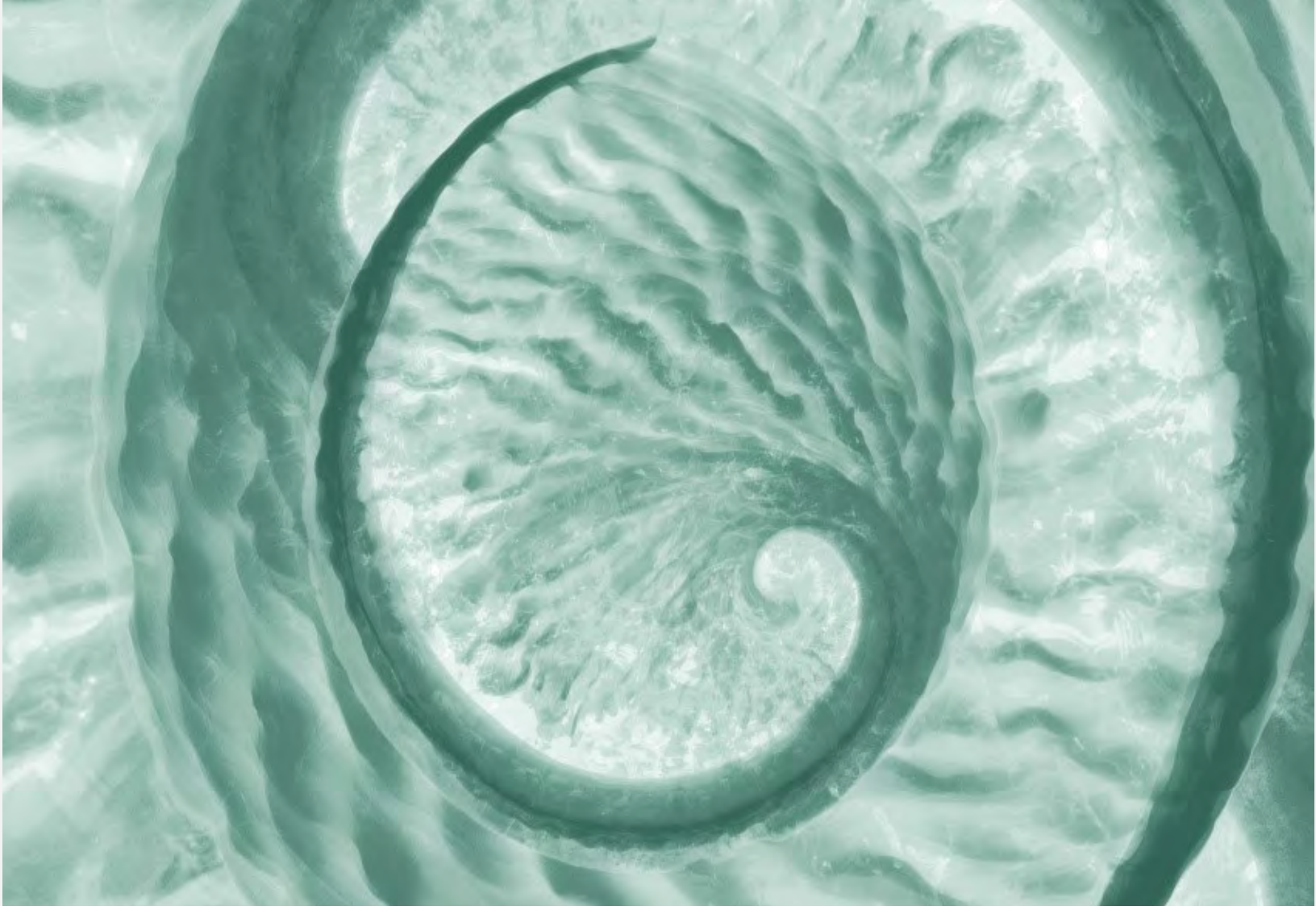

FFP Project 101, LLC

Remedial Investigation / Feasibility Study

Goldendale Energy Storage Project, FERC No. 14861

24 November 2021

Project No.: 0588595

The business of sustainability

ERM

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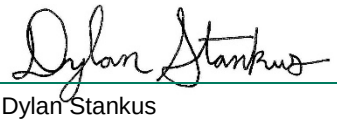
24 November 2021

Remedial Investigation / Feasibility Study

Goldendale Energy Storage Project, FERC No. 14861



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Abbreviations

Name	Description
AGO	Washington Attorney General's Office
AOC	area of concern
Applicant	FFP Project 101, LLC
BAL	Basalt Aquifer Lower Zone
BAU	Basalt Aquifer Upper Zone
CAP	Cleanup Action Plan
CGA	Columbia Gorge Aluminum
CGA Smelter Site	Former Columbia Gorge Aluminum site in its entirety
COC	chemical of concern
CUL	cleanup levels
Ecology	Washington State Department of Ecology
Order	Agreed Order No. DE 10483
EIS	Environmental Impact Statement
ERM	ERM-West, Inc.
FERC	Federal Energy Regulatory Commission
FS	Feasibility Study
FSP	Field Sampling Plan
KPUD	Klickitat Public Utility District
LMCO	Lockheed Martin Corporation
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
NSC	NSC Smelter, LLC
POC	Point of Compliance
Smelter PLPs	potentially liable parties/persons for the CGA Smelter Site
PLPs	potentially liable parties/persons
PPCD	prospective purchaser consent decree
Project	Goldendale Energy Storage Project
Project Area	area of the site to be developed for the Project
QAPP	Quality Assurance Plan
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI/FS	Remedial Investigation / Feasibility Study
SPL	spent pot liner
SWMU	solid waste management unit
UA	Unconsolidated Aquifer Zone
WAC	Washington Administrative Code
WSI	West Surface Impoundment

EXECUTIVE SUMMARY

The Goldendale Energy Storage Project (Project) is a proposed closed-loop, pumped-storage energy generation facility currently in a permitting process administered by the Federal Energy Regulatory Commission (FERC). FFP Project 101, LLC (the Applicant) proposes to construct the Project on property currently occupied by the closed Columbia Gorge Aluminum (CGA) aluminum smelter, located north of the Columbia River and south of the city of Goldendale, Klickitat County, Washington.

The current property owner, National Smelter, LLC (NSC), operated and subsequently closed the smelter and has been decommissioning and removing buildings and other structures for more than a decade. NSC and Lockheed Martin Corporation, a former owner/operator, have been assessing soil and groundwater conditions and removing impacted soil and debris at the CGA Smelter Site.

The Applicant holds an option with NSC to purchase 652 acres of the closed smelter property to develop the Project and intends to exercise the option after receiving an applicable license from FERC. The major components of the Project include the Upper Reservoir, the Lower Reservoir, a powerhouse, tunnels/penstocks, transmission lines, substation, and conveyance lines connecting those features. The proposed location of the Lower Reservoir overlaps a closed landfill, referred to as the West Surface Impoundment (WSI), that was formerly operated by the smelter. The WSI was closed in 2004 in accordance with applicable regulatory criteria under review and approval of the Washington State Department of Ecology (Ecology). Because the former smelter is a Resource Conservation and Recovery Act (RCRA) site, Ecology consulted with the U.S. Environmental Protection Agency on the closure.

The closed WSI (classified as non-hazardous and non-dangerous waste) is incompatible with construction of the Lower Reservoir. The WSI must be removed to provide a geotechnically stable foundation. To construct the Project, the contents of the WSI and associated contaminated soil would be excavated and disposed of off-site at an appropriate disposal facility, in accordance with applicable regulations.

A network of monitoring wells provides for post-closure monitoring of groundwater near the WSI. Monitoring of the wells is intended to continue for 30 years from the time of the WSI closure (2004) or until contaminants are below screening levels. To build the Project, some monitoring wells in the construction area will be abandoned. The Applicant proposes to replace selected groundwater monitoring wells, as necessary for groundwater monitoring of the former WSI.

The Applicant prepared an Initial Application for a Prospective Purchaser Agreement (PPA) in accordance with Washington Administrative Code 173-340-520 and Ecology's Toxics Cleanup Program Policy 520B, and submitted the Initial Application to Ecology and the Washington Attorney General's Office in December 2019. The Initial Application describes the rationale and general plan to remove the former WSI landfill and modify the landfill groundwater monitoring systems before constructing the Lower Reservoir.

A 28 April 2020 letter from Ecology (Ecology 2020) to the Applicant stated, "it is in the public interest and consistent with [Revised Code of Washington] RCW 70.105D.040(5) to begin work with the applicant toward development" of a Prospective Purchaser Consent Decree (PPCD) for the Project. Ecology's letter also stated, "the proposed project is not likely to contribute to a release or interfere with necessary remedial actions" ongoing on the former CGA Smelter Site.

On 25 June 2021, the applicant submitted the PPA Detailed Proposal (the "Detailed Proposal") to Ecology, consistent with WAC 173-30-520, to provide a detailed description of the Applicant's activities that are to be covered by the PPA (ERM, 2021). In accordance with Ecology's comments on the Detailed Proposal, ERM West, Inc. (ERM) has prepared this Remedial Investigation / Feasibility Study (RI/FS)

report on behalf of the Applicant to characterize the nature and extent of contamination in the former WSI landfill and propose cleanup alternatives for the former WSI landfill located within the property to be acquired by the Project. The recommended alternative in the FS proposes excavation and off-site disposal of the WSI and modifications to the associated groundwater-monitoring network to accommodate the future lower reservoir construction. This RI/FS is a companion to a Draft Cleanup Action Plan (CAP), prepared by the Applicant and to be finalized by Ecology as the Project CAP in support of the PPCD. The Draft CAP provides additional details regarding the removal of the WSI and decommissioning and replacement of groundwater monitoring wells in the Project Area.

FERC's decision to grant a license depends on definition and resolution of waste issues to the satisfaction of the state of Washington. The Applicant, upon receipt of the FERC license for the Project, will exercise its option to purchase the 652 acres to develop the Project.

1. INTRODUCTION

The Goldendale Energy Storage Project (Project) is a proposed closed-loop, pumped-storage energy generation facility currently in the licensing process administered by the Federal Energy Regulatory Commission (FERC). FFP Project 101, LLC (the "Applicant") holds an option to develop the Project on 652 acres (the "Project Area") on the western side of the approximately 7,000-acre former Columbia Gorge Aluminum (CGA) Plant property (the "CGA Smelter Site") near Goldendale, Klickitat County, Washington (Figure 1). The Project will be constructed on a 529.6-acre tract of land currently owned by NSC Smelter, LLC (NSC; the "Property Boundary"). A portion of the Project (i.e., the Lower Reservoir) will be constructed over environmental impacts associated with the CGA Smelter Site.

The CGA Smelter Site is a Resource Conservation and Recovery Act (RCRA) Corrective Action site being managed by the Washington State Department of Ecology (Ecology) as an active cleanup site under Agreed Order No. DE 10483 (the "Order") with Lockheed Martin Corporation (LMCO) and the current owner, NSC Smelter, LLC (NSC). LMCO and NSC, collectively the potentially liable persons (Smelter PLPs), are conducting investigation and cleanup under the Order and pursuant to Chapter 70.105D Revised Code of Washington (RCW), Model Toxics Control Act (MTCA).

In order to develop the Project within the CGA Smelter Site, the Applicant began a process to obtain a Prospective Purchaser Agreement (PPA) in accordance with Washington Administrative Code (WAC) 173-340-520 and Ecology's Toxics Cleanup Program Policy 520B, and submitted the Initial Application to Ecology and the Washington Attorney General's Office (AGO) on 4 December 2019. The Initial Application describes the rationale and general plan to address the CGA Smelter Site environmental impacts before constructing the Lower Reservoir.

The Applicant met with representatives of the Washington AGO and Ecology on 29 January 2020 to discuss the Initial Application. The Applicant held follow-up telephone conferences to review the Initial Application with the Washington AGO and Ecology staff on 19 February 2020, and with Ecology environmental staff, Washington Governor's staff representing the Executive Advisor for Tribal Affairs, and the Clean Tech section leader for the Washington Governor's office on 21 April 2020. The Applicant received a letter from Ecology dated 28 April 2020 (Ecology 2020) stating that "it is in the public interest and consistent with RCW 70.105D.040(5) to begin work with the applicant toward development" of a Prospective Purchaser Consent Decree (PPCD) for the Project.

ERM-West, Inc. (ERM), on behalf of the Applicant, submitted a Prospective Purchaser Agreement Detailed Proposal (the "Detailed Proposal") in 25 June 2021 (ERM 2021). The Detailed Proposal describes the Project to be covered under the PPA. In accordance with Ecology's comments on the Detailed Proposal, ERM has prepared this Remedial Investigation / Feasibility Study (RI/FS) report on behalf of the Applicant to characterize the nature and extent of contamination in the former WSI landfill and propose cleanup alternatives for the former WSI landfill located within the property to be acquired by the Project.

The Project provides a unique opportunity to reuse a decommissioned industrial facility; and proximity to the John Day Dam, Bonneville Power Administration transmission lines, and nearby wind farms makes the site ideal for a closed-loop, pumped-storage facility.

1.1 Scope of the Project Remedial Investigation / Feasibility Study

This RI/FS report characterizes the nature and extent of CGA Smelter Site contamination within the Project Area and proposes cleanup alternatives for impacted media. This document will support development of a PPCD for the proposed Project.

The Project Area includes a landfill referred to as the West Surface Impoundment (WSI) received non-hazardous, non-dangerous waste, generated by smelter operations. The WSI was closed by the Smelter PLPs in 2004 under RCRA and is currently in a long-term post-closure monitoring program required by Ecology as a condition of closure. The WSI (also known as solid waste management unit [SWMU] 4]) consists of an engineered liner, the WSI wastes, and an approved RCRA engineered cover (an “eco-cap”; see Appendix A). The Project Area includes portions of a groundwater monitoring network maintained by the PLPs to monitor groundwater impacts attributable to the CGA Smelter Site.

The FS describes cleanup action alternatives for environmental media in the Project Area that are not compatible with constructing the Project. This RI/FS is based entirely on information provided by others on behalf of the Smelter PLPs pursuant to the Order that include environmental impacts within the Project Area.

This RI/FS document does not consider investigation results or propose cleanup alternatives for areas of the CGA Smelter Site that are outside the proposed Project Area. The Smelter PLPs are investigating the broader CGA Smelter Site and assessing cleanup actions under the Order. The Applicant is not a potentially liable party (PLP) under the Order.

Sections 1 through 6 of this document discuss the RI findings for the Project Area. Sections 7 through 9 discuss the FS for the environmental impacts within the Property Area.

2. BACKGROUND

2.1 Location

The former CGA Smelter facility is located at 85 John Day Dam Road, Goldendale, Washington. The CGA Smelter Site is located north of the Columbia River approximately 9 miles southeast of the city of Goldendale in Klickitat County. The CGA Smelter Site includes portions of Sections 20 and 21 in T3N, R17E, Willamette Meridian.

2.2 Site History

Harvey Aluminum Company built the CGA Smelter in 1969 and 1970. There was one major expansion in 1971. Martin Marietta (later LMCO) owned the Facility from 1971 to 1985. Other owners included Commonwealth Aluminum from 1985 through 1987, Columbia Aluminum from 1987 through 1996, and Goldendale Aluminum from 1996 through closure in 2003.

The smelter operated as a primary aluminum smelter from approximately 1970 until 2003, when smelting ceased. Since 2003, the site owners have demolished structures, except for a few office and storage buildings and a small active wastewater treatment plant permitted under the National Pollutant Discharge Elimination System (NPDES) permit WA0000540. NSC is the current owner of the owns the CGA Smelter Site and surrounding land.

2.3 Site Setting

The CGA Smelter Site is in the southern margin of the Columbia Hills near the Columbia River within the Columbia Plateau physiographic province. The Columbia Plateau covers an area of approximately 63,000 square miles, within which the ground surface ranges in elevation from approximately 200 to 3,000 feet. Mountains surround the plateau: the Cascade Range to the west, the Okanogan Highlands to the north, the Clearwater Range to the east, and the Blue Mountains to the south (Shannon & Wilson, Inc. 2002).

Figure 2 shows the topography of the Project Area. The southern portion of the Project site is a relatively flat bench extending from the Columbia River northward to the base of steep bluffs. The bluffs rise steeply (approximately 2,300 feet of relief) from the bench. The northern portion of the Project site is a gentle, northward sloping surface extending from the bluff edge to the northern Project boundary.

2.4 Proposed Project Description

The Applicant proposes to build a pumped-storage hydroelectric facility. The Project is a “closed-loop” system and would use water supplied by KPUD for initial fill and periodic makeup water. The Project will provide critical electricity balancing capacity and carbon-free renewable energy to utilities in the Pacific Northwest and potentially California.

The Project includes the following major elements:

- Upper and Lower reservoirs and diversions
- Water conveyance systems (tunnels/penstocks)
- Powerhouse and associated equipment
- Transmission interconnection to Bonneville Power Administration’s John Day Substation

The footprint of the Lower Reservoir will overlap part of the existing WSI, which must be removed to construct the Project. Section 7.3 describes cleanup action alternatives for the WSI.

2.5 Environmental Setting

2.5.1 Topography

The CGA Smelter Site (including the Project Area) is located on a topographic bench at about 450 to 540 feet in elevation, and approximately 0.5 miles from the Columbia River south of CGA Smelter Site. The bench terminates at cliffs above the Columbia River. The Columbia River surface water elevation near the CGA Smelter Site is about 268 feet mean sea level in the Lake Umatilla pool upstream of the John Day Dam. North of the CGA Smelter Site, the Columbia Hills form a steep ridge with about 2,500 feet of relief with a talus slope extending down slope onto the CGA Smelter Site. Three natural seasonal drainages to the south of the former smelter and north of the Columbia River drain to the River. To construct the smelter, one of these drainages was modified into a series of settling ponds called the NPDES Ponds A through D. The topographic relief to support the Upper and Lower reservoirs of the proposed Project is shown on Figure 2.

2.5.2 Climate

The CGA Smelter Site is located in the eastern portion of the Columbia River Gorge in a semi-arid region. Average annual rainfall ranges from 9 to 12 inches per year with the driest periods occurring during summer through early fall (National Weather Service, Tetra Tech 2019). The CGA Smelter Site is characterized by hot and dry conditions in the summer (average daytime high temperature of 90 degrees Fahrenheit in July) and relatively cold conditions in the winter (average daytime high temperatures of 40 degrees Fahrenheit in December). Locally, most precipitation occurs in November through February. The wettest months are December and January with an average rainfall of about 2.5 inches per month.

2.5.3 Geohydrology

2.5.3.1 Geology

The CGA Smelter Site is located on the Columbia River Plateau where the bedrock is composed of the Miocene Columbia River Basalt Group (Bela 1982; USGS 2014). The rocks of the Columbia Plateau are primarily accumulations of successive lava flows that erupted during the Miocene epoch. Figure 3 is a geologic map of the Project Area.

Bedrock in the Project are members of the Columbia River Basalt Group. These lava flows are several thousand feet thick across most of the Columbia Plateau area, and are the result of numerous eruptions of basaltic lavas from vents in what is now northeast Oregon and southeast Washington. In many places, sedimentary units of variable thickness are present between the flows, marking quiescent periods between eruptions that allowed lacustrine and fluvial sediments to accumulate as the regional surface water flow adjusted to the new topography and drainage conditions resulting from each lava flow.

There is suspected Quaternary movement along some of the northwest/southeast trending fault sections (USGS 2014). An east-west trending thrust fault is present near the base of the Columbia Hills to the north of the site based upon a repeated section within the Grande Ronde Basalt (Bela 1982). Two generally northwest-southeast trending faults have been previously mapped near CGA Smelter Site one named Goldendale strike-slip fault and the other a combination strike-slip and normal fault, that intersect the thrust fault in the site vicinity (KPUD 2014). The Goldendale fault is inferred to be west of the WSI and about 1 mile downstream of John Day Dam. The second fault passes under the former location of the CGA Smelter Site with the fault trace appearing to coincide with the western gulley that leads from the western end of a boat basin up to the western end of the former CGA Facility. According to the John Day

Pool pumped-storage pre-application document (KPUD 2014), it is unlikely that the faults beneath the CGA Smelter Site are active or have the potential to produce earthquakes.

The bench area represents an erosional feature formed by erosional scour during the Pleistocene Missoula Floods (Bela 1982). Unconsolidated deposits near the CGA Smelter Site consist of glacial fluvial sediments, alluvium, colluvium shed from the ridge to the north, potential localized aeolian deposits, and manmade fill associated with highway construction, dam construction, and smelter construction and operations. The unconsolidated deposits in the Project Area are a discrete stratigraphic unit ranging from a few feet to about 60 feet thick in localized areas within flood-scoured depressions on the basalt bench surface.

2.5.3.2 Groundwater

Groundwater beneath the CGA Smelter Site is first encountered in an unconsolidated alluvial/colluvial aquifer underlain by a series of basalt bedrock aquifers that represent the more permeable zones within the basalts and typically correspond to flow tops. Groundwater underlying the Project Area of the CGA Smelter Site is encountered in three water bearing aquifers zones, which are defined in the CGA Smelter Site RI reports (Tetra Tech 2015 and 2019) as follows:

- Unconsolidated Aquifer Zone (UA)—shallow water in the colluvium, alluvium fill that overlies basalt bedrock. Groundwater occurs locally within the upper 2 to 3 feet of fractured basalt. The top of the UA occurs 14 to 28 feet below ground surface and is 38 to 70 feet thick.
- Basalt Aquifer Upper Zone (BAU)—groundwater occurs within the basalt flow sequences. The BAU is approximately 50 feet thick and occurs from elevation 400 to 350 feet.
- Basalt Aquifer Lower Zone (BAL)—underlies saturates zones beneath the BAU. The BAL is approximately 85 feet thick and occurs from elevation 350 to 265 feet.

Wells in the Project Lower Reservoir Area are in the UA and the BAU.

Groundwater beneath the CGA Smelter Site flows southwestward toward the Columbia River. The draft RI for the CGA Smelter Site (Tetra Tech 2019) indicate limited groundwater discharge to Columbia River sediment and surface water.

The typical depth to groundwater in the Project Area is 14 to 28 feet below the ground surface, depending on the well locations and seasonal fluctuations. The depth to groundwater beneath the WSI varies by area of the WSI. The WSI does not penetrate the groundwater table. Appendix A includes a typical section from northeast to southwest through the WSI (See Figure A4). As shown on Figure A4, the base of the WSI was approximately 10 feet above the water table in the unconsolidated deposits.

2.5.4 Surface Water and Sediments

The Columbia River is the major water body near CGA Smelter Site. The John Day River flows from Oregon into the Columbia River about 1 mile upstream of the former smelter. The John Day Dam spans the Columbia River and is equipped with fish passages by various runs of salmon and steelhead.

There are two small surface water bodies adjacent to a wetland approximately 1,500 feet southeast of the WSI. These two surface water bodies were not investigated as part of the CGA Smelter Site RI. The surface water bodies are not in the Project Area and are not anticipated to be impacted by the development of the Project.

Sediment bioassays indicated no toxicity to benthic organisms. The CGA Smelter Site RI (Tetra Tech 2019), therefore, concluded that no further investigation or remedial action is warranted for Columbia River sediments.

2.5.5 Wetlands

Wetlands delineated in the CGA Smelter Site RI (Tetra Tech 2019) consist primarily of Category III and IV palustrine emergent and/or palustrine scrub/shrub wetlands. Category III and Category IV wetlands are those with a moderate- to low-level function that have been disturbed in some way (e.g., grazing, historical grading activities, etc.).

ERM prepared a Wetlands and Waters Delineation Report based on field surveys within the Project Area in May 2019. ERM identified one palustrine, emergent wetland associated with a seep on a hillslope road cut along Highway 14, north of the WSI and outside the Project footprint for the Lower Reservoir (ERM 2019).

2.5.6 Ecology

Previous reports describe the ecology of the area (PGG 2014, FFP Project 101 2020, Tetra Tech 2015 and 2019). The CGA Smelter Site is part of Eastern Washington shrub-steppe community that includes sagebrush, bunch grass, rabbitbrush, intermixed with talus slopes and patches of forest. Trees are uncommon, except near water, such as wetlands, ponds, streams, and rivers. In wetter areas, common tree species include oak, pine, willow, and Russian olive. In areas suitable for agriculture, the native vegetation has been replaced with grain (in wetter areas) or other row crops (including grapes) that may require irrigation.

The habitat near CGA Smelter Site is commonly referred to as “scablands” that includes sagebrush and grasses between areas of exposed bedrock with a hummocky topography. The basalt forms cliffs in areas along the Columbia River and steep talus slopes north of CGA Smelter Site along the base of the Columbia Hills.

The Project FERC Final License Application (FFP Project 101 2020, Section 3) lists species and maps habitat areas. The area of the CGA Smelter Site, overall, provides habitat for bird species such as sparrows, chukar, quail, turkeys, crows, and raptors including the red-tailed hawk, and golden eagle. Ponds and wetland areas provide habitat for ducks, geese, and other water birds. Mammals may include mice and other rodents, rabbits, raccoons, skunks, foxes, coyotes, and deer. A few reptile species including rattlesnakes are present near of the CGA Smelter Site.

Tetra Tech (2019) identifies state or federally designated threatened and endangered species that may be present near the CGA Smelter Site, and in the nearby Columbia River. Listed species include the western gray squirrel (state listing as threatened) and various federally listed threatened fish including particular bull trout, steelhead, Chinook salmon, and chum salmon runs. The Snake River sockeye salmon is federally listed as endangered (Tetra Tech 2019).

The location of soil contamination within the Project Area are limited to the WSI which is a low-quality habitat and secured with fencing. The WSI is a landfill with an engineered RCRA cap consisting of soil and geosynthetic materials. Quarterly inspections and maintenance are completed to maintain integrity of the cap including removal of rodent holes and vegetation clearance (GeoPro 2021). According to MTCA WAC 173-340-7491(b), the WSI is exempted from Terrestrial Ecological Evaluation requirements as it was closed under RCRA program requirements and is undergoing long-term post-closure groundwater monitoring. The WSI removal is not anticipated to impact ecological resources in the Project Area (Section 5.4.1).

3. PROJECT AREAS OF INTEREST

3.1 Solid Waste Management Unit / Area of Concern Summary

The WSI is the only SWMU that is within the Project Area (Figure 4). Other structures to be constructed for the Project will not be located on the CGA Smelter Site historical operation areas or SWMUs.

Groundwater in the Uppermost Aquifer is an AOC for CGA Smelter site. Fourteen of the CGA Smelter Site groundwater monitoring wells are within the Project Area and must be abandoned to construct the Project.

The following sections describe SWMUs and areas of concern in the Project Area.

3.1.1 West Surface Impoundment

The WSI is an SWMU containing non-hazardous waste and non-dangerous waste produced by historical operations of the smelter. When operating, the WSI was an approximately 10-acre earthen impoundment with a maximum depth of approximately 18 feet. The smelter operators constructed the WSI by expanding naturally occurring landscape features and installing two layers of 15-millimeter thick Hypalon as a bottom liner. The WSI concentrated emission control wastewater to sludge by evaporation. The sludge accumulated in the WSI over time. In 1982, the WSI began receiving waste from the north SO2 scrubber and the tertiary treatment plant. The WSI was closed in place under RCRA in 2004 and is currently in long-term post closure monitoring.

Closure of the WSI included the following elements:

- Blending site borrow material with the landfill contents such that they would support construction equipment and consolidation of the landfill contents to reduce the impoundment footprint.
- Installing a ventilation system consisting of 12-inch wide strip drains, below the liner system that leads to three vertical ventilation pipes.
- Covering the landfill contents with an engineered RCRA cap that consists of geosynthetic clay liner, 30-millimeter thick polyvinyl chloride (PVC) geomembrane, and an 8-ounce nonwoven geotextile.
- Placing a 2-foot thick layer of cover soil consisting of soil from the on-site borrow pit and soils from the existing south berm road.
- Hydroseeding the final cover system.

The WSI historically received state-only dangerous wastes. These wastes were designated as WT02 (toxic dangerous waste) through a fish bioassay test performed by Martin Marietta Corporation. Martin Marietta Corporation reported this designation in its Part A permit application submitted on 6 August 1982. In November of 1995, Ecology revised WAC 173-303, and changed the bioassay criteria. Under the new criteria, the WSI wastes did not designate as dangerous. A RCRA Part B application was submitted by the Smelter PLPs in August 2004 to reflect closure of the WSI. Ecology approved the WSI closure plan in October 2004, and the WSI was closed on 30 November 2005. At the time of closure, the WSI contained an estimated 89,000 cubic yards of residual sludge.

Appendix A includes details of the approximate location of each type of waste within the WSI at the time of closure (see Figure A1 adapted from Parametrix [2004]); figures showing the final grading plan for the WSI after closure (Figure A2); a recent aerial photograph (Figure A3); and a geologic cross-section of the WSI (Figure A4).

3.1.2 Groundwater

The CGA Smelter Site groundwater monitoring well network within the Project Area (i.e., the WSI monitoring well network) consists of fourteen monitoring wells, of which eleven wells are within the Project footprint (i.e., the Lower Reservoir). Monitoring wells within the Project footprint must be decommissioned to construct the Project. Nine of the WSI monitoring wells within the Project Area are screened in the UA (see Section 2.5.3.2 for description of groundwater zones). Two wells (MW 2B and MW-7B) are screened in the BAU (Figure 4). MW-18 is screened in the BAL downgradient of WSI and outside the Project Area.

Six wells (MW-8A, MW-3B, MW-10A, MW-12A, MW14A, including downgradient MW-18) are located near the WSI. The Smelter PLPs monitor wells annually for sulfate, fluoride, chloride, and total cyanide.

Groundwater flow in the uppermost aquifer in the Project Area is generally southwestward toward the Columbia River. Appendix B, Figures B1 and B2, show groundwater elevations in the unconsolidated deposits and the upper basalt in the Project Area, as measured in 2018.

Monitoring data reported in the RI prepared by the Smelter PLPs (Tetra Tech 2019) indicate groundwater concentrations of fluoride and sulfate are above screening levels within the Project Area. Groundwater sampling results from UA and BAU monitoring wells within the Project Area in 2021 (GeoPro 2021) indicate concentrations of fluoride above the maximum contaminant level of 4.0 milligrams per liter (mg/L) and MTCA Method B Cleanup Level of 0.96 mg/L in the UA zone near the WSI. Sulfate exceeds the U.S. Environmental Protection Agency secondary maximum contaminant level of 250 mg/L in groundwater in the UA and BAU beneath the WSI and extends laterally to the southwest toward the Columbia River.

Table B2 lists selected groundwater quality data for monitoring wells in the Project Area, as measured in samples collected as a part of the CGA Smelter RI/FS and ongoing groundwater by the Smelter PLPs (Tetra Tech 2019; GeoPro 2021). Appendix B includes Figures from the CGA Smelter RI/FS showing fluoride and sulfate concentrations in groundwater in from samples collected in 2017 (Tetra Tech 2019).

3.1.3 Surface Soil

The WSI is the only SWMU that is within the Project Area. WSI materials are contained within an engineered RCRA cap that consists of geosynthetic clay liner, 30-millimeter thick PVC geomembrane, and an 8-ounce nonwoven geotextile. The RCRA cap is covered with a 2-foot thick layer of cover soil consisting of soil from the on-site borrow pit and soils from the existing south berm road.

There are no known areas of contaminated surface soil associated with the CGA Smelter Site within the Project Area.

3.2 Data Identification

Construction of the 62-acre Lower Reservoir will require excavation of the WSI, which includes the WSI wastes, liner, and gas collection piping. Excavated solid waste and soil in the WSI and construction area will be sampled, analyzed, and characterized for disposal at a permitted landfill. The Engineering Design Report and a Compliance Monitoring Plan (CMP) will describe the excavation process including sampling for waste constituents to assess soil quality at the excavation limits and to characterize soil for disposal.

3.3 Data Quality

The investigation and completion sampling must be of adequate data quality to support the remedial action objectives. The Smelter PLPs conducted soil and groundwater investigations, as described in the CGA Smelter Site RI (Tetra Tech 2019). An Field Sampling Plan and quality assurance plan (QAPP) were

included in the Final RI Phase 2 Work Plan that described sampling procedures and data-quality assurance (Tetra Tech 2015).

The Applicant will prepare a CAP, CMP, and QAPP to describe field procedures and data-quality assurance to be implemented during excavation of the WSI. The CMP (WAC 173-340-410) will provide details of monitoring required to demonstrate that the cleanup is implemented as intended and describes sampling and analysis to meet the requirements of WAC 173-340-820.

4. SITE CONCEPTUAL MODEL

A site conceptual model integrates understanding of sources, nature, and extent of contamination; fate and transport mechanisms; and potential receptors and exposure pathways to environmental contamination.

4.1 Current and Future Land Use

The Project Area is zoned industrial as is most of the surrounding CGA Smelter property. The Project Area is within an energy overlay zone (FFP Project 101 2020, Figure 9.1-2). The current owner of the CGA Smelter Site and adjacent property (NSC) plans to sell its land (and other assets) for commercial and industrial purposes. Land use surrounding the CGA Smelter property has been limited to livestock grazing, primarily cattle, in the sagebrush/grassland habitat.

Access to CGA Smelter Site and the Project Area (including the WSI) is restricted, with most of the former CGA Smelter facility fenced and locked. Some areas east of the former CGA Smelter facility (e.g., SWMU 31, Smelter Sign Area) are located outside the existing perimeter fencing; however, a full-time site manager is responsible for site security.

4.2 Potential Sources and Release Mechanisms

Former CGA Smelter operations are the source of the contamination identified on the CGA Smelter Site. In the 1970s, some of the solids/sludges from the NPDES ponds were periodically pumped to a series of shallow depressions to the east that became known as the East Surface Deposits Area. In 1978, these treatment processes were replaced by a dry scrubber and baghouse to remove particulates and fluoride gas, with a secondary wet scrubber process to remove sulfur dioxide. By 1985, the wastewater was diverted into the WSI. Solids from the clarifier and tertiary treatment system processes were also disposed in the WSI.

Fluoride and sulfate are constituents in smelting pot liners and in the air-emissions control sludge. Fluoride was present in the cryolite bath. Sulfur was present in the coke and pitch used in the manufacturing of briquettes used to line the pots.

Ore handling and the smelting process(s) were the predominant mechanisms for historical contaminant releases, including spills and leaks, storm and wastewater collection and discharge, and waste disposal. Investigations during closure of the WSI (Parametrix 2004) found that portions of the engineered lining system were degraded. Given the degraded state of the liner, the lining system may be compromised, resulting in releases and impacts to soil below the WSI.

4.3 Exposure Media and Transport Pathways

Potentially impacted environmental media resulting from past plant operations at the CGA Smelter Site included the following:

- Storm and wastewater in collection ponds and wet areas
- Surface water, including seeps, springs, wetlands, and the Columbia River
- Groundwater

RI/FS reports typically assess potential contaminant transport mechanisms in the context of cleanup technologies and source control. The CGA Smelter Site RI (Tetra Tech 2019) identified the following transport mechanisms for the CGA Smelter Site as a whole:

- **Infiltration and Leaching.** Infiltration of precipitation on the WSI could leach contaminants from shallow soils to groundwater.
- **Groundwater Flow.** Transport of dissolved COCs in groundwater could result in exposure at exposure points.
- **Aeolian Transport.** Wind-driven soil from surface sources could deposit contaminated soil down wind.
- **Wild Fire Transport.** Wild fires can potentially generate contaminants by burning on the CGA Smelter Site or nearby and with subsequent aeolian transport and deposition. Wildfires may also result in increased erosion and runoff in the fire areas.

The FS and remedy for the Project Area consider possible infiltration into and leaching of contaminants from the WSI. The FS completed by the Smelter PLPs will consider other CGA Smelter Site sources and transport mechanisms.

4.4 Ecological and Human Receptors

Potential exposure to COCs in soil and/or groundwater and/or physical stresses (e.g., destruction of habitat and disturbance) during the proposed Project construction and operation represent the primary effects to potential ecological and human receptors in the Project Area.

4.4.1 Ecological Receptors

Ecological exposure to COCs within the WSI is unlikely given the location of soil impacts are limited to the WSI which is a low-quality habitat and secured with fencing. Wildlife is not considered a potential receptor. The WSI is a landfill with an engineered RCRA cap consisting of soil and geosynthetic materials. Quarterly inspections and maintenance are completed to maintain integrity of the cap including removal of rodent holes and vegetation clearance (GeoPro 2021). According to MTCA WAC 173-340-7491(b), the WSI is exempted from Terrestrial Ecological Evaluation requirements as it was closed under RCRA program requirements and is undergoing long-term post-closure groundwater monitoring.

4.4.2 Human Receptors

The CGA Smelter Site is currently zoned for industrial use. Land use surrounding the CGA Smelter Site includes livestock grazing, primarily cattle, in the sagebrush/grassland habitat (Tetra Tech 2019). Access to CGA Smelter Site and the Project Area is restricted, with most of the area fenced with locked gates.

Exposures by humans could occur through contact with or ingestion of contaminated subsurface soil, dust entrained in air; or use of contaminated groundwater. The 2019 Tetra Tech RI/FS describes possible exposure to CGA Smelter Site related contaminants. Potential human receptors at the Cap Area include current and future users of the CAP Area, potential trespassers, and potential future users of CAP Area groundwater. During remedial construction, construction workers could also be exposed if dust is not well controlled. Current water rights identify drinking water as a possible beneficial use (PGG 2014); however, there are currently no drinking water wells located in the Project Area.

5. REGULATORY FRAMEWORK

5.1 Permitting and Regulatory Overview

Key environmental permitting and orders pertaining to the Project are detailed below.

5.1.1 State Environmental Policy Act

Ecology is preparing an Environmental Impact Statement (EIS) for the Project. The EIS will help Washington State make decisions related to the Project based on environmental impacts. The State estimates that the EIS will be complete in 2022. The EIS may specify conditions for WSI removal and monitoring well removal and replacement.

5.1.2 Resource Conservation and Recovery Act

The Project will be constructed on part of the CGA Smelter Site identified as a RCRA site in 1981, identification number WAD990828642. The WSI (SWMU 4) received state-only dangerous wastes based on bioassay criteria in place and regulated under the RCRA permit. Ecology later determined that the waste in the WSI is solid waste.

The RCRA closure process for the WSI began in 2004. A revised RCRA Part B application was submitted in August 2004 (Golder 2004) to reflect closure of the WSI. Ecology approved the WSI closure plan in October 2004, and the WSI was closed in November 2005. A final status permit has not been issued and the smelter CGA Smelter Site continues as a RCRA interim-status facility.

The WSI waste will be excavated, profiled, manifested, and transported to an off-site landfill that is licensed to accept both solid and hazardous wastes at an approved RCRA-permitted treatment storage and disposal facility.

5.1.3 Model Toxics Control Act

The Smelter PLPs have investigated the CGA Smelter Site under the Order, including the SWMUs and AOCs within the footprint of the proposed Project. The Applicant proposes to undertake remedial action to address SWMU 4 and the groundwater AOC within the Project Area in accordance with MTCA under a PPCD. When finalized, the PPCD will be filed at the appropriate superior court having jurisdiction.

5.1.4 Water Rights and Use

According to the Tetra Tech RI (2019), the largest water rights in the vicinity of the CGA Smelter Site were associated with aluminum smelter operation. The rights originally included both groundwater and surface water. These rights are designated for commercial and industrial purposes. The surface water right was for commercial and industrial purposes and has been reportedly transferred to Klickitat County Public Utility District (KPUD); the water use designation has been changed from industrial to municipal and the place of use has been expanded to various locations in Klickitat County. The groundwater right is for three wells and the designated use was for commercial, industrial and domestic purposes (Tetra Tech 2019).

5.1.5 Federal Energy Regulatory Commission

FERC has the exclusive authority to license most non-federal hydropower projects. A FERC Preliminary Permit for the Project was issued March 2018. A Final License Application for the Project was filed with FERC March 2020.

5.1.6 Local Review

Ecology will notify and seek comment from Klickitat County as part of land use planning review. Detailed plans for future use of the site should have completed at least an initial review by the local land use authority. The local authority should take into consideration historic land uses in the area, current and proposed land use plans and zoning, and current land use patterns in the area.

5.2 Chemicals of Concern

As discussed in Section 3, COCs in the Project Area identified in the CGA Smelter Site RIs include chemicals associated with the former aluminum reduction facility and wastes formerly disposed of in the WSI. COCs in the WSI and groundwater within the Project Area (Appendix B) include fluoride and sulfate.

5.3 Screening Levels

The primary screening levels identified for use in the RI/FS are MTCA Method A, B, and C Cleanup Levels (WAC 173-340). Method A, B, and C Cleanup Levels are summarized below.

- Method A provides tables of cleanup levels that are protective of human health for the 25 to 30 most common hazardous substances for soil and groundwater and including petroleum hydrocarbons. Method A is designed for cleanups that are relatively straightforward or involve only a few hazardous substances. Use of Method A may be appropriate for some specific-SWMUs at the CGA Smelter Site.
- Method B is the universal method under MTCA with cleanup levels acceptable for unrestricted (all) land uses and consistent with state and federal requirements. Human health levels for individual carcinogens cannot exceed one-in-a-million and cumulative site cancer-risk levels may not exceed 1 in 100,000. Levels of non-carcinogens cannot exceed the point at which a substance may cause illness in humans (that is the hazard quotient must be less than 1).
- Method C is a conditional method that is commonly used to set soil cleanup levels at qualifying industrial sites and for groundwater in some specific circumstances. Method C is based on less stringent exposure assumptions and higher lifetime cancer-risk thresholds than Method B. All practical methods of treatment must be used, and institutional controls must be implemented and maintained as part of site cleanup actions in which Method C cleanup levels are adopted.

The following sections summarize selected screening levels for soil (i.e., the WSI / SWMU 4) and groundwater that are within the Project Area consistent with the CGA Smelter Site RI (Tetra Tech 2019).

5.3.1 Soil Screening Levels

The CGA Smelter RI identified MTCA Method C Industrial Cleanup Levels for cleanup of soil at the WSI (Tetra Tech 2019). Soil screening levels were selected as the lower of values to protect site workers or to protect groundwater quality. Table 1 lists the soil screening levels.

- The Method C Industrial cleanup level for fluoride in soil is 210,100 milligrams per kilogram (mg/kg). There is no MTCA Method C Industrial cleanup level for sulfate in soil.
- Screening concentrations in soil to protect groundwater at the CGA Smelter Site are 615 mg/kg for fluoride and 2,150 mg/kg for sulfate (Tetra Tech 2019). There are no water supply wells within the Project Area.

Accordingly, the soil screening levels for the WSI are 210,100 mg/kg for fluoride and 2,150 mg/kg for sulfate.

5.3.2 Groundwater Screening Levels

The CGA Smelter Site RI identified Groundwater screening levels as drinking water MCLs, MTCA Method B formula values, or secondary MCLs (Tetra Tech 2019). The MCL for fluoride in groundwater is 4.0 mg/L, and the MTCA Method B formula value is 0.96 mg/L. There is no groundwater MCL for sulfate. The CGA Smelter Site RI used the sulfate secondary MCL of 250 mg/L to screen sulfate concentrations in groundwater.

This RI/FS does not specify corrective actions in groundwater. The Smelter PLPs will conduct corrective action in groundwater under the Order.

5.4 Point of Compliance

The standard Point of Compliance (POC) for direct contact with soils extends from the ground surface throughout the Project to 15 feet below the ground surface (see WAC 173-340-740(6)(d)). The soil POC is established as the WSI area from the ground surface to a depth of 15 feet below ground surface. Construction of the Project will entail excavation of the WSI and impacted soil with COC concentrations that exceed the identified screening levels. Soil below the WSI excavation with residual concentrations of COCs lower than the soil screening levels is not a risk to humans and will not adversely impact groundwater. Accordingly, the soil POC is established as the WSI area from the ground surface to a depth of 15 feet below ground surface.

For purposes of assessing groundwater quality beneath the Project Area and the need to protect potential human exposure to contaminated groundwater, this RI/FS identifies the area beneath the WSI and down gradient extent to the Property boundary as a conditional POC for groundwater.

6. DESCRIPTION OF CLEANUP ACTION ALTERNATIVES

The FS (Sections 6, 7, and 8 of this report) describes alternatives for removing the WSI and impacted soil at concentrations greater than MTCA Method C Industrial Cleanup Levels within the Project Area.

6.1 Approach to Cleanup Action Alternatives

This section describes cleanup actions applicable to the Project, as described in the PPA Detailed Proposal. The MTCA regulation, WAC 173-340-350(8), broadly describes the elements of an FS. As agreed by Ecology in its comments on the PPA Detailed Proposal, this FS focuses on cleanup alternatives within the Project Area that are compatible with the proposed Project. This FS considers soil with concentrations that are above applicable screening criteria.

The soil cleanup action alternatives considered in this document are those necessary to address wastes in the WSI, underlying and/or surrounding soils in the Project Area, and as compatible with the Project. The groundwater cleanup alternatives are being developed by the Smelter PLPs, and groundwater actions are not considered in the Project FS.

This FS does not consider cleanup alternatives for areas of the CGA Smelter Site that are outside the Project Area.

6.2 Remedial Action Objectives

The remedial action objectives (RAOs) are the primary objectives for selecting a site-specific cleanup action consistent with MTCA. The RAOs for the CGA Smelter Site environmental impacts within the Project Area include:

- RAO1: Mitigate potential exposures of on-site human and ecological receptors to waste and impacted soil with COCs at concentrations higher than MTCA Method C Industrial Cleanup Levels (i.e., Soil Screening Levels).
- RAO2: Select a remedial alternative that is compatible with constructing the Project, consistent with the PPA Detailed Proposal, and meets the requirements of the Order and the Smelter PLPs.

The Smelter PLPs will conduct an FS to assess cleanup action for other areas of the CGA Smelter Site and for groundwater. This RI/FS for the Project Area does not address cleanup actions for groundwater, other than to address groundwater-monitoring wells located within the project footprint and evaluate conditions of the groundwater AOC relative to potential for exposure to human receptors.

6.3 Soil Cleanup Action Alternatives

Cleanup action alternatives considered in the FS for the Project Area are institutional controls alone and excavation and off-site disposal of waste and impacted soil in the WSI. Other cleanup alternatives such as containment or bioremediation were considered but are not compatible with the Project.

6.3.1 Alternative 1: Institutional Controls Alone

Under Alternative 1, the WSI would remain in place. Institutional controls would control potential exposures to wastes in the WSI.

WAC 173-340-440 defines institutional controls as *measures undertaken to limit or prohibit activities that may interfere with the integrity of an interim action or cleanup action or that may result in exposure to hazardous substances at a site*. By this definition, institutional controls are applicable only at sites and

under conditions where residual contamination remains and where exposure is possible. Such non-engineered measures may include fences, use restrictions, or signage.

The WSI is the only SWMU that is within the Project Area. Contaminants within the WSI are contained within an engineered RCRA cap that consists of geosynthetic clay liner, 30-millimeter PVC geomembrane, and an 8-ounce nonwoven geotextile. The RCRA cap is covered with a 2-foot thick layer of cover soil consisting of soil from the on-site borrow pit and soils from the existing south berm road. Institutional controls would limit, restrict, or prohibit activities, such as excavation or other earthwork that could result in exposure to COCs (fluoride and sulfate).

Alternative 1, institutional controls alone, is not compatible with constructing the Project (i.e., does not meet RAO 2). Alternative 1 is not carried forward for additional consideration in this RI/FS.

6.3.2 Alternative 2: Excavation/Disposal

Alternative 2 consists of excavating the WSI and impacted soil beneath the WSI with concentrations higher than MTCA Method C Industrial Cleanup Levels. Excavated materials will be sampled for waste designation purposes and transported to an off-site landfill for disposal in accordance with applicable state and federal regulations. Confirmation soil sampling will be conducted below the WSI bottom liner, and/or other soil in the immediately adjacent area to the WSI to support assessment of excavation extent and potential for residual impacts of COCs.

The contents of the WSI, the bottom liner, the RCRA cover system, and the landfill ventilation system are incompatible with the Project. Therefore, the Applicant intends to remove the WSI contents and piping systems to safely construct the Lower Reservoir. Furthermore, the FLA for the Project (FFP 2020) indicated that the base of the Lower Reservoir would be at an elevation that is at or near the water table of the uppermost groundwater in the Lower Reservoir footprint. Construction of the Lower Reservoir will require removal and off-site disposal of the WSI in its entirety, as well as some potentially impacted soils in the vadose zone beneath the bottom liner of the WSI.

As described in Section 3.1.1, the capped WSI consists of a landfill ventilation system, a bottom liner of two layers of 15-millimeter thick Hypalon, waste materials from the WSI, an engineered RCRA cap, and a 2-foot thick layer of cover soil. Excavation will be completed using standard excavation and earth-moving equipment. The following earthwork quantities were estimated based on the available information on the cap and liner systems (Parametrix 2004).

- Engineered RCRA cover system: 40,350 in-place cubic yards
- Waste material disposed in the WSI: 89,000 in-place cubic yards
- Bottom Liner system: 16,200 cubic yards

To the extent practicable, the vegetative cover material component of the RCRA cover system will be removed and staged for reuse since those materials were not in direct contact with the WSI contents. The maximum proposed excavation depth is to 10 feet below the bottom of the WSI waste and liner system, to groundwater, or to hard basalt rock, whichever is shallowest. The WSI excavation is not expected to penetrate groundwater or encounter bedrock, as interpreted from Attachment A and summarized in Section 2.5.3.2.

The cost estimate for Alternative 2 (Section 7.1.8) assumes the volumes and depths listed above. The cost estimate assumes that up to 10 feet of soil will be excavated beneath the bottom liner and that up to 20 percent of the soil below the bottom liner is contaminated and must be disposed of off-site.

6.3.2.1 Institutional Controls

Alternative 2 may also include development of institutional controls, as necessary to prevent exposure to residual contamination in soil. Institutional controls will not be required if excavation of the WSI and confirmation sampling indicate that residual concentrations are below the approved MTCA cleanup levels.

If required to control exposure to residual contamination, institutional controls under Alternative 2 would be in the form of an environmental covenant to be recorded at the Klickitat County Auditor's Office to provide long-term protection of human health and the environment. The institutional controls would include restrictions or procedures to limit exposure to residual contaminated soil, if any, after the WSI is removed. The covenant would be executed by the property owner and recorded with the register of deeds for Klickitat County.

6.4 Groundwater Cleanup Action Alternatives

The Smelter PLPs will conduct an FS to assess cleanup actions for groundwater. This RI/FS for the Project Area does not address groundwater, other than to acknowledge the groundwater AOC and propose to decommission and replace groundwater-monitoring wells as necessary to construct the Project and meet the requirements of the Order and the Smelter PLPs.

The Applicant proposes to decommission and replace up to 16 groundwater-monitoring wells in the Project Area (see Section 3.1.2.). Replacement wells will be downgradient of the Lower Reservoir and the former WSI. The number of wells to be replaced will not likely exceed the number of wells decommissioned. The Applicant will develop a plan to decommission and relocate groundwater-monitoring wells. The number and location of replacement wells will be determined in consultation with Ecology and the Smelter PLPs to meet the requirements of a CAP for the CGA Smelter Site to be prepared by the Smelter PLPs.

As described in Section 3.1.2, groundwater monitoring wells downgradient of the WSI indicate COCs in groundwater above screening levels within the Project Area. Institutional controls for groundwater will be in the form of an environmental covenant to restrict beneficial use of groundwater from the Project Area and to implement measures to protect human health and the environment if construction encounters groundwater in the Project Area. The covenant would be executed by the property owner and recorded with the register of deeds for Klickitat County.

6.5 Initial Screening of Soil Cleanup Alternatives

Cleanup technologies are evaluated relative to one another on the basis of effectiveness, ability to implement, and cost.

6.5.1 Soil

Alternative 2, excavation/disposal and institutional controls, is carried forward. The excavation of the WSI waste is protective both in the short and long term as it removes impacted waste and soil permanently. Excavation is implementable using typical excavation equipment after securing proper permits for transport and disposal at an off-site facility.

Project Area will describe details of the well decommissioning and replacements. The Smelter PLPs will conduct groundwater monitoring under an access agreement with the Project.

7. EVALUATION OF REMEDIAL ALTERNATIVES

This section summarizes the evaluation of the remedial alternatives described in Section 7. MTCA identifies specific criteria against which alternatives are to be evaluated and categorizes them as either “threshold” or “other” requirements. Cleanup actions must at a minimum meet the threshold requirements. The other MTCA requirements are considered when selecting from among the alternatives that fulfill the threshold requirements.

7.1 Alternatives Evaluation

MTCA defines requirements (remedy selection criteria) that remedial alternatives must achieve to be selected as a cleanup action at a site. Alternative 2, waste removal and off-site disposal, is carried forward in the alternative evaluation. The sections below apply to soil remedial action Alternative 2, removal and disposal.

Pursuant to WAC 173-340-360(3)(d), a disproportionate cost analysis is not required if Ecology and the Applicant agree to a permanent cleanup action and it will be identified as the proposed cleanup action in a CAP. This section provides a qualitative evaluation of the proposed alternatives with respect to the seven MTCA criteria included in WAC 173-340-360(3)(e).

7.1.1 Protectiveness

Protectiveness is defined as the degree to which human health and the environment are protected by a given alternative, including risk reduction; the length of time required to meet cleanup standards.

Removing waste in the WSI and associated impacted soil in the Project Area will be protective of human health and the environment since WSI waste will be excavated and transported for off-site disposal. The waste and soil removal will eliminate a potential source of impacts to groundwater.

If required by the presence of residual contamination, institutional controls would protect human health and the environment by restricting property access and requiring actions to be implemented for future construction.

7.1.2 Comply with Cleanup Standards and Applicable State and Federal Laws

Removing waste in the WSI and associated impacted soil will achieve MTCA Method C Industrial Cleanup Levels.

7.1.3 Provide for Compliance Monitoring

The Applicant will prepare a compliance monitoring plan (WAC 173-340-410) to describe confirmation sampling of the WSI excavation to document the excavation achieves cleanup levels.

The Smelter PLPs will implement long-term groundwater monitoring at the CGA Smelter Site in accordance with requirements of the Order.

7.1.4 Permanence

The permanence of a cleanup action is measured by the degree to which it permanently reduces the toxicity, mobility, or volume of hazardous substances.

Excavation and off-site disposal will permanently remove the WSI source, thereby removing associated toxicity and the leachability transport as a contamination source to groundwater.

7.1.5 Effectiveness Over the Long Term

Effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the restoration timeframe, the magnitude of residual risk with the alternate.

Excavation and off-site disposal will be effective over the long term. Previously conducted fate and transport modeling by others demonstrates that suitable conditions currently exist to prevent migration of fluoride in groundwater for the long term. Alternative 2 has a sufficient degree of certainty and reliability.

7.1.6 Management of Short-term Risks

Short-term risks consider the degree to which human health and the environment are protected during construction and implementation of an alternative. Standard best management practices are expected to be implemented to manage potential risks to human health and the environment.

Excavation and off-site disposal presents short-term risks, due to material handling, high volumes of off-site truck traffic, and potential for transport of contaminants via erosion during rain events. The short-term risks are manageable by implementing safe work practices, a transportation plan, and an erosion and sediment control plan.

To satisfy WAC 173-340-520(1)(h)(iii), excavation work will be monitored as required by Ecology and dictated by best practices for minimizing generation of dust and in protecting the public and environment during the excavation and load-out process. Transport trucks will be covered to mitigate dust generation during transport to the disposal facility. If necessary, a haul truck tire wash system will also be employed.

7.1.7 Technical and Administrative Implementability

An alternative's technical and administrative implementability includes the following considerations:

- Whether the alternative is technically possible
- Availability of necessary facilities, services, and materials
- Administrative and regulatory requirements
- Scheduling
- Size and complexity of the alternative
- Monitoring requirements
- Access for construction and monitoring
- Integration of existing operations with the remedial action

Excavation and off-site disposal is technically feasible. Commonly used construction and excavation equipment and well drilling services are readily available. A permitted landfill that will accept the WSI waste is located nearby. The excavation and disposal will be conducted in accordance with local, state MTCA, and federal RCRA regulatory requirements and applicable or relevant and appropriate requirements.

The proposed excavation process is not expected to be complex. Existing access roads will accommodate equipment required for excavation, construction, drilling, and transportation. There are no ongoing operations at the Facility. The Applicant will coordinate fieldwork with the Smelter PLPs and regulatory agencies.

7.1.8 Cost

Table 2 summarizes estimated costs of the proposed excavation and off-site disposal. The cost estimate includes design, construction oversight, and construction costs. The cost estimate does not include long-term operation and maintenance costs or past costs to develop the RI/FS, Ecology oversight costs, or legal costs. The costs presented reflect FS-level design estimates assume a range of uncertainty (+50/-30 percent). This FS develops costs for alternatives applicable to the Project Area and compatible with the Project.

For soil, retained actions include the following:

- Excavation of the WSI and impacted soil beneath the WSI liner, as indicated by confirmation sampling. The cost estimate assumes up to 10 feet of overexcavation (i.e., below bottom liner) and 20 percent of the over-excavated soil is contaminated, requiring off-site disposal. Overexcavation spoils that are confirmed to meet cleanup levels will be used as backfill.

For the soil alternative, cost estimates include the following:

- Development of the CAP and design
- Mobilization and site preparation
- Excavation of contaminated soil, segregation of clean cover soils, confirmation sampling, waste designation, and off-site disposal
- Construction oversight
- Construction completion report

Long-term operation and maintenance costs of the Project Area will be included under a future Project operations plan. The Smelter PLPs will conduct groundwater monitoring, and the FS cost estimates do not include groundwater monitoring.

Groundwater costs do not include long-term monitoring that will be completed by the Smelter PLPs under the Order.

7.1.9 Provision for a Reasonable Restoration Timeframe

The restoration timeframe analysis can consist of qualitative estimates of the restoration timeframe for alternatives. Under MTCA, evaluation of a reasonable restoration timeframe considers potential implementation risks, practicality of a reduced restoration time, current and future land use, and likely effectiveness of institutional controls, among other factors.

The proposed Alternative 2 removes impacted waste and soil over a short timeframe. Removing the WSI and associated soil will reduce a source of contamination to groundwater, thereby accelerating the restoration timeframe for groundwater.

This RI/FS for the Project Area does not consider groundwater cleanup actions other than decommissioning and relocating monitoring wells, as necessary to construct the Project.

7.1.10 Other Model Toxics Control Act Requirements

Other requirements for evaluating remedial alternatives for the selection of a cleanup action include the following:

- Use of permanent solutions to the maximum extent practicable (WAC 173-340- 360(3)). MTCA specifies that when selecting a cleanup action, preference shall be given to actions that are

"permanent solutions to the maximum extent practicable." The regulations specify the manner in which this analysis of permanence is to be conducted.

- Provide for a reasonable restoration timeframe (WAC 173-340-360(4)). MTCA places a preference on those alternatives that, while equivalent in other respects, achieve cleanup levels at the POCs established for the CGA Smelter Site in a shorter period of time. MTCA includes a summary of factors that can be considered in evaluating whether a cleanup action provides for a reasonable restoration timeframe.
- Consider public concerns (WAC 173-340-360). Ecology considers public concerns by making draft copies of RI/FS and remedial decision documents available for review and comment and by evaluating and responding to comments received on the remedial alternatives.

WSI Alternative 2, excavation by removal of the WSI and associated soil, provides an adequate degree of protectiveness by preventing direct contact with the WSI waste once it is removed.

8. RECOMMENDED ALTERNATIVE

The recommended alternative is Alternative 2, excavation of the waste and soil in the WSI and off-site disposal. Excavation and off-site disposal meets each of the RAOs. Alternative 2 may include institutional controls that run with the land, as necessary to prevent exposure to residual contamination in soil if excavation confirmation sampling indicates residual concentrations of COCs remain above cleanup levels. Institutional controls will not be required if excavation of the WSI and confirmation sampling verify that residual concentrations are below the approved MTCA cleanup levels.

MTCA provides a process for evaluating sites to determine a remedy based on risk to human health and the environment, in conjunction with the feasibility, implementability, and cost of potential response actions. The contents of the WSI, the liner, the RCRA cover system, and the gas venting system are incompatible with engineering requirements to construct the Lower Reservoir of the Project. Alternative 2 is the only alternative that is compatible with the Project. A CAP will describe the process to implement the recommended alternative.

The Applicant proposes to decommission and replace up to 16 groundwater-monitoring wells in the Project Area. Replacement wells will be downgradient of the Lower Reservoir and the former WSI. The number and location of replacement wells will be determined in consultation with Ecology and the Smelter PLPs to meet the requirements of a CAP for the CGA Smelter Site to be prepared by the Smelter PLPs.

As may be required by the conditions at closure, an environmental covenant will be recorded to restrict the beneficial use of groundwater within the Project Area and to implement best management practices to protect human health and the environment if construction encounters groundwater in the Project Area.

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TABLES

Table 1
Soil Screening Level Summary
Columbia Gorge Aluminum Smelter Site Remedial Investigation Volume 1, (Tetra Tech, 2019)
Goldendale, Washington

Chemicals of Concern	MTCA Screening Levels							Range of Background Concentrations
	Method A		Method B	Method C		Ecological Screening Levels [e,f]		
	Unrestricted Land Use	Industrial			Protection of Groundwater	Priority Contaminants - Industrial Site	Ecological Indicator - Wildlife	
(mg/kg)								
Cyanide (Free)	NE	NE	48	2,100	1.9/40.4 [b]	NE	NE	NE
Fluoride	NE	NE	4,800	210,000	615 [c]	NE	NE	14.11[a]
Sulfate	NE	NE	NE	NE	2,150 [d]	NE	NE	NE

Notes

a. Site-specific background value from PGG (2013a) site investigation.

b. Cyanide soil screening levels for protection of groundwater based on literature distribution coefficient, MTCA Method B groundwater formula value/MCL, and fixed parameter three phase partitioning mode.

c. Fluoride soil screening level for protection of groundwater based on empirical demonstration consistent with WAC 173-340-747.

d. Sulfate screening level for protection of groundwater based on literature distribution coefficient, secondary MCL, and fixed parameter three-phase partitioning mode

e. Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure, Table 749-2, WAC 173-340-7492.

f. Ecological indicator soil concentration for protection of wildlife (Table 749-3, WAC 173-340-7493, MTCA).

MTCA = Model Toxics Control Act

NE = Not established in look-up Tables.

Table 2
Estimated Cost
Goldendale Aluminum West Surface Impoundment Excavation

Base Cost: Impoundment Excavation

Line Item	Unit	Quantity	Unit Price	Total Cost	Estimate Source, Assumptions
West Surface Impoundment Excavation					
Work plans, regulatory negotiation, design	EA	1	$ 200,000	$ 200,000	Project experience
Construction survey	Ac	10	$ 5,000	$ 50,000	RSMean, Topographical Surveys Aerial
Site Preparation					
Mobilization	LS	1	$ 200,000	$ 200,000	Engineering experience
Erosion, sediment control, dust control	LS	1	$ 100,000	$ 100,000	Engineering experience
Development of contractor staging area	LS	1	$ 100,000	$ 100,000	Preliminary estimate. Includes removing gas collection piping.
Abandonments of existing groundwater monitoring wells	EA	15	$ 4,000	$ 60,000	Engineering experience
Impoundment Excavation and Restoration					
Excavation of cover system	CY	32,267	$ 2	$ 78,000	24-inch thick including cover soil, geotextile, PVC liner, geosynthetic clay liner, bedding layer; RS Means 312316121030 10-14' excavation 3 CY excavator
Excavation of waste	CY	89,000	$ 3	$ 298,000	Quantity from Goldendale initial PPA; Price RS Means 312316131330 excavation 14-20' deep 3CY excavator
Excavation of liner system	CY	16,133	$ 3	$ 54,000	Soil, geomembrane, assume 12"; Price RS Means 312316131330 excavation 14-20' deep 3CY excavator
Transport of excavated material to commercial landfill	CY	137,400	$ 20	$ 2,724,000	Columbia Ridge Landfill (50 miles).
Disposal of excavated material in commercial landfill	CY	137,400	$ 51	$ 6,974,000	Columbia Ridge Landfill. Per ton + fees.
Grading and stabilization of excavation area	Ac	10	$ 2,000	$ 20,000	Minimal grading and restoration pending construction of the Project.
Replace groundwater Monitoring wells	EA	1	$ 550,000	$ 550,000	Estimate based on likely number of wells to decommission and replace. The final number
Construction completion reporting	EA	1	$ 80,000	$ 80,000	Disposal documentation. Construction completion reporting.
Construction Subtotal				**$11,488,000**	
Management and administration (10%)				$1,149,000	
Contingency (30%)				$3,447,000	
Total Capital Cost				**$16,084,000**	

Contingency Excavation Cost: Excavation Beneath Impoundment

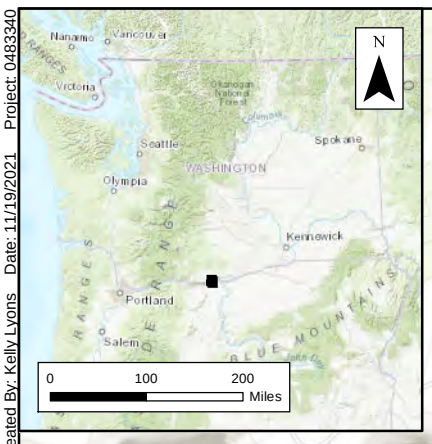
Line Item	Unit	Quantity	Unit Price	Total Cost	Estimate Source, Assumptions
West Surface Impoundment Overexcavation					Possible contaminated soil beneath the liner
Soil boring investigation	LS	1	$ 50,000	$ 50,000	Engineering experience. Investigation after excavation of waste to assess volume of impacted soil beneath liner.
Excavation					
Excavation below liner	CY	32,267	$ 3	$ 108,000	Soil, assume 10' excavation beneath liner, approximately 20% of the material is impacted; Cost RS Means 312316131330 excavation 14-20' deep 3CY excavator
Transport of excavated material to commercial landfill	CY	32,267	$ 20	$ 640,000	Columbia Ridge Landfill (50 miles).
Disposal of excavated material to commercial landfill	CY	32,267	$ 51	$ 1,638,000	Columbia Ridge Landfill. Per ton + fees.
Construction Subtotal				**$2,436,000**	
Engineering, management, and administration (15%)				$366,000	
Contingency (30%)				$731,000	
Total Capital Cost				**$3,533,000**	

Total Cost

Base Cost	LS	1	$ 16,084,000	$ 16,084,000
Contingency Excavation Cost	LS	1	$ 3,533,000	$ 3,533,000
Potential Total Cost				**$ 19,617,000**

FIGURES

Created By: Kelly Lyons Date: 11/19/2021 Project: 0483340



Upper Reservoir

Upper Reservoir Outer Berm

Headrace Tunnel

Powerhouse

Access Tunnel

Tailrace Tunnel

Water Supply Valve House

Multi-Use Tunnel

West Surface Impoundment

Lower Reservoir

John Day Dam Rd

Hartley Canyon

Substation

John Day Substation

0 2,000 4,000 Feet

Legend

- West Surface Impoundment (WSI)
- FERC Project Boundary
- Property Boundary
- Reservoir
- Reservoir Berm Outer Slope
- Laydown Area
- Powerhouse
- Substation
- Water Supply Valve House
- Access Tunnel
- Access Tunnel Portal
- Headrace/Tailrace Tunnel

Figure 1
Project Location
Remedial Investigation Feasibility Study
Goldendale Energy Storage Project
at the Former Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Environmental Resources Management
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FILE: M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 1 Project Location.mxd | REVISED: 11/19/2021 | SCALE: 1:24,000 when printed at 11x17

Source: Esri - World Topographic Map; NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Upper Reservoir

Lower Reservoir

Legend

- West Surface Impoundment (WSI)
- Proposed Reservoir
- Proposed Project Boundary

0 1,000 2,000 Feet

N

Figure 2
Topography
Remedial Investigation Feasibility Study
Goldendale Energy Storage Project
at the Former Columbia Gorge
Aluminum Smelter Site
Goldendale, Washington

Environmental Resources Management
www.erm.com

Source: Esri World Topographic Map; NAD 1983 StatePlane Washington South FIPS 4602 Feet

Created By: Kelly Lyons Date: 11/2/2021 Project: 0483340

FILE: M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 3 Topography.mxd | REVISED: 11/02/2021 | SCALE: 1:12,000 when printed at 11x17

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Mv(wfs)
Mv(gN2)
Qta
Mv(gR2)
Qfg
Qls
Lower Intake
Lower Reservoir
Qaf
Mv(wr)
Mv(wpr)
wtr

Legend

- West Surface Impoundment (WSI)
- Proposed Reservoir
- Proposed Project Boundary

Washington Faults & Folds

Dip-Slip Movement

- Normal fault - Identity and existence certain, location accurate.[43]
- Normal fault - Identity and existence certain, location concealed.[45]
- Thrust fault - Identity and existence certain, location concealed.[9]

Strike-Slip Movement

- Right-lateral strike-slip fault - Identity and existence certain, location accurate.[13]
- Right-lateral strike-slip fault - Identity and existence certain, location concealed.[15]

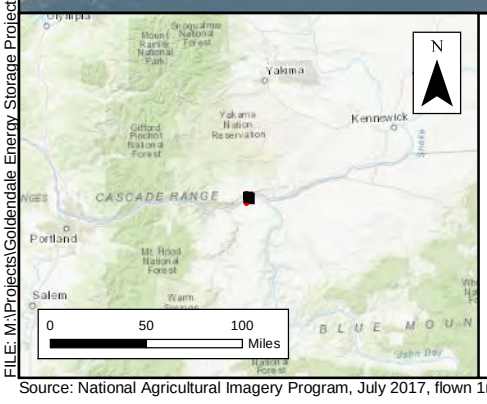
Washington Geologic Units

Unconsolidated Sediments

- Quaternary alluvial fans (Qaf), beach deposits, landslides (Qls), and talus (Qta)
- Pleistocene continental glacial, glacio-lacustrine, and outburst flood deposits, Fraser-age (Qfg)

Volcanic Rocks and Deposits

- Miocene Columbia River Basalt Group, Wanapum Basalt, MV(wpr) Priest Rapids Member, MV(wr) Roza Member, and MV(wfs) Frenchman Springs Member
- Miocene Columbia River Basalt Group, Grande Ronde Basalt: MV(gN2) Flows of normal magnetic polarity and MV(gR2) Flows of reverse magnetic polarity



N

0 1,000 2,000 Feet

Figure 3
Geology
Remedial Investigation Feasibility Study
Goldendale Energy Storage Project
at the Former Columbia Gorge
Aluminum Smelter Site
Goldendale, Washington

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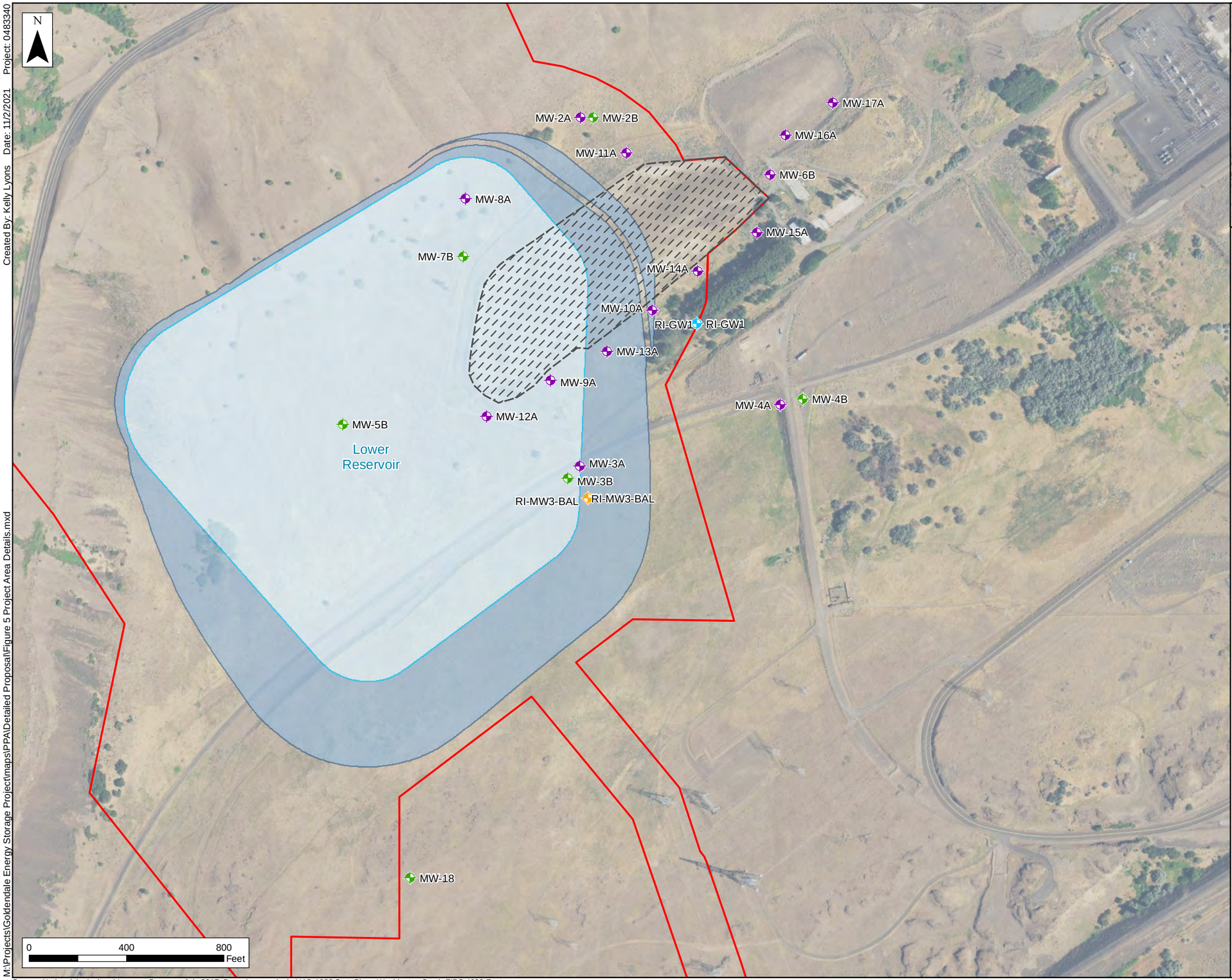
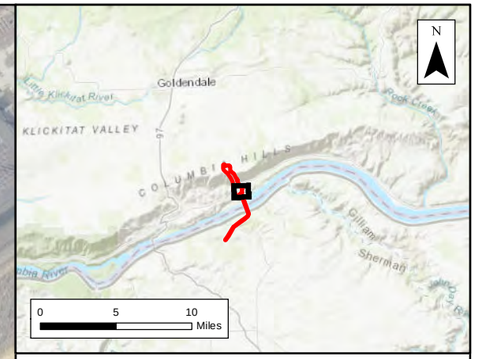
FILE: M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 4 Project Geology.mxd | REVISED: 11/02/2021 | SCALE: 1:12,000 when printed at 11x17

Source: National Agricultural Imagery Program, July 2017, flown 1m per pixel; NAD 1983 StatePlane Washington South FIPS 4602 Feet

Project: 0483340
Date: 11/2/2021
Created By: Kelly Lyons
M:\Projects\Goldendale Energy Storage Project\maps\PPAI\Detailed Proposal\Figure 5 Project Area Details.mxd





Legend

Existing Well
- Unconsolidated Aquifer Well
- Uppermost Basalt Aquifer Well

Proposed Well
- Deep Well with Coring (BAL)
- Temporary Shallow Well
- West Surface Impoundment (WSI)
- Reservoir
- Reservoir Berm Outer Slope
- Project Boundary

Notes:
All well locations approximate, no survey data available.

Figure 4
Project Area Details with Groundwater Monitoring Well Network
Remedial Investigation Feasibility Study
Goldendale Energy Storage Project
at the Former Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Environmental Resources Management
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Source: National Agricultural Imagery Program, July 2017, flown 1m per pixel; NAD 1983 StatePlane Washington South FIPS 4602 Feet

APPENDIX A WSI DETAIL

DRAWN BY: Kelly Lyons
M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 4 Waste Types.mxd. REVISED: 07/23/2020. SCALE: 1:1,200.000 when printed at 11x17

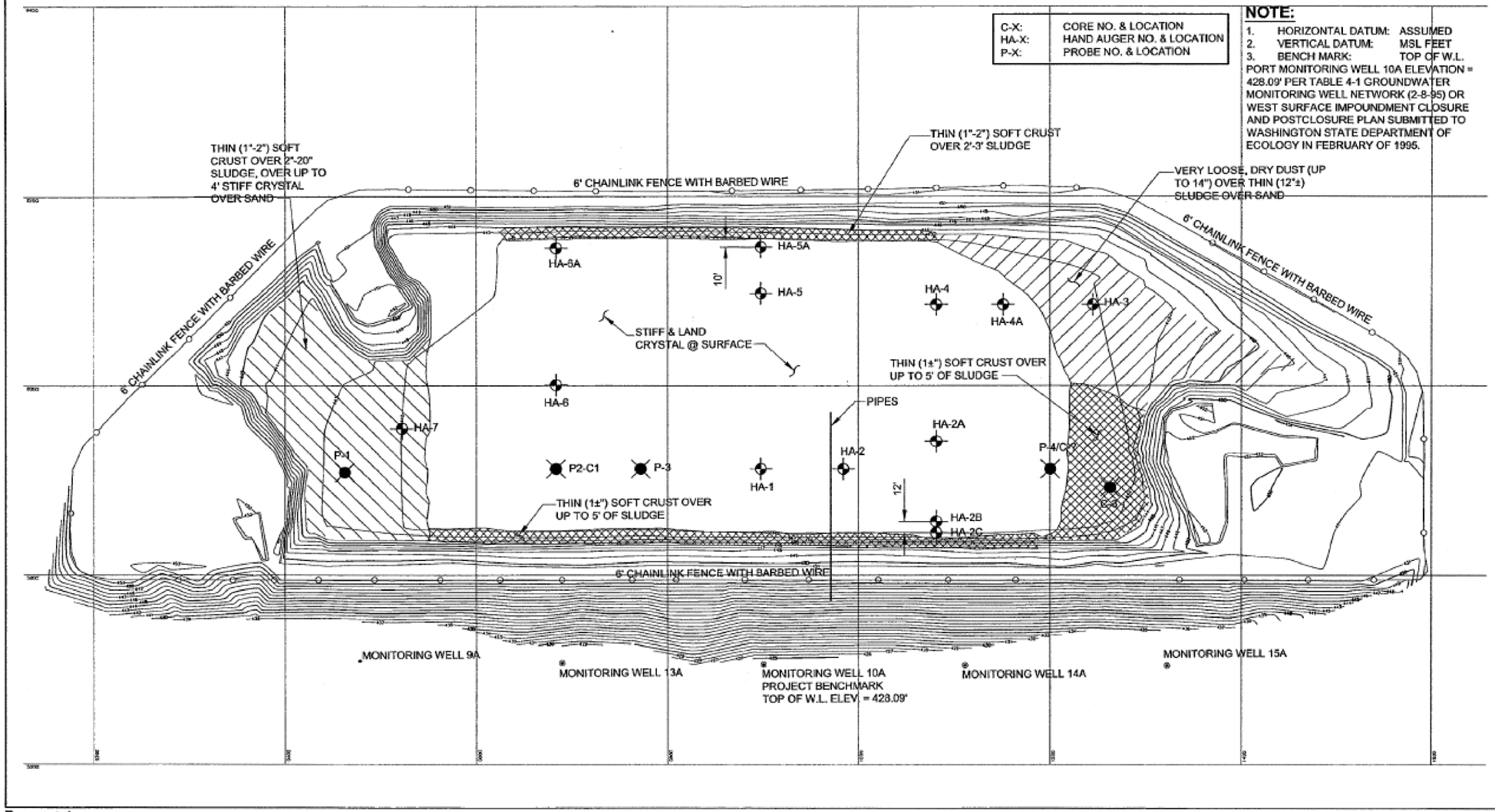


Figure 2-2
Waste Types & Locations
July 2004
Goldendale Aluminum

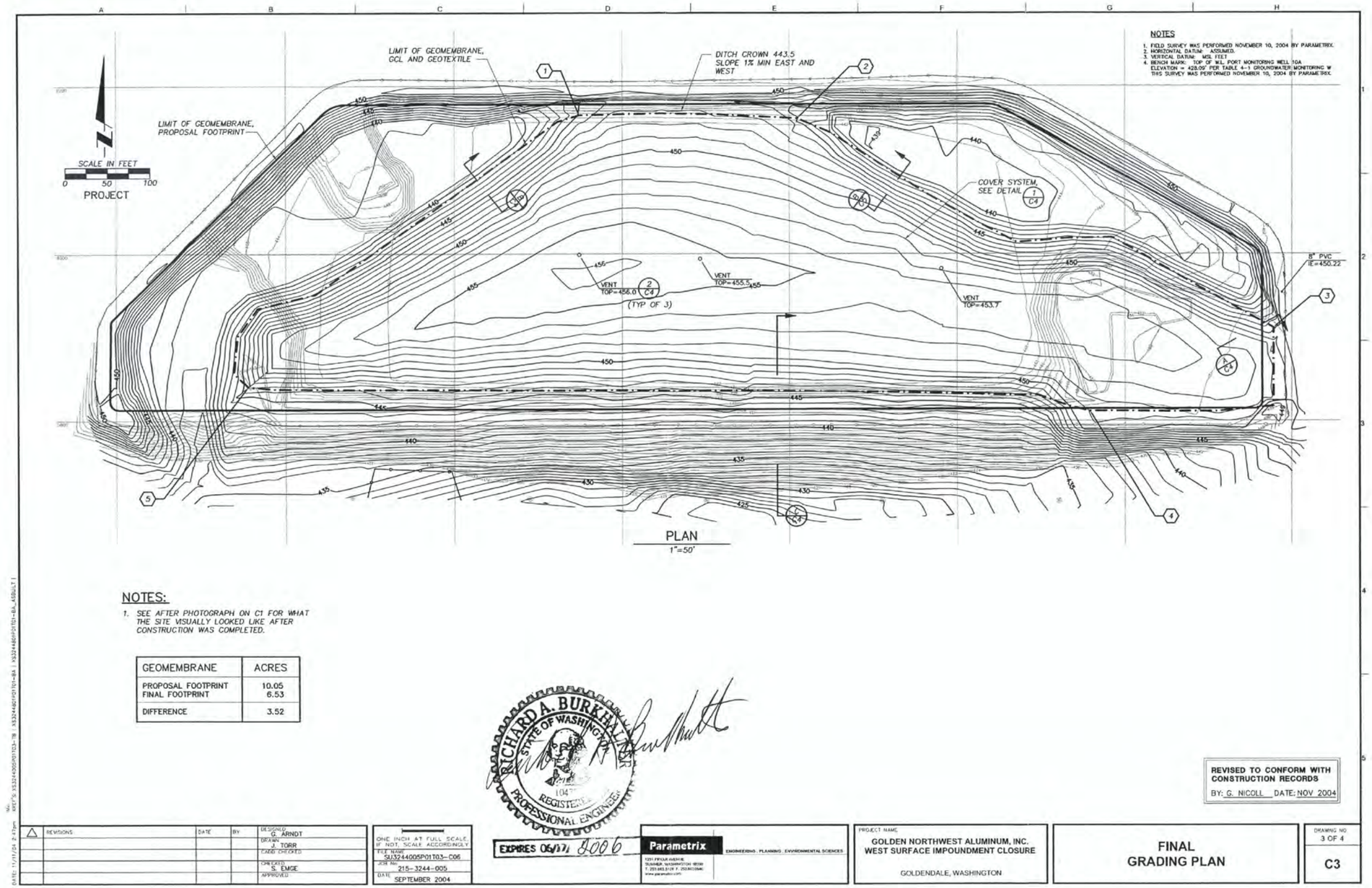
Source: Parametrix, Construction Quality Assurance Report, 2004.

Figure A1

Waste Types
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project
Goldendale, Washington

DRAWN BY: Kelly Lyons

M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 8 Final Grading Plan.mxd... REVISED: 07/24/2020... SCALE: 1:1,200,000 when printed at 11x17

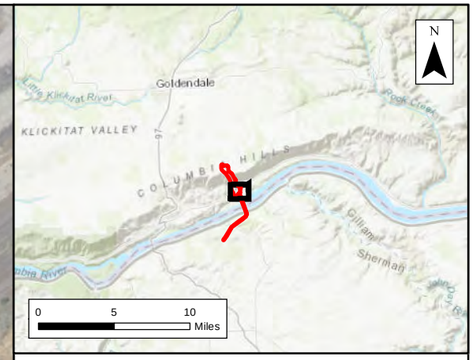


Source: Parametrix, Construction Quality Assurance Report, 2004.

Figure A2

WSI 2004 Closure Final Grading Plan
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project
Goldendale, Washington

Created By: Kelly Lyons Date: 7/23/2020 Project: 0483340



Legend

Project Boundary

Figure A3

WSI Aerial Photograph
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project
Goldendale, Washington

Environmental Resources Management
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M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 9 WSI Aerial.mxd

Source: National Agricultural Imagery Program, July 2017, flown 1m per pixel; NAD 1983 StatePlane Washington South FIPS 4602 Feet

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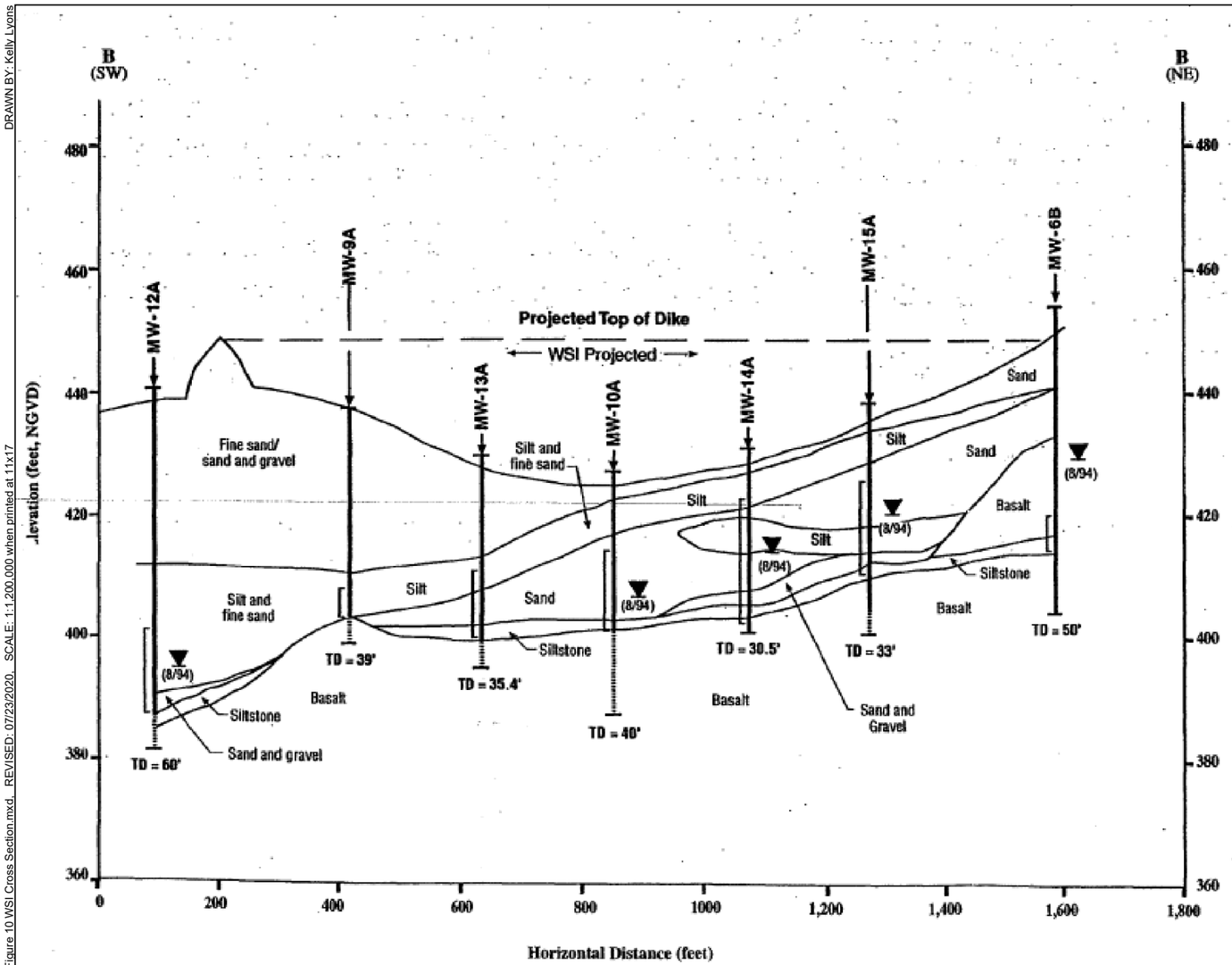
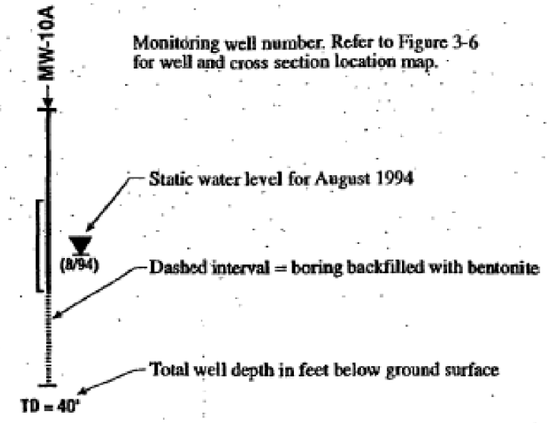
M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 10 WSI Cross Section.mxd



LEGEND



NOTES

1. Wells MW-9A and MW-13A reported as "dry" after April and July 1992, respectively.
2. Subsurface conditions depicted on cross sections are interpretations and represent the opinion of the CH2M HILL hydrogeologist. Actual subsurface conditions may differ.

Vertical Exaggeration: 10X

Figure 3-3
Hydrogeologic Cross Section B-B'

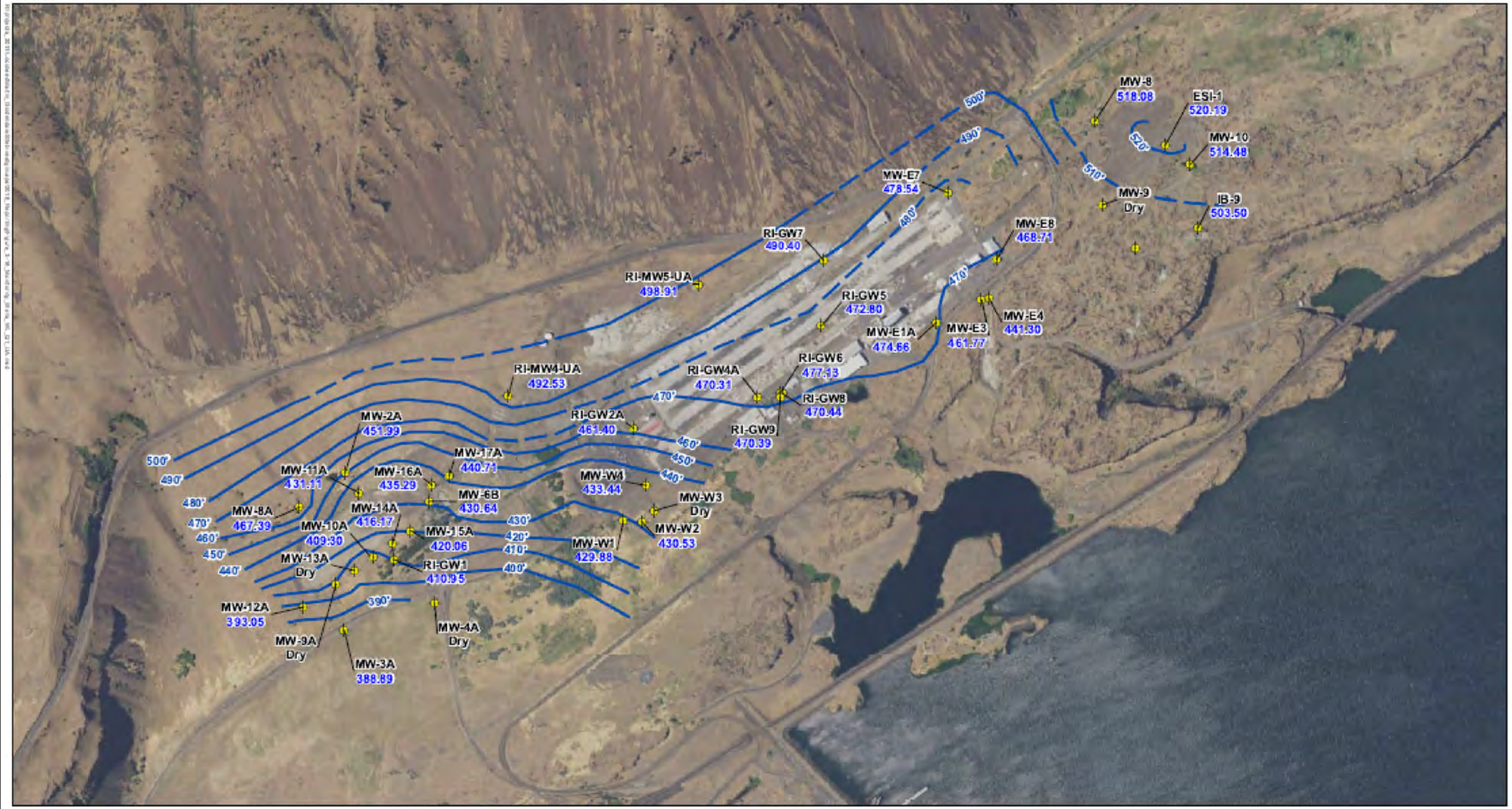
Source: Parametrix, Construction Quality Assurance Report, 2004.

Figure A4

West Surface Impoundment Cross Section
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project Goldendale, Washington

APPENDIX B GROUNDWATER CONDITIONS

DRAWN BY: Kelly Lyons
M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 15 Potentiometric Surface UA.mxd REVISED: 07/23/2020, SCALE: 1:1,200,000 when printed at 11x17



Legend

- Unconsolidated Aquifer (UA) Well
- 388.89 Round 1 (Winter 2017) Static Water Level Elevation
- 300' 10' Water-Level Elevation Contour

N W E S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

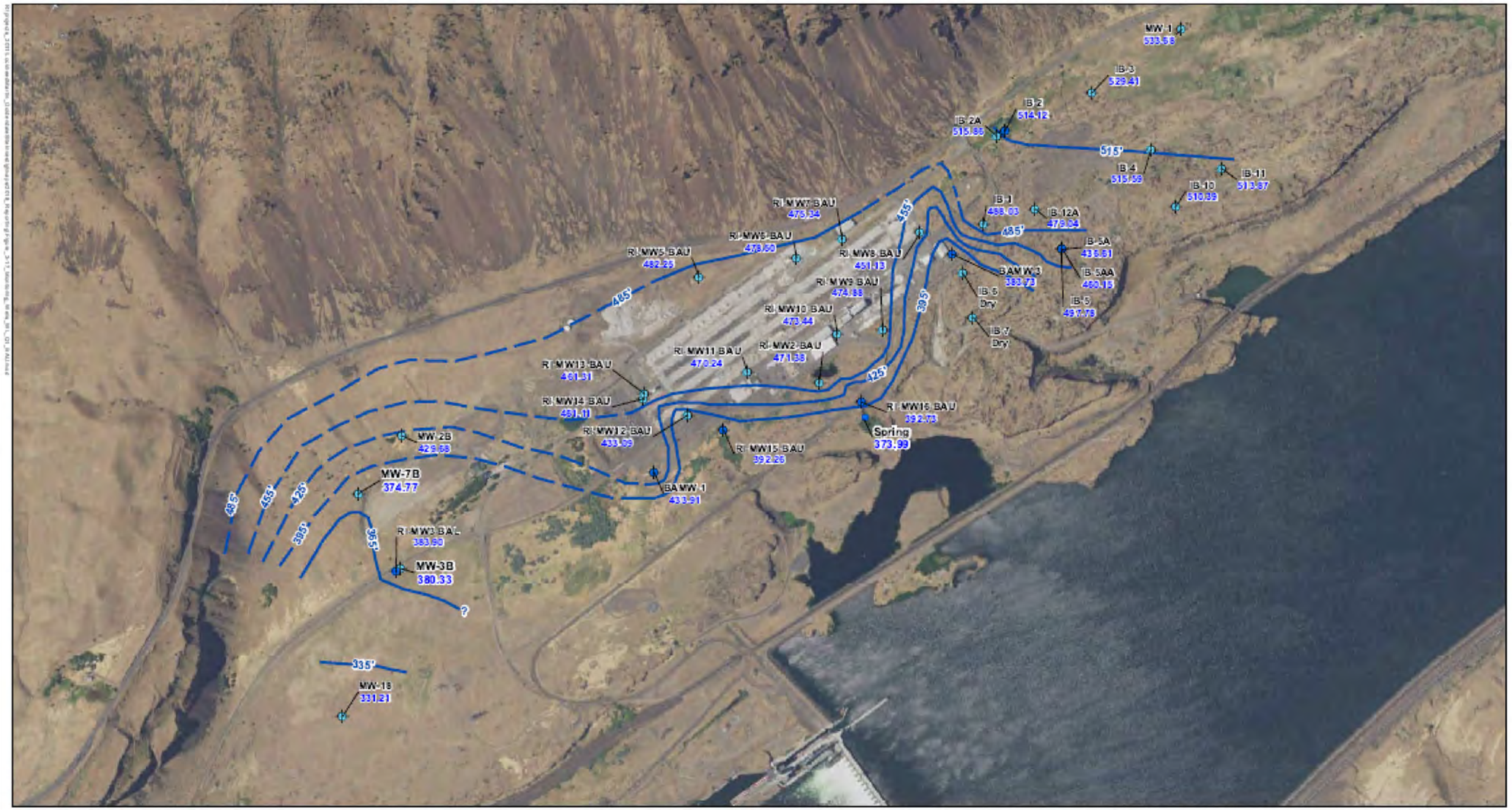
Figure 2-16
Water-Level Elevations
Unconsolidated Aquifer Wells (UA)
Quarter 1 (Winter 2017)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Figure B1
Potentiometric Surface for Uppermost Aquifer Groundwater Wells
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project
Goldendale, Washington

Source: Tetra Tech, et al., 2017.

DRAWN BY: Kelly Lyons
REVISED: 07/23/2020 SCALE: 1:1,200,000 when printed at 11x17
M:\Projects\Goldendale Energy Storage Project\maps\PPA\Detailed Proposal\Figure 16 Potentiometric Surface BAU.mxd



Legend

Uppermost Basalt Aquifer Well (BAU)

BAU_1 - Shallower Water-bearing Zone

BAU_2 - Deeper Water-bearing Zone

331.21 Round 1 (Winter 2017) Water-Level Elevation

515' 30' Water-Level Elevation Contour

Spring

N
W E
S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-17
Water-Level Elevations
Uppermost Basalt Aquifer Wells (BAU)
Quarter 1 (Winter 2017)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Figure B2
Potentiometric Surface for Uppermost Basalt Aquifer Groundwater Wells
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project
Goldendale, Washington

Source: Tetra Tech, et al., 2017.

Appendix B - TABLES

Table B1
Monitoring Well Construction Information
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project, Goldendale, WA

Well ID	Construction Date	Well Material	Well Diameter (in)	Screen Interval (ft bgs)	Total Depth of Well (ft bgs)
MW-02A	4/5/1984	PVC Schedule 40	2	50 - 55	55
MW-02B	4/5/1984	PVC Schedule 40	4	104 - 109	109
MW-03A	4/13/1984	PVC Schedule 40	2	19.5 - 24.5	24.5
MW-03B	4/7/1984	PVC Schedule 40	4	46 - 51	51
MW-04A	4/17/1984	PVC Schedule 40	4	16 - 21	21
MW-04B	NA	NA	4	35 - 40	50
MW-05B	NA	NA	4	97 - 102	110
MW-06B	4/20/1984	PVC Schedule 40	4	35 - 40	50
MW-07B	4/25/1984	PVC Schedule 40	2	104 - 109	109
MW-08A	5/7/1989	PVC Schedule 40	4	21.5 - 31.5	32
MW-09A	4/18/1989	PVC Schedule 40	4	30.5 - 35.5	35.5
MW-10A	4/20/1989	PVC Schedule 40	4	13 - 25.5	26
MW-11A	4/28/1989	PVC Schedule 40	4	19 - 29	29.5
MW-12A	5/2/1989	PVC Schedule 40	4	40 - 54	55
MW-13A	5/4/1989	PVC Schedule 40	4	18.5 - 30.5	31
MW-14A	5/6/1989	PVC Schedule 40	4	8.5 - 29.5	30.5
MW-15A	5/6/1989	PVC Schedule 40	4	12.5 - 28	29
MW-16A	1/10/1990	PVC Schedule 40	4	22 - 42	43
MW-17A	1/10/1990	PVC Schedule 40	4	15 - 35	35
MW-18	10/1/2004	NA	4	35 - 50	51

Notes:
in = inches
ft = ft
bgs = below ground surface
NA = Not available.
MW-4B and MW-5B were abandoned in 1989.

Table B2
Summary of WSI Groundwater Monitoring Data
Remedial Investigation / Feasibility Study
Goldendale Energy Storage Project, Goldendale, WA

	Location ID	Upgradient Well MW-8A		Downgradient Well MW-3B		Downgradient Well MW-10A		Downgradient Well MW-12A		Downgradient Well MW-14A		Downgradient Well MW-18	
	Analyte	Sulfate	Fluoride	Sulfate	Fluoride	Sulfate	Fluoride	Sulfate	Fluoride	Sulfate	Fluoride	Sulfate	Fluoride
Lowest Groundwater Protection Standard		250	0.96	250	0.96	250	0.96	250	0.96	250	0.96	250	0.96
Sample Date	**Unit**												
2/16/2005	mg/L	**10**	**0.9**	**2300**	**0.6**	**940**	**1.8**	*Dry*	*Dry*	**4000**	**9.6**	**1500**	**0.6**
5/11/2005	mg/L	**9.8**	**0.3**	**2500**	**0.4**	**910**	**1.5**	*Dry*	*Dry*	**3500**	**8.6**	**1300**	**0.4**
8/29/2005	mg/L	**8.9**	**0.4**	**2700**	**0.6**	**670**	**1.2**	*Dry*	*Dry*	**3600**	**30**	**1500**	**0.4**
11/1/2005	mg/L	**9.6**	**0.9**	**2600**	**0.9**	**670**	**2.7**	*Dry*	*Dry*	**2800**	**25**	**1300**	**1.8**
2/27/2006	mg/L	**9.27**	**2.8**	**2610**	**0.7**	**1570**	**2.3**	*Dry*	*Dry*	**2170**	**31**	**1520**	**0.9**
6/5/2006	mg/L	**9.8**	**0.2**	**2220**	**0.2**	**1650**	**3.2**	*Dry*	*Dry*	**2380**	**27**	**1490**	**0.2**
7/31/2006	mg/L	**9.8**	**0.1**	**2000**	**3.7**	**860**	**2.3**	*Dry*	*Dry*	**3300**	**30**	**1500**	**2.6**
10/9/2006	mg/L	**9.7**	*<0.2*	**2500**	**3.8**	**850**	**1.9**	*Dry*	*Dry*	**3900**	**24**	**1600**	**2.4**
3/13/2007	mg/L	**10**	*<0.1*	**2500**	**3.8**	**1100**	**3.4**	**1800**	**6.3**	**4400**	**16**	**1600**	**2.6**
6/22/2007	mg/L	**1**	*<10*	**2500**	<10	**1100**	*<10*	*Dry*	*Dry*	**7900**	**19**	**1700**	*<1*
9/24/2007	mg/L	**10**	*<1*	**2200**	<1	**760**	**1.2**	*Dry*	*Dry*	**6400**	*<50*	**1400**	*<50*
11/14/2007	mg/L	--	--	--	--	--	--	*Dry*	*Dry*	--	--	--	--
5/8/2008	mg/L	**10**	*<1*	**2200**	<50	**2700**	*<50*	*Dry*	*Dry*	**5500**	*<50*	**1300**	*<50*
10/14/2008	mg/L	**10**	**0.1**	**2600**	<10	**860**	*<10*	*Dry*	*Dry*	**6500**	**20**	**1600**	*<1*
5/29/2009	mg/L	**9**	*<1*	**2200**	<1	**2000**	**2**	*Dry*	*Dry*	**7000**	**30**	**1500**	**1**
10/27/2009	mg/L	**10**	*<1*	**2606**	<1	**760**	<1	*Dry*	*Dry*	**5900**	**24**	**1200**	<1
5/26/2010	mg/L	**9.3**	*<1*	**2300**	**2.3**	**2200**	**4.4**	*Dry*	*Dry*	**5200**	**32**	**1500**	**2**
10/6/2010	mg/L	**8.9**	*<1*	**2400**	<1	**710**	**1**	*Dry*	*Dry*	**4000**	**18**	**1600**	*<1*
7/26/2011	mg/L	**7.8**	*<1*	**2000**	<1	**1800**	**3.3**	*Dry*	*Dry*	**3900**	**23**	**1600**	*<1*
4/19/2012	mg/L	**10**	**0.18**	**2200**	**0.16**	**5800**	**1.9**	*Dry*	*Dry*	*Dry*	*Dry*	**1700**	**0.2**
6/20/2013	mg/L	**9.4**	**0.16**	**1900**	**0.16**	**4700**	**3.1**	*Dry*	*Dry*	**2300**	**17**	**1500**	**0.13**
4/25/2014	mg/L	**9.5**	**0.19**	**2000**	**0.18**	**6100**	**2**	*Dry*	*Dry*	**2100**	**18**	**1700**	**0.12**
7/20/2015	mg/L	**9.5**	**0.16**	**1900**	**0.14**	**1900**	**2**	*Dry*	*Dry*	**1100**	**6.8**	**1300**	**0.11**
8/2/2016	mg/L	**9.3**	**0.13**	**1900**	**0.12**	**3500**	**2.1**	*Dry*	*Dry*	**1400**	**3.5**	**1700**	**0.12**
8/9/2017	mg/L	**9.6**	**0.15**	**1700**	**0.15**	**2900**	**3.2**	*Dry*	*Dry*	**1700**	**2.5**	**1300**	**0.11**
7/26/2018	mg/L	**9.5**	**0.15**	**1800**	**0.16**	**4800**	**4.1**	*Dry*	*Dry*	**1800**	**3.6**	**1400**	**0.11**
7/24/2019	mg/L	**5.4**	**0.14**	**1500**	**0.15**	**4000**	**3.7**	*Dry*	*Dry*	**1700**	**2.8**	**1200**	**0.12**
6/20/2020	mg/L	**11**	**0.16**	**1700**	**0.14**	**5700**	**4.4**	*Dry*	*Dry*	**2000**	**7**	**1400**	**0.13**
7/29/2021	mg/L	**9**	**0.15**	**1500**	**0.17**	*Dry*	*Dry*			**1100**	**7.8**	**1200**	**0.11**

Notes:

Data compiled from the *2021 Annual Groundwater Monitoring Report and Surface Maintenance Report. September 20, 2021, Appendix A*
< = Compound not detected at concentrations above the laboratory reporting detection limit.
The laboratory reporting detection limit is shown.
Bold are detected results
Grey shaded cells = results exceed lowest groundwater protection standard
Empty cells = Data not available from GeoPro LLC 2021 Annual Groundwater Monitoring Report
-- = Data not available from GeoPro LLC 2021 Annual Groundwater Monitoring Report
mg/L = Milligrams per liter

APPENDIX B Groundwater Conditions from Tetra Tech 2019 Remedial Investigation Figures

R:\projects_2011\LockheedMartin_Goldendale\siteinvestigmaps\2018_Reporting\Figure_2-25_Monitoring_Wells_Fluoride_Q1-4_UA.mxd

NESI Wetland
Q1: 20 J
Q2: NS
Q3: NS
Q4: NS

MW-8
Q1: 20
Q2: 8.9
Q3: 6.5
Q4: 6.4

ESI-1
Q1: 31 J
Q2: 13
Q3: 9.7
Q4: 11

MW-10
Q1: 8 J
Q2: 5.5
Q3: 4.8
Q4: 4.5

MW-9
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

IB-9
Q1: 4.5 J
Q2: 6.8
Q3: 7.7
Q4: 0.030 U

MW-E7
Q1: 3.3 J
Q2: 2.3 J
Q3: 2.4 J
Q4: 2.7

MW-E8
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-E3
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-E4
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-E1A
Q1: 11 J
Q2: 29
Q3: 24
Q4: 20

RI-GW7
Q1: 17
Q2: 13
Q3: 6.7 J
Q4: 15 J

RI-GW5
Q1: 17
Q2: 16 J
Q3: 17 J
Q4: 17

RI-GW6
Q1: 10
Q2: 16
Q3: Dry
Q4: 7.0

RI-MW5-UA
Q1: 0.27
Q2: 0.56
Q3: 0.30
Q4: 0.19 J

RI-MW4-UA
Q1: 0.15 J
Q2: 0.29
Q3: 0.22
Q4: 0.13 J

RI-GW4A
Q1: 4.8
Q2: 5.1 J
Q3: 5.5
Q4: 5.5

RI-GW2A
Q1: 2.7
Q2: 2.8 J
Q3: 3.3 J
Q4: 2.7 J

RI-GW9
Q1: 2.7
Q2: 0.72
Q3: 1.0
Q4: 0.65

RI-GW8
Q1: 4.4
Q2: 2.4
Q3: 1.1
Q4: 3.1

Stormwater Pond
Q1: 4.2 J
Q2: NS
Q3: NS
Q4: NS

Spring 1
Q1: 3.9
Q2: 3.5 J
Q3: 3.8
Q4: 3.7

MW-11A
Q1: 0.2 J
Q2: 0.03 UJ
Q3: 0.16 J
Q4: 0.030 U

MW-17A
Q1: 2.2
Q2: 4.6
Q3: 6.1
Q4: 2.8

MW-2A
Q1: 0.19
Q2: 0.03 U
Q3: 0.18 J
Q4: 0.030 U

MW-16A
Q1: 0.9
Q2: 0.55 J
Q3: 1.2
Q4: 0.98

MW-8A
Q1: 0.19
Q2: 0.03 UJ
Q3: 0.19 J
Q4: 0.030 U

MW-10A
Q1: 1.5
Q2: 0.03 U
Q3: 46
Q4: 30 U

MW-13A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-9A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-6B
Q1: 1.2
Q2: 0.95
Q3: 1.0
Q4: 0.72

MW-15A
Q1: 0.13
Q2: 0.03 U
Q3: 0.12 J
Q4: 0.030 U

MW-W4
Q1: 0.67 J
Q2: 0.35 J
Q3: 0.51
Q4: 0.35

MW-W1
Q1: 0.41
Q2: 0.17 J
Q3: 0.53
Q4: 0.087 J

MW-W3
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-W2
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-12A
Q1: 1.7
Q2: 2.1
Q3: 3.6
Q4: 2.0

MW-4A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-14A
Q1: 5
Q2: 0.03 U
Q3: 3.0 J
Q4: 30 U

MW-3A
Q1: Dry
Q2: Dry
Q3: 0.57 J
Q4: 0.29

RI-GW1
Q1: 0.77
Q2: 0.03 U
Q3: 1.2
Q4: 0.89

Legend

- Unconsolidated Aquifer (UA) Well
- MW-12A / 1.7 — Well Identification / Concentration
- Spring/Pond/Wetland Water Sample

Screening Levels
- 4 mg/L MCL
- 0.96 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NESI: North of the East Surface Impoundment Area
Concentrations in milligrams per liter (mg/L)
NS: Not Sampled

J: Estimated Concentration
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-26
Concentrations for Fluoride In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\siteinvestigmaps\2018_ReportingFigure_2-27_Monitoring_Wells_Fluoride_Q1-4_BAU.mxd

IB-2
Q1: 0.56 J
Q2: 0.03 U
Q3: 0.93
Q4: 0.69

NESI Wetland
Q1: 20 J
Q2: NS
Q3: NS
Q4: NS

MW-1
Q1: NS
Q2: 0.03 U
Q3: 0.22
Q4: 0.22

IB-3
Q1: 0.31
Q2: 0.19 J
Q3: 0.26
Q4: 0.28

IB-2A
Q1: 13
Q2: 16 J
Q3: 14
Q4: 15

IB-4
Q1: 0.5
Q2: 0.23
Q3: 0.15 J
Q4: 0.28

IB-11
Q1: 0.68
Q2: 0.76
Q3: 0.73
Q4: 0.76

RI-MW7-BAU
Q1: 0.84
Q2: 0.79 J
Q3: 0.90 J
Q4: 0.54

RI-MW8-BAU
Q1: 9.8
Q2: 15 J
Q3: 11 J
Q4: 6.8

IB-12A
Q1: 4.4 J
Q2: 0.03 U
Q3: 4.0
Q4: 4.5

IB-1
Q1: 1.1
Q2: 0.67
Q3: 1.2
Q4: 0.80

RI-MW6-BAU
Q1: 3.2
Q2: 2.9
Q3: 4.1 J
Q4: 4.2

RI-MW5-BAU
Q1: 0.63
Q2: 0.03 U
Q3: 0.72
Q4: 0.34 J

IB-5A
Q1: 0.16
Q2: 0.03 U
Q3: 0.030 U
Q4: 0.17 J

IB-10
Q1: 0.2
Q2: 0.21
Q3: 0.046 J
Q4: 0.28

BAMW-3
Q1: 19
Q2: 23 J
Q3: 20 J
Q4: 17

RI-MW9-BAU
Q1: 0.87 J
Q2: 0.42 J
Q3: 0.84
Q4: 0.98

RI-MW11-BAU
Q1: 2.2
Q2: 1.9
Q3: 2.3 J
Q4: 2.4

RI-MW10-BAU
Q1: 1.2
Q2: 1.2 J
Q3: 1.6 J
Q4: 1.4

RI-MW13-BAU
Q1: 2.2
Q2: 2.4
Q3: 2.1 J
Q4: 1.8 J

IB-5AA
Q1: 0.14
Q2: 0.17 J
Q3: 0.044 J
Q4: 0.030 U

IB-6
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-2B
Q1: 0.18
Q2: 0.03 U
Q3: 0.19 J
Q4: 0.030 U

RI-MW14-BAU
Q1: 2.4
Q2: 2.7
Q3: 2.5 J
Q4: 2.1 J

IB-5
Q1: 0.25 J
Q2: 0.03 U
Q3: 0.053 J
Q4: 0.030 U

Stormwater Pond
Q1: 4.2 J
Q2: NS
Q3: NS
Q4: NS

IB-7
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-7B
Q1: 0.27
Q2: 0.03 U
Q3: 0.12 J
Q4: 0.030 U

RI-MW12-BAU
Q1: 1.3
Q2: 1
Q3: 1.2 J
Q4: 1.3 J

RI-MW2-BAU
Q1: 3.8
Q2: 3.4
Q3: 3.6
Q4: 3.4

Spring 1
Q1: 3.9
Q2: 3.5 J
Q3: 3.8
Q4: 3.7

MW-3B
Q1: 0.09 J
Q2: 0.03 UJ
Q3: 0.060
Q4: 0.030 UJ

RI-MW3-BAL
Q1: 0.094 J
Q2: 0.03 UJ
Q3: 0.73
Q4: 0.030 U

BAMW-1
Q1: 0.3
Q2: 0.11 J
Q3: 0.36
Q4: 0.053 J

RI-MW15-BAU
Q1: 2
Q2: 1.9
Q3: 1.6
Q4: 1.9

RI-MW16-BAU
Q1: 0.79 J
Q2: 0.59 J
Q3: 0.80 J
Q4: 0.43

MW-18
Q1: 0.08 J
Q2: 0.03 J
Q3: 0.097 J
Q4: 0.030 U

Legend

Uppermost Basalt Aquifer Well (BAU)

- BAU_1 - Shallower Water-bearing Zone
- BAU_2 - Deeper Water-bearing Zone

MW-12A
1.7
Well Identification
Concentration

- Spring/Pond/Wetland Water Sample

Screening Levels

- 4 mg/L MCL
- 0.96 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NESI: North of the East Surface Impoundment Area
Concentrations in milligrams per liter (mg/L)
NS: Not Sampled

J: Estimated Concentration
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-27
Concentrations for Fluoride In Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\deliverables\groundwater\2018_ReportingFigure_2-28_Monitoring_Wells_Fluoride_Q1-4_BAL.mxd

Well 2
Q1: NS
Q2: NS
Q3: NS
Q4: NS

RI-MW1-BAL
Q1: 2.7 J
Q2: 0.58
Q3: 0.19 J
Q4: 0.31

RI-MW19-BAL
Q1: 0.5 J
Q2: 0.2
Q3: 0.13 J
Q4: 0.17 J

IB-13
Q1: 3.4 J
Q2: 3.5
Q3: 3.9
Q4: 3.7

BAMW-2
Q1: 0.89
Q2: 0.39
Q3: 0.64
Q4: 0.67

Well 1
Q1: 0.65
Q2: NS
Q3: NS
Q4: NS

IB-13A
Q1: 1.9 J
Q2: 1.2
Q3: 1.4
Q4: 1.7

Well 3
Q1: 0.34
Q2: 0.4
Q3: 0.49
Q4: 0.067J

RI-MW2-BAL
Q1: 0.76
Q2: 0.5
Q3: 1.1 J
Q4: 0.69

BAMW-4
Q1: 9
Q2: 9.7
Q3: 8.8
Q4: 8.0 J

IB-8
Q1: 0.98
Q2: 0.03 UJ
Q3: 1.3
Q4: 0.03 UJ

RI-MW18-BAL
Q1: 0.71 J
Q2: 0.46 J
Q3: 0.65 J
Q4: 0.39

RI-MW17-BAL
Q1: 2.8
Q2: 2.6
Q3: 3.2 J
Q4: 3.0

RI-MW20-BAL
Q1: 0.34 J
Q2: 0.03 UJ
Q3: 0.17 J
Q4: 0.26

Legend

Lower Basalt Aquifer Well (BAL)

- BAL_1 - Shallower Water-bearing Zone
- BAL_2 - Deeper Water-bearing Zone
- BAL_3 - Deepest Water-bearing Zone

RI-MW20-BAL
0.34 J
Well Identification
Concentration

Production Well

Screening Levels
- 4 mg/L MCL
- 0.96 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
Concentrations in milligrams per liter (mg/L)
NS: Not Sampled

J: Estimated Concentration
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-28
Concentrations for Fluoride In Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\siteinvestigation\gis\2018_Reporting\Figure_2-31_Monitoring_Wells_Sulfate_Q1-4_UA.mxd

NESI Wetland
Q1: 120
Q2: NS
Q3: NS
Q4: NS

MW-8
Q1: 48
Q2: 64
Q3: 36
Q4: 36

ESI-1
Q1: 43
Q2: 1,200
Q3: 1,800 J
Q4: 1,800

MW-10
Q1: 50
Q2: 460
Q3: 440 J
Q4: 700

MW-E7
Q1: 47 J
Q2: 69
Q3: 62
Q4: 60

MW-E8
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-9
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

IB-9
Q1: 2,500
Q2: 1.600
Q3: 1.500
Q4: 15

RI-GW7
Q1: 17 J
Q2: 20
Q3: 43
Q4: 22 J

RI-MW5-UA
Q1: 22
Q2: 32
Q3: 22
Q4: 24 J

RI-GW5
Q1: 180
Q2: 190
Q3: 160
Q4: 170

MW-E3
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-E4
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-11A
Q1: 9.3
Q2: 9.7
Q3: 9.3
Q4: 10 J

MW-17A
Q1: 14
Q2: 15
Q3: 13
Q4: 16 J

RI-MW4-UA
Q1: 14
Q2: 12
Q3: 12
Q4: 13 J

RI-GW4A
Q1: 33
Q2: 26
Q3: 29 J
Q4: 30

RI-GW6
Q1: 4
Q2: 1.7
Q3: Dry
Q4: 16

MW-E1A
Q1: 27
Q2: 23
Q3: 63
Q4: 72

MW-2A
Q1: 13
Q2: 11
Q3: 10
Q4: 11 J

MW-16A
Q1: 22
Q2: 23
Q3: 19
Q4: 20 J

RI-GW2A
Q1: 43
Q2: 46
Q3: 46
Q4: 48 J

MW-8A
Q1: 8.7
Q2: 9
Q3: 8.7
Q4: 9.8 J

Stormwater Pond
Q1: 100
Q2: NS
Q3: NS
Q4: NS

MW-6B
Q1: 20
Q2: 20
Q3: 19
Q4: 21 J

MW-W4
Q1: 43 J
Q2: 54
Q3: 50
Q4: 54

MW-10A
Q1: 3,900
Q2: 8,600
Q3: 7,900
Q4: 5,300

RI-GW9
Q1: 0.56 B
Q2: 7.3
Q3: 0.46 J
Q4: 8.1

RI-GW8
Q1: 32
Q2: 31
Q3: 39
Q4: 40

Spring 1
Q1: 64
Q2: 60
Q3: 40
Q4: 32

MW-15A
Q1: 140
Q2: 450
Q3: 160
Q4: 190 J

MW-13A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-W1
Q1: 630
Q2: 170
Q3: 370
Q4: 610

MW-W3
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-9A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-14A
Q1: 1,600
Q2: 1,700
Q3: 2,400
Q4: 2,300

MW-W2
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

MW-12A
Q1: 710
Q2: 680
Q3: 680
Q4: 750 J

MW-3A
Q1: Dry
Q2: Dry
Q3: 44
Q4: 44

RI-GW1
Q1: 1,100
Q2: 1,400
Q3: 1,000 J
Q4: 1,100

MW-4A
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

Legend

Unconsolidated Aquifer (UA) Well

MW-12A
710
Well Identification
Concentration

Spring/Pond/Wetland Water Sample

Screening Levels
250 mg/L Secondary MCL

MCL: Maximum Contaminants Level
J: Estimated Concentration
Concentrations in milligrams per liter (mg/L)

NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-32
Concentrations for Sulfate In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\siteinvestigmaps\2018_ReportingFigure_2-33_MonitoringWells_Sulfate_Q1-4_BAU.mxd

NESI Wetland
Q1: 120
Q2: NS
Q3: NS
Q4: NS

IB-2
Q1: 550
Q2: 710
Q3: 610
Q4: 470

MW-1
Q1: NS
Q2: 11
Q3: 11
Q4: 13

IB-3
Q1: 18
Q2: 24
Q3: 17
Q4: 18

IB-4
Q1: 64
Q2: 53
Q3: 58
Q4: 55

IB-11
Q1: 83
Q2: 91
Q3: 87
Q4: 89

RI-MW7-BAU
Q1: 210
Q2: 140
Q3: 170
Q4: 220 J

RI-MW8-BAU
Q1: 110
Q2: 89 J
Q3: 110
Q4: 120

IB-2A
Q1: 38
Q2: 40
Q3: 35
Q4: 32

IB-1
Q1: 29
Q2: 59
Q3: 61 J
Q4: 58

IB-12A
Q1: 930
Q2: 2,200
Q3: 1,800 J
Q4: 2,500

RI-MW6-BAU
Q1: 93
Q2: 130
Q3: 120
Q4: 110

RI-MW5-BAU
Q1: 31
Q2: 21
Q3: 29
Q4: 28 J

BAMW-3
Q1: 170
Q2: 160 J
Q3: 160
Q4: 180

IB-5A
Q1: 1,000 J
Q2: 980
Q3: 1,100 J
Q4: 1,100

IB-10
Q1: 250
Q2: 300
Q3: 280
Q4: 270

RI-MW9-BAU
Q1: 40
Q2: 59
Q3: 52
Q4: 49

RI-MW10-BAU
Q1: 27
Q2: 27
Q3: 28
Q4: 32 J

RI-MW11-BAU
Q1: 90
Q2: 62
Q3: 59
Q4: 63

IB-6
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

IB-5AA
Q1: 380
Q2: 440
Q3: 460 J
Q4: 460

RI-MW12-BAU
Q1: 42
Q2: 69 J
Q3: 91
Q4: 68 J

MW-2B
Q1: 12
Q2: 10
Q3: 10
Q4: 11 J

Stormwater Pond
Q1: 100
Q2: NS
Q3: NS
Q4: NS

IB-7
Q1: Dry
Q2: Dry
Q3: Dry
Q4: Dry

IB-5
Q1: 480 J
Q2: 470
Q3: 550 J
Q4: 550

RI-MW13-BAU
Q1: 43
Q2: 42 J
Q3: 43
Q4: 43 J

RI-MW2-BAU
Q1: 39
Q2: 74
Q3: 41
Q4: 32

RI-MW16-BAU
Q1: 51 J
Q2: 53
Q3: 55
Q4: 53

MW-7B
Q1: 140
Q2: 150
Q3: 140
Q4: 160

RI-MW14-BAU
Q1: 44
Q2: 42
Q3: 43
Q4: 43 J

MW-3B
Q1: 1,800
Q2: 1,800
Q3: 1,600
Q4: 1,700

BAMW-1
Q1: 34
Q2: 30
Q3: 31
Q4: 33

RI-MW15-BAU
Q1: 120
Q2: 140 J
Q3: 130
Q4: 130

Spring 1
Q1: 64
Q2: 60
Q3: 40
Q4: 32

RI-MW3-BAL
Q1: 2,000
Q2: 2,100
Q3: 2,100
Q4: 2,000

MW-18
Q1: 1,400
Q2: 1,400
Q3: 1,300
Q4: 1,300

Legend

Uppermost Basalt Aquifer Well (BAU)

- BAU_1 - Shallower Water-bearing Zone
- BAU_2 - Deeper Water-bearing Zone

MW-18
1,400
Well Identification
Concentration

Spring/Pond/Wetland Water Sample

Screening Levels
250 mg/L Secondary MCL

MCL: Maximum Contaminants Level
J: Estimated Concentration
Concentrations in milligrams per liter (mg/L)

NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-33
Concentrations for Sulfate In
Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\siteinvestigmaps\2018_Reporting\Figure_2-34_Monitoring_Wells_Sulfate_Q1-4_BAL.mxd

Well 2
Q1: NS
Q2: NS
Q3: NS
Q4: NS

RI-MW1-BAL
Q1: 260
Q2: 310
Q3: 300
Q4: 300

IB-13
Q1: 380
Q2: 420 J
Q3: 440 J
Q4: 420

RI-MW19-BAL
Q1: 93
Q2: 87 J
Q3: 83
Q4: 75

BAMW-2
Q1: 230
Q2: 270
Q3: 220
Q4: 190

IB-8
Q1: 770
Q2: 970
Q3: 980
Q4: 1,000 J

IB-13A
Q1: 78
Q2: 310 J
Q3: 450 J
Q4: 290

Well 1
Q1: 96
Q2: NS
Q3: NS
Q4: NS

RI-MW2-BAL
Q1: 61
Q2: 68
Q3: 65
Q4: 58

BAMW-4
Q1: 250
Q2: 350
Q3: 340
Q4: 360 J

RI-MW18-BAL
Q1: 88
Q2: 85 J
Q3: 90
Q4: 90

Well 3
Q1: 20
Q2: NS
Q3: 17
Q4: 20

RI-MW17-BAL
Q1: 120
Q2: 150
Q3: 160
Q4: 160

RI-MW20-BAL
Q1: 340
Q2: 420
Q3: 450
Q4: 450

Legend

Lower Basalt Aquifer Well (BAL)

- BAL_1 - Shallower Water-bearing Zone
- BAL_2 - Deeper Water-bearing Zone
- BAL_3 - Deepest Water-bearing Zone

RI-MW20-BAL
340
Well Identification
Concentration

Production Well

Screening Levels
250 mg/L Secondary MCL

MCL: Maximum Contaminants Level
J: Estimated Concentration
Concentrations in milligrams per liter (mg/L)

NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N
W E
S

0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-34
Concentrations for Sulfate In
Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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