Fort Hall Mine Landfill

1500 North Fort Hall Mine Road

Pocatello, Idaho

FINAL

2023 Offsite Groundwater Monitoring Report

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Acronyms and Abbreviations

µg/L	micrograms per liter
alpha	significance level
alluvium	alluvial sediments
bgs	below ground surface
BHHRA	baseline human health risk assessment
CF	confidence factor
cis-1,2-DCE	cis-1,2-dichloroethene
City	City of Pocatello
COC	chemical of concern
COPCs	chemicals of potential concern
COV	coefficient of variation
CSIA	compound-specific isotope analysis
CTE	central tendency exposure
DO	dissolved oxygen
DWSIA	domestic water source inventory area
EcoSSL	EPA's Ecological Soil Screening Levels
EPA	U.S. Environmental Protection Agency
ft/ft	feet per foot
FHML	Fort Hall Mine Landfill (the Site)
GPS	global positioning system
HI	hazard index
HQ	hazard quotient
IDGW	Idaho Groundwater Rule
IDEQ	Idaho Department of Environmental Quality
IDWR	Idaho Department of Water Resources
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
J	estimated result
LANL	Los Alamos National Laboratory
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LDS	Latter-Day Saints (The Church of Jesus Christ of Latter-Day Saints)
LOAEL	Lowest-observed-adverse-effect level
LPRV	Lower Portneuf River Valley
mg/L	milligrams per liter
MCL	maximum contaminant level
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
µS/cm	microsiemens per centimeter
MW	monitoring well
n	number of data points
NCEA	National Center for Environmental Assessment
NOAEL	no-observed-adverse-effect level
NTU	Nephelometric Turbidity Units
ORP	oxidation-reduction potential
%	percent

p-value	probability value
PA	City of Pocatello monitoring well
PCE	tetrachloroethene
PPRTV	Provisional Peer Reviewed Toxicity Values
PVA	Portneuf Valley Aquifer
QAPP	Quality Assurance Project Plan
RAGS	EPA's Risk Assessment Guidance for Superfund
RfC	reference concentration
RfD	reference dose
RL	reporting limit
RME	reasonable maximum exposure
RPD	relative percent difference
RSL	regional screening levels
RW	domestic well
S	Mann-Kendall summation statistic
SCEM	site conceptual exposure model
S/D	shallow/deep (well)
SF	slope factor
Site, the	Fort Hall Mine Landfill
SLERA	screening-level ecological risk evaluation
SLRA	screening-level risk assessment
SOP	standard operating procedure
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
U	nondetect result
UJ	estimated nondetect result
UF	uncertainty factor
VC	vinyl chloride
VI	vapor intrusion
VISL	vapor intrusion screening level
VOC	volatile organic compound
WOE	weight of evidence
YSI	Yellow Springs Instruments Pro Digital Sampling System

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Section 1

Introduction

Under Task Order No. 11 of the Bannock County Master Services Agreement contract executed on July 24, 2018, CDM Smith was tasked with implementing a groundwater sampling program at select monitoring, remediation, and domestic wells to evaluate a chemical of concern (COC) plume emanating from the Fort Hall Mine Landfill (FHML) (the Site) (**Figure 1-1**) in accordance with the current consent order between Bannock County and Idaho Department Environmental Quality (IDEQ) (IDEQ 2016). Field activities, laboratory results, data validation, and updated COC distribution and statistical trends are presented herein.

1.1 Purpose of the Report

The 2023 annual offsite groundwater sampling event was conducted in accordance with the *Final Fort Hall Mine Landfill, Groundwater Monitoring Program Plan Quality Assurance Project Plan (QAPP)*, dated May 25, 2021 (CDM Smith 2021b). The overall purpose of the 2023 offsite monitoring event was to assess the impacts of COCs leaching to groundwater from the FHML to the Portneuf Valley Aquifer (PVA), and to evaluate risks to human health and the environment.

The purpose of this report is to:

- Present the analytical and field data collected during the 2023 offsite groundwater sampling event.
- Update the lateral trichloroethene (TCE) groundwater plume extent downgradient of the FHML.
- Evaluate COC trends in offsite City of Pocatello (City) monitoring wells and domestic supply wells with sufficient data to conduct statistical analysis.
- Update the screening-level risk assessment (SLRA) to evaluate potential human health risks due to the following:
  - Use of groundwater as the sole source of household water.
  - Potential vapor intrusion into residences located above contaminated groundwater.
  - Use of groundwater as a source of domestic water for irrigation.
- Update the screening-level ecological risk evaluation (SLERA) to evaluate potential ecological risks due to ingestion of groundwater that may be used to provide drinking water for animals.
- Provide recommendations for the 2024 City and domestic well monitoring program.

1.2 Site Background

The following sections briefly describe site history and use, COC discharge from the FHML, geology and hydrogeology, fate and transport of COCs, and the offsite FHML monitoring well network.

1.2.1 Site Location and Use

The Site is located on North Fort Hall Mine Road in Bannock County, Idaho, approximately 7 miles southeast and hydrologically upgradient of the City (**Figure 1-1**). The landfill is alternately known as the Fort Hall Canyon Landfill or Bannock County Landfill (IDEQ 2016) and has received hazardous and nonhazardous waste since 1943. More information pertaining to site history and use within the FHML property boundary can be found in recent semiannual reports (CDM Smith 2022a, 2022c).

1.2.2 COC Discharge from the FHML to the PVA

In October 1991, TCE contamination was identified in monitoring wells installed immediately downgradient of FHML Cell 1 (Brown and Caldwell 1992). By 1993, high concentrations of TCE were observed in downgradient domestic wells within the PVA, and two municipal supply wells (#14 and #33, shown on **Figure 1-2**) were subsequently closed because of TCE concentrations (Brown and Caldwell 1994). Within the domestic wells (designated with "RW"), TCE exceeded the groundwater maximum contaminant level (MCL) drinking water standards, with the highest concentrations of 290 micrograms per liter (?g/L) observed in RW-2076F.

Approximately 45 domestic wells have been sampled since 1991 at varying frequency. **Figure 1-3** presents the maximum extent of the TCE plume using the highest concentrations observed to date for statistical kriging used to estimate the boundaries of the plume (see CDM Smith 2019a for a more detailed description of the kriging). Although the greatest impacts from COC discharging from the FHML to the PVA were observed in the 1990s, the subsequent extent of the COC plume and concentration trends indicate that impacts continue, with several domestic wells currently exceeding the MCL for TCE (CDM Smith 2021c).

1.2.3 Site Geology

In the vicinity of the FHML, Quaternary valley fill deposits of loess and silty gravels are found within the Fort Hall Canyon, which grade into alluvial fan deposits extending northward from the mouth of Fort Hall Canyon. The alluvial deposits consist of stream channel and alluvial fan deposits that are interbedded, discontinuous units of sand, gravel, silt, and clay. Coarse materials are generally subangular to subrounded fragments of red to green metaquartzite and argillite. Interstitial materials are slightly to moderately plastic, light- to medium-brown silt and clay. The alluvial fan deposits grade into the Lower Portneuf River Valley (LPRV) fill deposits that predate Upper Gravels from the Bonneville flood event and form the benches along the southwestern edge of the valley. The nature of the lateral and vertical grading between the three sedimentary deposits is unclear at this time. These sedimentary deposits all overlie, and are derived from, the Tertiary Starlight Formation (AEEC 2018).

The base of Fort Hall Canyon intersects the LPRV. Six lithologic groups have been defined in the southern portion of the LPRV (Welhan et al. 1996):

- Bedrock, of variable composition but dominated by pink to white quartzite and varicolored shale or argillite, predominantly of Proterozoic age (Caddy Canyon Formation).
- Middle to late Tertiary basin-filling sediments and volcaniclastics of the Starlight Formation.
- Quaternary valley fill and alluvial deposits composed of non-indurated silty gravels and cobbles with lenses of sand, silt, and intercalated clays.
- Portneuf basalt deposited along the eastern edge of the LPRV.
- Coarse-grained clean gravel and cobbles in the center of the LPRV, known as the Upper Gravels (equivalent to the Michaud Gravels in the northern LPRV), deposited by the Bonneville Flood event and which comprise the most productive portion of the underlying LPRV aquifer.
- A silt "mantle" of variable thickness (0 to 43 feet) overlying the Upper Gravels, originating from overbank flood material from periodic Portneuf River flooding.

Seismic refraction geophysical surveys were conducted by Brown and Caldwell as part of the initial site investigations at the mouth of Fort Hall Canyon in 1992 and 1993 (Brown and Caldwell 1992, 1994). The presence of a basin and range-type normal fault that strikes slightly west of north through Fort Hall Canyon was confirmed. This fault was originally identified as a thrust fault by Trimble (1976) and later revised to a normal fault by Rodgers et al. (2006). The fault is estimated to have a dip of 15 to 20 degrees southwest, and it has a surface exposure on the west-facing slope of the canyon. The fault was estimated to be located 100 to 200 feet below ground surface (bgs) at the mouth of the canyon and approximately 180 feet wide, with formation offset downward to the west approximately 3.5 miles (Trimble 1976).

1.2.4 Site Hydrogeology

The aquifer system beneath the FHML consists of loess, alluvium (associated with the Fort Hall Canyon Creek), the alluvial fan extending to the north of the canyon, and the underlying Starlight Formation. The aquifer system is primarily unconfined beneath the FHML, but some areas have evidence of confined conditions, particularly on the east side of Fort Hall Canyon Creek near the landfill. The water table is situated within the Starlight Formation in some areas and in the alluvium or loess in other areas. The units in the aquifer system are hydraulically connected and chemicals are expected to migrate between them. Groundwater in the alluvium and the Starlight Formation discharges into the PVA near monitoring wells MW-103S/D, MW-118D, and MW-116S, downgradient of the remediation system.

The alluvium consists of stream channel and alluvial fan deposits that are interbedded, discontinuous units of sand, gravel, silt, and clay. The Starlight Formation is described as "middle to late Tertiary basin-filling sediments and volcaniclastics" by Welhan et al. (1996). The Starlight Formation is less transmissive than the alluvium, though in some instances, the top 10 feet of the Starlight Formation has been found to be similarly transmissive as the overlying alluvium.

Inflows to the aquifer system underlying the FHML area are direct recharge from precipitation and seepage from Fort Hall Canyon Creek. Average precipitation recorded at the landfill weather station was approximately 12 inches per year throughout the last 6 years of records. Welhan (1996) estimated average annual precipitation to Fort Hall Canyon to be 20.4 inches per year. The total estimated water budget for the PVA has previously been estimated at 5.5 billion gallons per day (**Figure 1-4**).

Groundwater flowing through the mouth of Fort Hall Canyon discharges to the Lower PVA. As noted above, the PVA comprises northern, eastern, and southern subaquifers and is the sole source for drinking water for the communities of Pocatello and Chubbuck. In the southern portion of the PVA, wells have high yields because they are completed in coarse, clean upper gravels at depths less than 100 to 150 feet bgs.

The transmissivity of the upper gravels was estimated at approximately 10 square feet per second, with aquifer storage estimated at 0.005 (unitless), based on constant discharge pumping tests of municipal wells (CH2M Hill 1994).

The Lower PVA aquifer system is defined by the lateral boundaries of the geologic contact between the Quaternary alluvium with less permeable rock formations (i.e., Starlight Formation along the south/southwestern boundary near the FHML). The contact between the Upper Gravels and underlying Tertiary Starlight Formation is steep on the southwest side becoming more of an undulating surface in the center of the valley (CH2M Hill 1994).

Groundwater flows through the Lower PVA from southeast to northwest, with groundwater discharging to the Lower PVA from tributary basins, including Fort Hall Canyon. Horizontal flow gradients within the Lower PVA vary from zero (stagnation zone) to 0.003 feet per foot (ft/ft) over the 9,330 feet between the confluence of Fort Hall Canyon and the Lower PVA and PA-3. These gradients are considerably smaller than what is regularly observed within Fort Hall Canyon. Vertical head gradients were measured to be negligible at MW-106, PA-4 and PA-9 well clusters within the Lower PVA (CDM Smith 2020b). An upward gradient was measured at upgradient well pair MW-116S/D in 2019, where groundwater discharge from Fort Hall Canyon is occurring.

1.2.5 Offsite Monitoring and Domestic Well Network

An extensive monitoring well network has been established throughout the FHML and offsite in the PVA to evaluate the impacts of the FHML to groundwater (**Figure 1-2**). The offsite groundwater well monitoring network consists of multiple well groups, as outlined below.

1. **Cell 1 and Offsite Bannock County Monitoring Wells**. The Cell 1 monitoring well group currently consists of Bannock County groundwater monitoring wells located adjacent to and downgradient of Cell 1 on the FHML property. These wells are monitored to assess the extent of contamination immediately north-northeast of the Cell 1 boundary. There are eight Bannock County monitoring wells located offsite of the FHML property boundary on private property (**Figure 1-2**). Data results and analysis for these wells are presented in spring and fall semiannual monitoring reports and are not discussed here (e.g. CDM Smith 2023a).

2. **City Monitoring Wells.** Groundwater monitoring wells installed by the City have been monitored to evaluate groundwater quality and COC plume migration toward the municipal supply wells (**Figure 1-2**). Except for MW-37 and MW-38, City monitoring wells are designated with a "PA."

3. **City Municipal Supply Wells.** Twenty-one municipal supply wells have been installed by the City. The City has used some of these wells to monitor the extent of

the plume and the presence of COCs in city drinking water supply. Municipal supply wells #14 and #33 have historically been impacted by FHML-related COCs.

4. **Domestic Wells.** Nearly 50 domestic or irrigation groundwater wells (designated with "RW") in the PVA have been monitored at least once between 1991 and 2022 to assess the extent of the offsite groundwater plume and to monitor COC concentrations within and surrounding impacted residential domestic water wells. CDM Smith samples some of these domestic wells annually.

1.2.6 COC Fate and Transport

Natural biodegradation of chlorinated solvents is well established in peer-reviewed literature and shown to occur under both aerobic (with oxygen) and anaerobic (without oxygen) conditions. Under aerobic conditions, tetrachloroethene (PCE) is considered recalcitrant (i.e., it does not degrade biologically), and TCE degradation is very slow. This is part of the reason these chemicals persist and tend to form relatively large plumes in aerobic transmissive aquifers.

However, under anaerobic conditions, PCE and TCE can undergo biotic transformation via anaerobic reductive dechlorination, in which bacteria use PCE and TCE as alternate electron acceptors in the absence of oxygen. During anaerobic dechlorination, sequential transformation occurs from PCE to TCE to cis-1,2-dichloroethene (cis-1,2-DCE) (primary) or trans-1,2-DCE to vinyl chloride (VC) to ethene and/or ethane and chloride. The most common dechlorination pathway is the conversion of TCE to cis-1,2-DCE to VC to ethene and ethane.

In addition to the anaerobic pathway, other degradation mechanisms for the lower chlorinated ethenes and ethanes, such as cis-1,2-DCE and VC, include anaerobic oxidation (coupled to sulfate or iron reduction) and aerobic oxidation (i.e., used as a carbon and energy source for aerobic microorganisms), which generates carbon dioxide and water. These alternate degradation mechanisms are important when there is significant sulfate or iron available anaerobically or in redox transition zones, where anaerobic groundwater comes into contact with aerobic groundwater in the downgradient/distal plumes or periodic infiltration of aerobic precipitation during rain events. This can occur either down- or cross-gradient from the anaerobic source zone or below the anaerobic treatment zone if there is a vertical gradient resulting in vertical mixing with aerobic groundwater.

In addition to the chlorinated ethenes, reductive daughter products ethene and ethane can be oxidized (i.e., used as carbon and energy sources) by aerobic and/or anaerobic sulfate- or iron-reducing microorganisms. Under conditions in which reductive daughter products are being directly oxidized, a complete mass balance to cis-1,2-DCE, VC, ethene, and/or ethane is not observed.

Geochemical conditions dictate the potential for degradation of chlorinated ethenes. In general, anaerobic conditions facilitate reductive dechlorination of chlorinated ethenes, and aerobic conditions can facilitate (1) cometabolism of TCE in the presence of methane, and (2) both cometabolism and direct oxidation of the lower chlorinated ethenes cis-1,2-DCE and VC. In general, reductive dechlorination mechanisms result in a carbon isotope shift during degradation, allowing degradation via this mechanism to be documented using compound specific isotope analysis (CSIA), which has recently been performed at the Site (CDM Smith 2019b, 2020a). In contrast, oxidative processes, such as direct oxidation reactions, generally do not result in a carbon isotope shift and thus cannot be discerned using carbon CSIA data.

Geochemical results and interpretation are provided in recent groundwater monitoring reports (e.g., CDM Smith 2023a). Geochemical conditions within Fort Hall Canyon near the remediation system are generally (1) aerobic on the east side of Fort Hall Canyon and upgradient of the remediation system and (2) anaerobic on the west side of Fort Hall Canyon. Generally, aerobic conditions are interpreted based on concentrations of dissolved oxygen (DO) greater than 1 milligram per liter (mg/L), while anaerobic conditions are defined based on low concentrations of DO (less than 1 mg/L) with methane production observed. Additionally, oxidation-reduction potential (ORP) is generally positive under aerobic conditions and negative under anaerobic conditions. Within the PVA, geochemical conditions are aerobic (i.e., oxygen is present, ORP is positive).

Thus, in the FHML Cell 1 source area(s) on the west side of the Fort Hall Canyon area, attenuation of COCs by biodegradation is likely occurring primarily via anaerobic processes, while aerobic processes likely dominate biodegradation on the east side of Fort Hall Canyon and in the distal PVA plume (CDM Smith 2019b, 2020a). Anaerobic degradation of PCE and TCE is significant immediately downgradient of Cell 1 but was not observed in the CSIA data downgradient of MW-118D (CDM Smith 2019b), which indicates that decreasing concentrations in this area are likely due to processes that do not cause an isotopic shift, such as physical (i.e., dilution, dispersion) attenuation. Both VC and cis-1,2-DCE degrade within the aerobic and anaerobic plume areas, which is why they do not persist in the Lower PVA.

An injection pilot study was conducted in April 2023 to evaluate the feasibility and effectiveness of slurry injections to deliver reactive amendments and enhance permeability to the west side of the Fort Hall Canyon area. Additionally, a tracer study was conducted in May 2023 in the east side of Fort Hall Canyon to evaluate groundwater flow and distribution. Results and interpretation of these tests will be presented under a separate cover in a forthcoming pilot study evaluation report.

1.3 Report Organization

This report is organized into the following sections:

1.0 Introduction: This section describes the purpose and organization of the report and summarizes site background information, including the site location, geology, and hydrogeology, the nature and extent of contamination, and COC fate and transport.

2.0 2023 Offsite Field Sampling Activities: This section presents a summary of the 2023 offsite sampling activities, including private property owner correspondence, groundwater sampling and analysis, decontamination and handling of investigation-derived waste, and any deviations from the QAPP (CDM Smith 2021b) or sampling plan (**Appendix A**).

3.0 Groundwater Monitoring Results: This section presents the results of the 2023 offsite sampling activities and presents a summary of the data quality and usability, water level elevations, and groundwater analytical results.

4.0 Data Analysis: This section presents the updated PCE and TCE plume extents and the statistical analysis of PCE and TCE trends in select wells.

5.0 Screening-Level Risk Assessment: This section presents an updated SLRA based on new information collected during the 2023 sampling event to evaluate human health risks due to groundwater and vapor intrusion and updated SLERA to evaluate ecological risks due to ingestion of groundwater by animals.

6.0 Conclusions and Recommendations: This section presents the conclusions of the data analysis and provides recommendations per the decision criteria developed in the QAPP (CDM Smith 2021b) for 2024 offsite groundwater sampling activities at the Site.

7.0 References: This section presents references used to prepare this report.

The following appendices are also provided:

- **Appendix A** – IDEQ Approved Recommendations for the 2023 Annual Offsite Sampling Plan.
- **Appendix B** – Field Documentation.
- **Appendix C** – Laboratory Analytical Results.
- **Appendix D** – Data Usability Assessment Report.
- **Appendix E** – Analytical Laboratory Data Packages.
- **Appendix F** – Time Series Plots.

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Section 2

2023 Offsite Field Sampling Activities

During the 2023 annual offsite sampling event (July 17–23), groundwater samples were collected from domestic wells and City of Pocatello monitoring wells. Offsite well construction details are presented in **Table 2-1**. All July 2023 offsite sample locations are presented in **Table 2-2** and on **Figure 2-1.** Several offsite Bannock County monitoring wells were sampled in April 2023, results for which are presented under a separate cover (CDM Smith 2023b). During the July 2023 sampling event, select onsite wells were also sampled as part of the ongoing project pilot study (CDM Smith 2023d). The results from these wells will be reported under a separate cover when the pilot study period is complete.

The 2023 offsite sampling activities were performed in accordance with the QAPP (CDM Smith 2021b) and the *2022 Sampling Reduction Memorandum* (**Appendix A**) except as described in **Section 2.4**.

2.1 Private Property Access

Consent was requested and received from property owners or a property management company to access properties and collect samples from offsite groundwater monitoring wells and/or domestic water wells sampled.

2.1.1 City Monitoring Well Access

The offsite City monitoring wells are located on private land used as a community ballpark and leased out for farming. Sampling consent was arranged between CDM Smith's procurement/legal department and the leasing agency employed by the property landowner, the Latter-Day Saints (LDS) Church. Unlike the domestic well private property consent forms, these consent forms allow access for a single sampling event only and are re-instated each year.

2.1.2 Domestic Well Access

Prior to the annual offsite sampling event, each property owner was contacted to confirm their receipt of 2022 sampling data (if their well was sampled) and to schedule a sampling appointment. If not already on file, property access consent forms were mailed to or distributed to each private property planned for 2023 sampling. If neither verbal nor written consent was obtained, the domestic well was not sampled.

2.2 Groundwater Sampling

The offsite monitoring, domestic, and municipal supply wells sampled during this event are presented in **Table 2-2** and on **Figure 2-1**.

Appendix B contains the field documentation for the 2023 annual offsite sampling event, including equipment calibration forms, well purge forms, sample chain-of-custody forms, and the field logbook.

2.2.1 Domestic Well Reconnaissance

Efforts were conducted in 2019 and 2020 to confirm the existence, location, and general characteristics of the wells and incorporated into the CDM Smith database, as described in previous offsite sampling reports (CDM Smith 2020a, 2020c). If found, Idaho Department of Water Resources (IDWR) well identification numbers (e.g., metal tag number) were used to match the well to its historical well driller's report in the IDWR database, which supplied the well construction information and subsurface geology. If no match was available, the well depth was typically obtained from the owner. Well construction information was used in the field to identify necessary purge volumes. Field teams verified global positioning system (GPS) coordinates via a cellular phone application for each domestic well. Field-verified coordinates and lithology from well logs were incorporated into the FHML conceptual site model and used to update site maps and geologic cross sections.

With each subsequent annual domestic well sampling event, updated information obtained from property owners via telephone or in-person during sampling the well is updated in the CDM Smith database and communication log.

2.2.2 Groundwater Elevation Measurements

Synoptic water levels were not collected for groundwater wells during the 2023 offsite monitoring event. Domestic wells are not opened by sampling teams, and water is only accessible by a spigot at the well head, except for RW-2203H. Depth to groundwater was measured at each well at which a pump was deployed for sampling; these measurements are listed on well purge forms (**Appendix B**).

2.2.3 Groundwater Sampling Procedures

Groundwater wells were sampled in accordance with the following standard operating procedures (SOPs) (CDM Smith 2019a):

- SOP 1-2 – Sample Custody.
- SOP 1-12 – Low-Stress (Low-Flow) Groundwater Sampling.
- SOP 2-1 – Packaging and Shipping Environmental Samples.
- SOP 2-2 – Guide to Handling Investigation-Derived Waste.
- SOP 4-1 – Field Logbook Content and Control.
- SOP 4-2 – Photographic Documentation of Field Activities.
- SOP 4-5 – Field Equipment Decontamination at Nonradioactive Sites.
- SOP 6-1 – Tap Water Sampling of Residential and Extraction Wells.

The following water quality parameters were collected at each location prior to collecting groundwater samples using a Yellow Springs Instruments Pro Digital Sampling System (YSI) water quality meter:

- DO
- ORP

- pH
- Temperature
- Specific conductivity

Additionally, turbidity was measured at each location using a Hanna Instruments Turbidity Portable Meter. In select wells sampled for pilot study monitoring, ferrous iron measurements were collected in the field.

2.2.3.1 Low-Flow Sampling

City monitoring wells, RW-2203H, and MW-116S were sampled according to the procedures outlined in SOP 1-12, "Low-Stress (Low-Flow) Groundwater Sampling," as specified in the QAPP (CDM Smith 2021b). A bladder pump was used, set to approximately the middle of the well-screened interval, to pump groundwater at flow rates of 50–500 milliliters per minute. Minimal drawdown and/or stabilized drawdown was used to ensure that the water sampled was representative of the formation surrounding the screened interval and not the stagnant water column. Water quality parameters were continuously monitored using a flow-through cell, and when stabilization was achieved, a groundwater sample was collected. Purge forms are provided in **Appendix B**.

2.2.3.3 Tap Sampling

All domestic wells except for RW-2203H were sampled according to the procedures outlined in SOP 6-1, "Tap Water Sampling of Residential and Extraction Wells" as specified in the QAPP (CDM Smith 2021b). Most domestic wells sampled had a nearby frost-free spigot where groundwater could be collected. Some wells without spigots had alternate access points used per the owner's request.

Groundwater was purged from domestic wells at the maximum flow rate prior to field parameter measurement. For wells with unknown well construction, 300 gallons were purged at the maximum flow rate. For wells with known well construction, the minimum purge volume was either 3 well volumes or 300 gallons, whichever was lower. Volumes purged from each well are presented in **Table 2-2**. Purge water was disposed according to the owner's preferences, typically in the lawn or a nearby field and usually diverted with a garden hose.

After purging the minimum volume, water quality parameters were collected every 3 to 5 minutes until parameters stabilized. The water source was left continuously running during field parameter collection; however, the flow rate was decreased, if possible, to an appropriate rate for sample collection. Field parameters were measured with grab samples, which were sealed in the water quality meter sample cup without headspace to minimize the impact of oxygen in the ambient air. Field parameter grab samples were collected from the spigot with the hose removed, if possible. After field parameters stabilized, the groundwater sample was collected from the spigot directly, if possible, at a flow rate low enough to prevent aeration of groundwater and bubble entrapment in the sample vials. Purge forms for domestic wells are provided in **Appendix B**.

2.2.4 Sample Analysis

Samples were analyzed according to the QAPP (CDM Smith 2021b). All groundwater well samples were analyzed for volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (EPA) Method 8260B. No additional analyses were performed in July 2023.

2.3 Decontamination and Investigation-Derived Waste

All nondedicated sampling equipment (e.g., bladder pump equipment and water level meters) was decontaminated following the procedure outlined in SOP 4-5, "Field Equipment Decontamination at Nonradioactive Sites" (as specified in the QAPP, CDM Smith 2021b). Decontamination procedures for groundwater sampling equipment used a triple wash system. The first wash contained potable water and a laboratory-grade detergent. The second wash contained potable water, and the third wash contained distilled water for rinsing. Before use, reuse, and at the end of the sampling event, all bladder pump equipment was disassembled, scrubbed, and decontaminated using this triple wash system. Decontamination water and purge water from monitoring well sampling was containerized and properly disposed of onsite at the landfill. Personal protective equipment was disposed of onsite at the landfill.

2.4 Deviations

Except where noted below, sampling locations and procedures did not deviate from the sampling plan (**Appendix A**) or QAPP (CDM Smith 2021b).

2.4.1 City of Pocatello Monitoring Wells

The following deviations with respect to City monitoring wells occurred:

- Muni-Well-14 was not sampled because there was a pipe leaking during the event per City employees.
- Muni-Well-33 was not sampled as the pump was pulled by the City at some point of time prior to the event.
- PA-4 and PA-8 were sampled at their middle screened interval, rather than the shallowest screened interval. This was because the wells were planned for comparative passive sampling with HydraSleeves, and the placement of HydraSleeves was dependent on groundwater elevations from 2022, which were relatively low. However, the access agreement with the LDS property management company was not finalized in time to perform the comparative sampling, and the wells were sampled with low-flow methods, according to the sampling plan in **Appendix A**.

2.4.2 Domestic Wells

The following deviations with respect to domestic monitoring wells occurred:

- RW-2151H appears to have a cycling pump that causes discoloration of the water intermittently. This has been observed in prior sampling events (CDM Smith 2021c, 2020a, 2020c). To avoid excessive purge times and pump burnout, field parameters were measured, and samples were collected only during periods of clear water.
- The sampling access for RW-2172H makes it impossible to obtain a low-flow sample. There is only one flow rate for the water, which is so high that even with a splitter directing much of the flow into other hoses, the water access point sprays water such that samples are likely highly aerated.
- RW-2203H was sampled outside of the turbidity stabilization requirement. It is suspected that the old pump and well infrastructure in the well is disintegrating and causing this turbidity, despite low-flow purging. This well has historically been challenging to sample and is not used by the property owner.

- The purge volume for RW-7200P was corrected in the field. The corrected purge volume is listed on the purge form (**Appendix B**) and **Table 2-2** and will differ from the sampling plan (**Appendix A**).
- The homeowner for RW-7505P informed CDM Smith of the pump depth. The minimum purge volume was updated based on this information in the field and will differ from the sampling plan table in **Appendix A**.
- RW-8048P was sampled outside of the ORP stabilization requirement. The ORP fluctuated between positive and negative values every 30–45 minutes, preventing stabilization after a long purge time.
- Samples collected from the following wells are difficult to achieve under low-flow conditions because of the groundwater access piping or sampling ports: RW-2172H.

2.4.3 Bannock County Monitoring Wells

The following deviations with respect to monitoring wells occurred:

- Ferrous iron results were not collected in MP-2 or MW-125.
- The sample at MW-118D was collected with DO outside of the stabilization requirements (**Section 2.2.3**).

2.4.4 Sampling Equipment

The YSI water quality meter DO sensor appeared to be malfunctioning during sampling of RW-2140H and PA-8 on July 23, 2023. The sensor was reading negative DO values; thus, the data were inaccurate. The field team recorded on well purge forms where this occurred (**Appendix B**). For these wells, other purge parameters were used to determine when parameters had stabilized adequately for sampling.

Other wells that are suspect of the YSI water quality meter DO sensor malfunctioning are wells that had DO reading above 10 mg/L. Wells were this was observed are RW-2172H, RW-2203H, RW-7677P, and RW-7773P. In RW-2172H and RW-7677P, this may be because of possible aeration of the sample because of the high flow rate of water at the sampling port.

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Section 3

Groundwater Monitoring Results

This section presents the groundwater monitoring results of the 2023 annual offsite sampling event. **Figure 2-1** presents the groundwater wells sampled during this event, which include City municipal supply wells and domestic wells. All analytical results are presented in **Appendix C**.

3.1 Groundwater Data Usability Assessment

Data validation was performed in accordance with the analytical methods and National Functional Guidelines for Organic Superfund Methods Data Review (EPA 2020b). Holding times, sample preparation blanks (method, equipment, source, trip), duplicates (field), surrogate compound recovery, matrix spike/matrix spike duplicates (MS/MSDs), laboratory control sample/laboratory control sample duplicates (LCS/LCSDs), interferences, reporting limits (RLs), and compound identification and quantification were included in the review.

All data were received in final form, and validation was performed on the final data. CDM Smith validated laboratory analytical data with the EQuIS Data Quality Module for the VOC analyses. The validation narrative is provided in **Appendix D**, and the final laboratory data packages for each laboratory sample delivery group are included in **Appendix E**. All data are suitable for their intended use. Some of the results should be used with caution as noted by the "J/ UJ" qualifiers applied during the data validation process.

3.1.1 Precision

Precision was assessed by comparing the relative percent differences (RPDs) or absolute differences for laboratory duplicate samples, field duplicate samples, MS/MSD analyses, and LCS/LCSD analyses. Laboratory in-house limits were used for laboratory duplicate samples LCS/LCSD and MS/MSD duplicate analyses. An RPD field duplicate criteria of 30 percent (%) was used for field duplicates. For field duplicates where results were greater than five times the level of quantification, the RPD was calculated and compared with the 30% precision criteria. Where results were less than five times the RL, the absolute difference was calculated and compared with a precision criterion of less than or equal to the RL. **Table D-2** (**Appendix D**) presents comparisons of results for primary samples and associated field duplicates. All RPDs met their respective control limits except for select LCS/LCSD results. No data required qualification for RPD criteria.

3.1.2 Accuracy

Accuracy was assessed with percent recoveries in MS/MSD, LCS/LCSD, and surrogate recoveries. All percent recoveries in LCS/LCSDs, MS/MSDs, and for surrogates met the control limit criteria except for high recoveries for many compounds and a low recovery of one compound in LCS and LCSD samples. No data were qualified for the high recoveries and associated results for the compound with the low recovery were qualified (UJ).

Samples RW-2151H-20230720, RW-7505P-20230720, and PA-3-20230722 were analyzed from vials with headspace. All results for these three samples were qualified estimated (J/UJ).

3.1.3 Comparability

Comparability from one sampling event to another is achieved by structuring the field sampling program and protocol for sample collection and analyses. CDM Smith's technical SOPs are followed to ensure consistent sampling techniques. In addition, EPA-approved analytical methods and RLs are defined and used to ensure comparability of data.

All data included in this report have been validated and are considered acceptable for use; **Appendix D** provides the full validation narrative and results. Results qualified J/UJ should be used with caution.

3.1.4 Completeness

An analytical completeness goal of 90% for each analytical group was used to determine completeness. Analytical completeness was evaluated for each analytical group through comparison of the number of nonrejected data to the number of requested analyses. All analyses for field samples that were submitted to the laboratory were successfully analyzed, yielding a completeness result of 100%, which met the 90% goal.

3.1.5 Sensitivity

The RLs achieved for all samples were adequate to meet the data quality objectives.

3.2 Offsite Monitoring and Domestic Well Groundwater Sampling Results

Analytical results from the 2023 annual offsite sampling event are discussed below.

3.2.1 VOCs

Detections of VOCs are presented in **Table 3-1** (City wells), **Table 3-2** (domestic wells), and **Table 3-3** (Bannock County monitoring well). The results are screened against the EPA MCLs and Idaho Groundwater Rule (IDGW) Primary and Secondary Standards for drinking water. Results for PCE, TCE, cis-1,2-DCE, and VC are also shown on **Figures 3-1** through **3-3**.

Appendix C presents the 2023 analytical data and all available historical TCE and PCE data. Time series plots in **Appendix F** present available data for chlorinated ethenes and geochemical parameters by well.

3.2.1.1 City Monitoring Wells

Consistent with 2022 results (CDM Smith 2022b), none of the City monitoring well VOC results exceeded the EPA MCL or IDGW primary standard (**Table 3-1**). However, TCE was detected in the following wells:

- PA-1 (0.5 J µg/L)
- PA-3 (0.8 J µg/L)
- PA-4 (1.1 µg/L)

3.2.1.2 Domestic Wells

TCE exceeded the MCL and IDGW primary standard in the following wells (**Table 3-2**):

- RW-2140H (24 µg/L)

- RW-2151H (6 µg/L)
- RW-2172H (17 µg/L)
- RW-2203H (13 µg/L)
- RW-2237H (25 µg/L)
- RW-7677P (7 µg/L)

TCE was detected below the MCL in the following domestic wells:

- RW-2076F (0.92 J µg/L)
- RW-7549P (2 µg/L)
- RW-8012P (0.99 J µg/L)
- RW-8030P (4.9 µg/L)
- RW-8048P (3.9 µg/L)
- RW-8284P (1.5 µg/L)

PCE did not exceed the MCL and IDGW primary standard in any wells and was detected in the following domestic wells (**Table 3-2**):

- RW-2140H (4.3 µg/L)
- RW-2151H (0.47 J µg/L)
- RW-2172H (3.2 µg/L)
- RW-2203H (1.3 µg/L)
- RW-2237H (4 µg/L)
- RW-7677P (1.2 µg/L)

The reductive daughter product cis-1,2-DCE was detected at values less than the MCL in the following domestic wells:

- RW-2140H (1.4 µg/L)
- RW-2172H (1.2 µg/L)
- RW-2203H (0.57 J µg/L)
- RW-2237H (1.5 µg/L)
- RW-7677P (0.37 J µg/L)

Other reductive daughter products trans-1,2-DCE and VC were not detected in any domestic wells.

3.2.1.3 Bannock County Monitoring Wells

MW-116S was the only offsite Bannock County monitoring well sampled during the 2023 offsite sampling event. PCE (2 µg/L), TCE (14 µg/L), and cis-1,2-DCE (0.52 J µg/L) were detected. Only TCE exceeded the MCL and IDGW primary standard (**Table 3-3**).

3.2.2 Geochemical Parameters

Geochemical parameters are often used to assess conditions in groundwater affected by the landfill leachate/waste, including redox conditions, pH, and alkalinity, and to evaluate conditions that facilitate COC degradation. Field parameters (conductivity, pH, temperature, turbidity, DO, and ORP) are presented in **Tables 3-1** (City wells), **Table 3-2** (domestic wells), and **Table 3-3** (Bannock County monitoring well). Additional geochemical parameters were not measured in the 2023 annual offsite sampling event.

3.2.2.1 Specific Conductance

Specific conductance was measured at all sampled wells. Results are presented in **Tables 3-1**, **3-2**, and **3-3**. Relatively high specific conductance (greater than 1,000 microsiemens per centimeter [µS/cm]) was observed at wells MW-116S, RW-2140H, RW-2172H, RW-2237H, and RW-2879M (**Tables 3-2** and **3-3**). All other locations had specific conductance less than 1,000 µS/cm.

3.2.2.2 pH

pH was measured at all sampled wells. In City monitoring and Bannock County monitoring well (**Tables 3-1** and **3-3**), pH ranged from 6.91 to 8.12 standard units. No pH levels outside of the IDGW Secondary drinking water standard (range 6.5 to 8.5 standard units) were observed. In domestic wells pH ranged from 6.62 to 7.71 standard units (**Table 3-2**). No pH levels outside of the IDGW Secondary drinking water standard (range 6.5 to 8.5 standard units) were observed.

3.2.2.3 Redox Conditions

DO, ORP, sulfate, ferrous iron, and methane are redox parameters used to evaluate reducing conditions at a location. Redox conditions often control the mobility and subsequent concentration in groundwater of redox-sensitive metals such as iron, manganese, and arsenic. Under reducing conditions, these metals are transformed from their oxidized (and immobile) states to their more soluble, reduced forms. In addition, many metals that are not redox sensitive are sorbed to iron and manganese oxyhydroxides, which may dissolve under reducing conditions, releasing sorbed metals. If site soil/sediments contain redox-sensitive metals, elevated concentrations in groundwater will be observed in areas with reducing conditions.

In 2023, all City monitoring and domestic supply wells exhibited aerobic conditions, as indicated by DO greater than 1 milligram per liter (mg/L) (**Tables 3-1** and **3-2**). Bannock County monitoring well MW-116S was the only well that exhibited anaerobic conditions (**Table 3-3**). This is generally consistent with 2022 results (CDM Smith 2022c).

Negative ORP readings were observed at domestic supply wells RW-2172H, RW-2213F, RW-2237H, RW-7549P, RW-7677P, RW-8012P, RW-8048P, RW-8105PS, and RW-8284P. Negative ORP readings were observed at City wells PA-1, PA-3, PA-4, and PA-8. ORP readings were positive in all other sampled wells.

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Section 4

Data Analysis

As discussed in **Section 2.2**, an extensive monitoring well network is used to assess impacts of the FHML Cell 1 source to groundwater within the Fort Hall Canyon and PVA. **Appendix C** presents all available historical and current PCE and TCE data, and **Appendix F** provides chlorinated ethene time series plots for the City monitoring wells and domestic wells sampled in July 2023. Statistical analyses of other wells sampled in previous events can be found in their respective sampling event reports (CDM Smith 2020a, 2020c, 2021c, 2022a).

The following sections present the updated PCE and TCE groundwater plume extent and statistical trend analysis-based incorporation of the latest data results.

4.1 Plume Extent

Groundwater sampling results collected from the spring semiannual and offsite 2023 monitoring events were used to update the current lateral extents of PCE and TCE groundwater plumes via data interpolation with modeling software Leapfrog Works, version 2.2.2. These updated isoconcentration contours are presented in **Figure 4-1** (PCE only, 5 µg/L) and **Figure 4-2** (TCE only, 5 and 100 µg/L) with July 2023 results.

As shown in **Figure 4-1**, PCE above 5 µg/L is present predominantly in the groundwater along the eastern boundary of Cell 1, throughout the remediation system area, and along the Fort Hall Mine canyon into the PVA, extending northwest from the base of the landfill. In May and June 2023, the highest offsite concentrations of PCE occurred in RW-2140H and RW-2237H and did not exceed the MCL.

As shown in **Figure 4-2,** the TCE plume has a similar footprint to PCE, except that it extends farther to the northwest along the Lower PVA towards the City (CDM Smith 2019b). The maximum TCE concentrations are observed at the base of Cell 1 in the vicinity of the remediation system (CDM Smith 2020b). The distal edge of the 5 µg/L isoconcentration contour is currently estimated to be between RW-2237H and RW-8030P. As with the PCE plume, there is little bounding data available in the offsite area between the remediation system and RW-2140H because of lack of access to the private properties located there and because of the steeply sloped hillside north of Cell 1, so the plume contour was estimated and manually adjusted. Consistent with previous sampling events, the highest offsite concentrations of TCE exceeded the MCL and occurred in the vicinity of RW-2172H and RW-2203H. RW-2237H had the highest concentration of TCE when sampled in May 2023 (CDM Smith 2023b). In June 2023, TCE was not detected in domestic supply wells downgradient of RW-8030P. Additionally, in City monitoring wells, TCE was detected at concentration below the MCL in several screened intervals.

The data used for isoconcentration interpolation include annual 2023 sampling results from domestic and City monitoring wells (presented in this report), and spring 2023 sampling results from Cells 1, 2, and 4 and offsite monitoring wells, presented under a separate cover (CDM Smith 2023a). Thus, approximately 120 locations onsite and offsite contribute to the contouring.

A description of the model development is provided in the Final QAPP (CDM Smith 2021b). The PCE and TCE plume contours were estimated by using a kriging algorithm to create a contour map of the most recent PCE and TCE concentration results for a given location available through 2023. A three-dimensional representation of TCE concentrations in groundwater is shown at the 5 µg/L and 100 µg/L isoconcentration levels. Nondetect results are entered as one-tenth of the reporting detection limit. Analytical data were log-transformed as part of the interpolation process. The interpolations are accurate at each data point but are estimated between data points. Groundwater interpolations have a dynamic surface resolution of 50 feet and horizontal-to-vertical anisotropy of 10:1. Model settings have been revised according to site conditions, and contours have been further revised manually in reported data figures. For instance, there is not extensive bounding data in the distal portions of the plume (i.e., near northernmost City municipal supply wells #14 and #33); the original interpolations were revised to adjust for this.

4.2 Statistical Analysis of PCE and TCE

For wells with adequate PCE and TCE data, a statistical analysis was conducted in accordance with EPA and IDEQ guidance (EPA 2009; IDEQ 2014) to evaluate concentration trends. These data are used to assess the overall plume trends. **Figures 4-1** and **4-2** present the offsite monitoring well trend summary for PCE and TCE, respectively. The following sections describe the statistical approach and results for each well group.

4.2.1 Statistical Approach

Groundwater data for PCE and TCE from City monitoring wells and domestic wells sampled in 2023 were analyzed for statistically significant concentration trends. Trends were statistically evaluated with Mann-Kendall and Theil-Sen tests to identify datasets with increasing, decreasing, stable trend, or no trend and their associated trendline slope.

Mann-Kendall analysis compares each data point to later data points in the same data set to develop a summation statistic, the S, based on all the individual data point comparisons (EPA 2009). The magnitude of S illustrates the variance of the data set, and the sign of S corresponds to the trend. The probability (p-value) is the test statistic used to determine whether the trend is statistically significant at the alpha level chosen. The confidence level associated with the trend result equals the value of the p-value subtracted from one, as a percentage. A statistically significant trend is considered to be present if the confidence level is greater than 95% for increasing and decreasing results, with a direction corresponding to the sign of S. Between 95 and 90% confidence, a trend is considered “probable”. No trend with a confidence level is considered statistically significant. The coefficient of variation (COV) is equal to the dataset standard deviation divided by its mean, and it is used to distinguish between data sets with no trend and a stable trend.

The statistical calculations are performed using the EnvStats R package (Millard 2013), which is consistent with EPA ProUCL v5.2 (EPA 2022), and Mann Kendall trend results are interpreted from the calculations according to the following approach, described in the Mann-Kendall Analysis Decision Matrix (Aziz et al. 2003) and used in the GSI Mann-Kendall Toolkit (Connor et al. 2012):

- Increasing (S greater than 0, CF greater than 95%)
- Probably increasing (S greater than 0, CF between or equal to 95%, and 90%)

- No trend (S greater than 0, CF less than 90%)
- Stable (if S is less than or equal to zero and coefficient of variation less than 1)
- Probably decreasing (S less than 0, CF between or equal to 95%, and 90%)
- Decreasing (S less than 0, CF greater than 95%)

Data sets were only evaluated with these statistical tests if the following conditions were met:

- The data set contained at least 6 data points and no more than 40.
- The data set contained less than 50% nondetect (MDL) results.

The time frame of analysis varies based on available data. In most cases, all available data are used in the analysis, often beginning in the early 1900s. Select wells are also statistically evaluated for shorter timeframes because of the greater density in available data in more relevant timeframes.

4.2.2 City Monitoring Wells

City monitoring wells were installed by the City for groundwater sampling (PA wells) or for groundwater extraction (MW-38 and MW-37). These wells are located in the Lower PVA downgradient of the FHML, beyond the Fort Hall Canyon. PA-1, PA-3, PA-4, and PA-8 are currently sampled annually. For wells with multiple screened intervals (i.e., PA-4 and PA-8), data were separated by sample depth, where known, for the time series plots and statistical analysis. Only the middle screen interval was sampled for PA-4 and PA-8.

The statistical summary for City monitoring wells is presented in **Table 4-1**. Statistically significant trends were exhibited as follows:

- PCE: Decreasing in PA-3 and PA-4 (middle interval).
- TCE: Decreasing in all sampled City wells—PA-1, PA-3, PA-4 (middle interval), and PA-8 (middle interval).

4.2.3 Domestic Wells

Domestic wells are potable supply and irrigation wells located on private properties located downgradient to the FHML. Over the last few decades, some of these domestic wells have been sampled at regular intervals.

The statistical summary for City monitoring wells is presented in **Table 4-2**. Statistically significant trends for all available data were exhibited as follows:

- Both PCE and TCE exhibited decreasing trends in RW-2140H, RW-2151H, RW-2172H, and RW-2203H. TCE also exhibited decreasing trends in RW-7549P and RW-7677P and a probably decreasing trend in RW-8012P.
- Both PCE and TCE exhibited no statistical trend with stable concentrations in RW-2237H.
- PCE exhibited no statistical trend with stable concentrations in RW-7677P and RW-8012P.

- All other evaluated data sets did not exhibit a statistically significant trend.

Truncated data sets (2017–2023) were evaluated for RW-2076F, RW-2140H, and RW-8030P. The following trends were observed:

- Neither PCE nor TCE exhibited a statistically significant trend in RW-2076F.
- PCE exhibited a decreasing trend in RW-2140H and RW-8030P.
- TCE exhibited a decreasing trend in RW-2140H and a probably decreasing trend in RW-8030P.

4.2.4 Offsite Bannock County Monitoring Wells

Offsite Bannock County monitoring wells are typically sampled during semiannual spring and fall monitoring events. Because some are on private property, the sampling sometimes occurs at more convenient times for property owners. In July 2023, MW-116S was sampled. All other offsite Bannock County monitoring wells were sampled in spring or fall 2023 and will be analyzed under respective reports.

The statistical summary for offsite Bannock County monitoring wells is presented in **Table 4-3**. Neither PCE nor TCE exhibited statistically significant trends when all available data were analyzed (i.e., 2000–2023 timeframe); however, TCE concentrations were statistically stable for the timeframe. Consistent with semiannual reports (CDM Smith 2023a, b, c), a truncated time frame was also analyzed for MW-116S (**Table 4-3**). From 2017–2023, PCE again exhibited no trend (stable), and TCE exhibited a decreasing trend.

Section 5

Screening-Level Risk Assessment

This section presents a SLRA based upon the analytical results obtained from offsite wells (monitoring and domestic) in April 2023 and July 2023. Wells sampled in July 2023 are presented in **Table 2-2**. Wells sampled in April 2023 are discussed under a separate cover (CDM Smith 2023b).

The SLRA includes the following receptors and exposure pathways:

- Human health risks due to use of groundwater as the sole source of household water.
- Human health risks due to potential vapor intrusion into residences located above contaminated groundwater.
- Human health risks due to use of groundwater as a source of domestic water for irrigation.
- Ecological risks due to ingestion of groundwater that may be used to provide drinking water for animals.

This SLRA is consistent with those conducted in 2019 through 2022 as reported in (CDM Smith 2020a, 2020c, 2021c, 2022a). The results of the 2019 through 2022 SLRA have been retained in several tables in this report for ease of comparison with the outcomes of the SLRA based upon the 2023 analytical results.

Sections 5.2 through **5.6** present the screening-level human health risk evaluation. **Section 5.7** presents the screening-level ecological risk evaluation. The purpose of the screening-level evaluations is to frame the analytical results for the samples collected during the 2023 offsite groundwater sampling event. If a baseline human health risk assessment (BHHRA) were to be conducted as more data are available for the Site, potential complete and significant pathways that could require quantitative evaluation may include, but are not limited to:

- Direct ingestion, vapor inhalation (i.e., shower steam), and dermal exposure to impacted groundwater by offsite residents and workers using a domestic well for their sole source of household water (i.e., they are not connected water services from the City Water Department).
- Direct ingestion, vapor inhalation (i.e., fine water mist created by sprayers), and dermal exposure to impacted groundwater by residents using a domestic well for irrigation water.
- Ingestion of crops watered by domestic wells used for irrigation.
- Direct contact exposure to crops and other plants that have been watered by domestic wells used for irrigation.
- Vapor intrusion into residences located above impacted groundwater, with subsequent inhalation of vapors by residents.

A quantitative BHHRA must consider seasonal variations in groundwater COC concentrations and incorporate a sufficient number of samples to support statistical analysis. For an individual well, a minimum of 8 to 10 samples would be needed. Collection of time series data for established COCs improves the confidence that variability around mean concentration values have been accurately estimated. Following collection of a sufficiently large data set, the data must be evaluated to assure a minimum level of data quality, compare data to background conditions, and confirm COCs. Based on the validated data, toxicity and exposure assessments will need to be performed to enable risk characterization.

Because sufficient time series data and data for all potentially contaminated media have not yet been collected, a BHHRA is beyond the scope of this report. Instead, a preliminary SLRA is presented, based on comparison of groundwater data collected in 2023 with EPA regional screening levels (RSLs) for tap water and vapor intrusion screening levels (VISLs) estimated from groundwater concentrations using the EPA VISL calculator.

Exceedances of RSLs indicate properties that may be at risk because of exposure to impacted groundwater that is the sole source of household water at these residences. Similarly, groundwater samples collected from City of Pocatello monitoring wells have been compared to RSLs. The potential health risks associated with impacted groundwater used for irrigation cannot be assessed at the screening level for human health exposure but has been included for ecological receptors (see **Section 5.7.2**). Screening-level risks have been generated for indoor air that may be subject to vapor intrusion at residences located above contaminated groundwater. Screening-level risks are discussed further in **Sections 5.3** and **5.4**.

The SLERA presented in **Section 5.8** is focused on the evaluation of the use of groundwater as a water source for ecological receptors. The SLERA does not evaluate all potentially complete exposure pathways because of lack of data for some media types and lack of data that are representative of the range of environmental conditions.

5.1 Current and Potential Future Uses of Groundwater

Figure 5-1 presents the current Drinking Water Source Inventory Area (DWSIA) and Bannock County parcel boundaries for properties in the Lower PVA. Most parcels are zoned as residential or commercial properties, except for a few at the southern boundary that are zoned agricultural. The FHML operates under a nonconforming use provision.

The Lower PVA is the sole source of drinking water for the Pocatello and Chubbuck communities, as well as surrounding unincorporated Bannock County land area. Domestic wells also supply water for agricultural purposes (gardening/crop irrigation). In **Figure 5-1**, parcels are color coded based on whether a City water supply connection is available or active. There are 340 parcels within the DWSIA, 52 of which have one or more wells installed on the property. Forty-four parcels contain one or more domestic or irrigation wells, and 28 of these 44 parcels are not connected to the municipal water supply.

Figure 5-2 presents the property parcel map for domestic wells in the vicinity of the current COC plume, including the property connection status. There are 10 parcels with domestic or irrigation wells that are fully or partially within the current modeled extent of the TCE groundwater plume, and all except 3 of these parcels are connected to City water. Wells on parcels not connected to municipal water supply that include a portion of the TCE plume include RW-7505P, RW-7549P, RW-7455P, and RW-7499P. The first two wells are sampled annually, and in 2023, COCs did not exceed the MCLs. The property owner for RW7455P and RW-7599P has denied sampling access to Bannock County.

5.2 HHRA Approach

The methods used to conduct this SLRA include:

- Data evaluation/hazard identification.
- Toxicity assessment.
- Exposure assessment.
- Risk characterization.
- Uncertainty analysis.

This approach is consistent with EPA's *Risk Assessment Guidance for Superfund (RAGS)* (EPA 1989), although it has been abbreviated for this screening-level evaluation.

5.2.1 HHRA Data Evaluation/Hazard Identification

Identification of chemicals of potential concern (COPCs) for this SLRA is based on: (1) detection of VOCs at concentrations above the laboratory's RL; and (2) detection of metals above the Federal Primary Drinking Water MCLs. The data set used for this evaluation consists of the samples collected in April and July 2023 from the offsite Bannock County and City monitoring wells and residential/domestic wells (26 locations total). TCE, PCE, and cis-1,2-DCE are the only VOCs that were detected in groundwater within the DWSIA (**Table 5-1**).

TCE was detected in 18 wells at concentrations ranging from 0.45 µg/L to 30 µg/L with measured concentrations from eight wells exceeding the groundwater standard. PCE was detected in eight wells at concentrations ranging from 0.47 µg/L to 5.2 µg/L, with the measured concentration in one well exceeding the groundwater standard. TCE and PCE were the only VOCs with exceedances of the groundwater standards (EPA MCL or IDGW primary standards) based on comparison of the MCL with the maximum observed concentration;[1] therefore, these analytes were retained as a COPC for further assessment.[2]

5.2.2 Toxicity Assessment

5.2.2.1 Overview

The objective of a toxicity assessment is to identify the types of adverse health effects that are caused by a particular chemical, and how the appearance of these adverse effects depends on exposure level. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure. The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the noncancer effects of the chemical, while the second addresses the cancer effects of the chemical. This two-part approach is employed because there are typically major differences in the time course of action and the shape of the dose-response curve for cancer and noncancer effects.

[1] The detection limit for 1,2-dibromo-3-chloropropane and 1,2-dibromoethane was greater than the MCL.

[2] Chemicals not detected in any sample collected were not retained as COPCs for further risk quantification.

5.2.2.2 Noncancer Effects

All chemicals can cause adverse health effects at a sufficient dose. However, when the dose is sufficiently low, typically no adverse effect is observed. Thus, in characterizing the noncancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be safe, while doses above the threshold are likely to cause an effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect, and the lowest dose that does produce an effect. These are referred to as the no-observed-adverse-effect level (NOAEL) and the lowest-observed-adverse-effect level (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, to be conservative (protective), noncancer risk evaluations are not based directly on the threshold exposure level but on a value referred to as the reference dose (RfD) for oral exposures (e.g., incidental ingestion of soil, ingestion of drinking water, ingestion of dietary items), with units of mg per kg body weight per day, or the reference concentration (RfC), with units of milligrams per cubic meter for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD and RfC values are derived from the NOAEL, LOAEL, or benchmark dose by dividing by an uncertainty factor (UF) that reflects the limitations of the data used. If the data are from studies in humans, and if the observations are considered to be very reliable, the UF may be as small as 1.0. However, the UF is normally at least 10, and can be much higher if the data are limited. UFs are assigned to account for uncertainty arising from extrapolation of animal data to humans, the use of a LOAEL instead of a NOAEL, the use of less than chronic exposure, and other limitations in the available data (e.g., lack of reproductive data).

The effect of dividing the NOAEL or the LOAEL by a UF is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects. Thus, there is always a “margin of safety” built into a RfD and RfC, and levels equal to or less than the RfD or RfC are nearly certain to be without any risk of adverse effect. Levels higher than the RfD or RfC may carry some risk, but because of the margin of safety, a level above the RfD or RfC does not mean that an effect will necessarily occur. The protectiveness of this margin of safety will vary from chemical to chemical, depending upon the quality of the data and the size of any applied UF. A chemical for which large UF has been applied will generally have a higher margin of safety than a chemical with a smaller UF.

5.2.2.3 Cancer Effects

For cancer effects, the toxicity assessment process has two components. The first is a qualitative evaluation of the weight of evidence (WOE) that the chemical does or does not cause cancer in humans. Previously, this evaluation was performed by EPA using the system summarized in **Exhibit 5-1**:

Exhibit 5-1 Toxicity Assessment – Cancer Effect

WOE Group	Meaning	Description
A	Known human carcinogen	Sufficient evidence of cancer in humans.
B1	Probable human carcinogen	Suggestive evidence of cancer incidence in humans.

WOE Group	Meaning	Description
B2	Probable human carcinogen	Sufficient evidence of cancer in animals, but lack of data or insufficient data in humans.
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals.
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans.
E	Not carcinogenic to humans	Strong evidence that it does not cause cancer in humans.

EPA has developed a revised classification system for characterizing the WOE for carcinogens (EPA 2005). However, this system has not yet been implemented for a number of chemicals, so the older classification scheme is retained for use in this assessment.

For chemicals that are classified in Group A, B1, B2, or C using EPA guidelines (EPA 1986), the second part of the toxicity assessment is to describe the carcinogenic potency of the chemical. This is done by quantifying how the number of cancers observed in exposed animals or humans increases as the dose increases. Typically, it is assumed that the dose-response curve for cancer has no threshold, arising from the origin and increasing linearly until high doses are reached. Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This is referred to as the slope factor (SF), which has dimensions of risk of cancer per unit dose.

Estimating the cancer SF is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses, frequently in the part of the dose-response curve that is no longer linear. Thus, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired (but unmeasurable) slope at low dose. To account for the uncertainty in this extrapolation process, EPA typically chooses to use the 95% upper confidence limit of the slope as the SF. This means there is a 95% probability that the true cancer potency is lower than the value chosen for the SF. This approach ensures that there is a margin of safety in cancer risk estimates.

For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 microgram per cubic meter in air.

5.2.3 Toxicity Values

Toxicity values (RfD, RfC, SF, and IUR values) established by EPA are listed in the Integrated Risk Information System (IRIS) (EPA 2023a). Other toxicity values are available as interim recommendations from EPA's Superfund Technical Assistance Center operated by the National Center for Environmental Assessment (NCEA). A toxicity value hierarchy was developed by EPA for use in site-specific risk assessments (EPA 2003). This hierarchy provides an order of preference of toxicity values, with Tier 1 being the preferred source of toxicity information, if available, then Tier 2, followed by Tier 3. The recommended hierarchy of toxicity values is:

- Tier 1 – EPA’s IRIS: IRIS assessments have undergone external peer review in accordance with EPA peer review guidance at the time of the assessment. IRIS health assessments contain EPA consensus toxicity values.

- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs): The Office of Research and Development/NCEA/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 – Other Toxicity Values: Tier 3 includes additional EPA and non-EPA sources of toxicity information, such as the California Environmental Protection Agency and Agency for Toxic Substances and Disease Registry. Priority should be given to sources of information that are the most current, are transparent and publicly available, and which have been peer-reviewed.

The EPA RSL tables include a summary of toxicity values derived from these sources using the tiered system described above. These tables are maintained by EPA and periodically updated (EPA 2023b). All toxicity values used in this assessment were taken from the most recent version of the RSL tables (November 2023).

5.2.4 Exposure Assessment

The exposure assessment describes how residents in the DWSIA could come in contact with chemicals in groundwater. The assessment addresses exposures that could result under existing conditions and from reasonably anticipated potential land uses in the future. The exposure assessment contributes to the SLRA by describing the following:

- Populations that might be exposed.
- Exposure pathways by which individuals could become exposed.
- Magnitude, frequency, and duration of potential exposures.

5.2.4.1 Site Conceptual Exposure Model

A human health site conceptual exposure model (SCEM) has been prepared for the FHML. The SCEM consists of the following components:

- A primary contamination source (FHML).
- Contamination release mechanisms (e.g., leaching from former Cell 1).
- Potential secondary contamination sources (e.g., contaminated soil).
- Contaminant transport mechanisms (e.g., infiltration to groundwater, groundwater to soil vapor partitioning, vapor intrusion, and accumulation in residential living spaces).
- Contaminated exposure media (e.g., groundwater, soil, soil gas, indoor air).
- Exposure routes (e.g., ingestion, direct dermal contact, and inhalation of COCs during domestic water use; inhalation of COCs from indoor air; ingestion of COCs from contaminated produce).
- Potentially exposed receptors (e.g., residents).

Figure 5-3 presents the SCEM. The SCEM illustrates how the exposure pathways create the potential for human health risk. The exposure pathways define how the contaminant source, impacted media, transport mechanisms, and exposure routes are linked together to make contaminants available for exposure by human receptors. In **Figure 5-3**, each potential exposure pathway is evaluated to determine if it is complete and whether it likely to be an important contributor to total exposures and risks. Boxes lacking a symbol under the "Human Health Receptors" heading in **Figure 5-3** indicate that the exposure pathway from source to receptor is incomplete. Boxes with closed circles indicate that the exposure pathway is potentially complete and may be an important contributor to total exposures. Boxes with an "X" indicate that the exposure pathway is potentially complete but deemed to be minor relative to the other pathways being evaluated.

Complete groundwater exposure pathways include the following:

- Ingestion – Potential use of groundwater for potable use presents risks of human health exposure to the contaminants through ingestion of drinking water and use in cooking.
- Inhalation – Potential use of groundwater for domestic purposes presents risks of human health exposure to VOCs through inhalation during activities such as bathing.
- Dermal absorption – Potential use of groundwater for domestic purposes presents risks of human health exposure to VOCs through skin contact during activities such as bathing.

Vapor intrusion is also a potential exposure pathway. Vapors from groundwater may enter a residence through preferential pathways (e.g., cracks in the foundation).

Additional exposures that may need to be considered in a BHHRA, but are not considered for quantitative evaluation in the SLRA include:

- Ingestion, inhalation, and dermal exposure to well water during irrigation activities is considered minor compared to exposures resulting from indoor use of water. The contribution of these pathways to total exposures could be evaluated in a BHHRA.
- Ingestion of fruits and vegetables irrigated with well water is considered a minor exposure pathway and has been evaluated qualitatively. Quantitative evaluation could be completed as part of a BHHRA.
- Dermal exposure, inhalation, and incidental ingestion of soils during digging or excavation activities are assumed to be minor because of the depth to groundwater.

5.2.4.2 Exposure Assessment

For every exposure pathway of potential concern, it is expected that there will be differences between different individuals in the level of exposure at a specific location because of differences in intake rates, body weights, exposure frequencies, and exposure durations. Thus, there is normally a wide range of average daily intakes between different members of an exposed population. Because of this, all daily intake calculations must specify what part of the range of doses is being estimated. Typically, attention is focused on intakes that are "average" or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range (e.g., the 95th percentile). These two exposure estimates are referred to as Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME), respectively.

Generic screening levels are based on default exposure parameters and factors that represent RME conditions for long-term/chronic exposures. The RME scenario includes, but is not limited to, the assumptions listed in **Table 5-2** for adult and child residents (EPA 2014a). This combination of conservative assumptions provides some assurance that the estimated risks presented under the RME scenario represent the high end of plausible exposure.

Based on the assumption of random exposure over an exposure area, risk from a chemical within an exposure area is related to the arithmetic mean concentration of that chemical averaged over the entire exposure area. For the SLRA, the exposure point concentration is represented by the 2023 sampling results.

5.3 Risk Characterization for Groundwater

The risk characterization was focused on noncancer hazards because noncancer hazards are the more sensitive endpoint compared to cancer risks for TCE. The potential for noncancer effects from a COPC was evaluated by comparing the results for sampling in 2023 for each well to the residential RSL for tap water. This ratio of site-related exposure to the noncancer risk level is called the hazard quotient (HQ). This total HQ, across chemicals, is referred to as the hazard index (HI). If the HI value is less than or equal to 1, noncancer hazards are not expected from any chemical, alone or in combination with others. If the screening level HI exceeds 1, it may be appropriate to perform a follow-on evaluation in which HQ values are added only across chemicals that affect the same target tissue or organ system (e.g., the liver). This is because chemicals that do not cause toxicity in the same tissues are not likely to cause additive effects. Because the COPCs evaluated in this SLRA do not act on the same target organs, HI values were not calculated. The HQ values represent the total exposure across the ingestion, inhalation, and dermal contact exposure pathways from the use of tap water. Note, these values do not consider potential vapor intrusion (VI) risk; potential VI risk is evaluated using VISL.

Table 5-3 presents the HQ values for groundwater exposures based on the 2019 through 2023 data set, with results from 2019 through 2022 retained for comparative purposes. In 2023, 9 of the 26 wells have TCE HQ values that exceed the threshold of 1. Wells with HQ values greater than 1 are shaded gray. All the wells noted had an HQ exceedance of 1 in prior years. In 2023, HQ values ranged from 2 to 11 based on TCE exposures, with HQ values following a decreasing trend over time for most wells. Four wells (MW-103S, RW-2237H, RW-7677P, and RW-8030P) show a higher TCE HQ in 2023 compared to 2022.[3] No wells in 2023 had PCE HQ values that exceed the threshold of 1.

5.4 Risk Characterization for Indoor Air

The EPA VISL calculator was used to calculate potential indoor air concentrations due to VI and the associated carcinogenic risk and noncancer health hazards based on groundwater concentrations for volatile COPCs. The subsurface target concentrations in the VISL calculator are based on the generic conceptual model for VI described in EPA's VI guidance (EPA 2015). This conceptual model assumes a groundwater or vadose zone source of volatile vapors that diffuse upward through unsaturated soils towards the surface and into buildings. In this model, the soil in the vadose zone is considered to be relatively homogeneous and isotropic, though horizontal layers of soil types can be accommodated. The receptors are assumed to be occupants in buildings with poured concrete foundations (e.g., basement or slab on grade foundations or crawlspaces with a liner or other vapor barrier).

[3] MW-103S does not have data for 2022, and the 2023 HQ was compared to the 2021 HQ.

As described in EPA's VI guidance, VI is a potential human exposure pathway for a specific building or collection of buildings when the following conditions are met:

- A subsurface source of vapor-forming chemicals is present (e.g., in the soil or in groundwater) underneath or near the building(s).
- Vapors form and have a route along which to migrate (be transported) toward the building(s).
- The building(s) is(are) susceptible to soil gas entry, which means openings exist for the vapors to enter the building and driving "forces" exist to draw the vapors from the subsurface through the openings into the building(s).
- One or more vapor-forming chemicals composing the subsurface vapor source(s) is(are) also present in the indoor environment.
- The building(s) is(are) occupied by one or more individuals when the vapor-forming chemical(s) is(are) present indoors.

If one (or more) of these conditions is currently absent and is reasonably expected to be absent in the future (e.g., vapor migration is significantly and persistently impeded by natural geologic, hydrologic, or biochemical [e.g., biodegradation] processes and conditions), the vapor intrusion pathway is referred to as "incomplete" (EPA 2015).

The underlying assumption for this generic model is that site-specific subsurface characteristics will reduce or attenuate vapor concentrations as vapors migrate upward from the source and that site-specific building characteristics will tend to further dilute the vapors as they mix with the air in the building (EPA 2014b). Depth to groundwater and the soil profile of the vadose zone are expected to reduce the upward migration of volatile organic vapors to potential receptors.

Therefore, calculated indoor air concentrations and associated risks are likely to be conservative. **Table 5-4** summarizes the predicted indoor air concentrations and associated risks calculated using EPA's VISL calculator. Calculations are based on the concentrations of TCE in groundwater samples from wells in 2023, a revised generic attenuation factor (0.0005), and an average groundwater temperature of 13.5 degrees Celsius. A lower attenuation factor was selected from the default because of the thickness of the vadose zone (approximately 80–90 feet from the water table to ground surface) and geologic logs that indicated significant intervals of low permeability silts and clays. The generic conceptual model for VI assumes a groundwater or vadose zone source of volatile vapors that diffuse upward through unsaturated soils toward the surface and into buildings (EPA 2014b). Not all of these properties have residential structures currently on them, but zoning allows for residential building in the future.

Because the PCE risk from groundwater exposure was determined to be negligible (no HQ values above 0.1), vapor intrusion risk calculations were first performed using the maximum groundwater concentration of 5.2 μg/L to determine if a well-by-well analysis was needed. The maximum VI PCE HQ from this evaluation was 0.025; therefore, a well-by-well evaluation was not performed. PCE risks because of VI were confirmed to be below a level of concern.

As seen in **Table 5-4,** in 2023 only MW-103S had a VI HQ value greater than 1. MW-103S is an offsite monitoring well and does not represent potential current residential exposure.

5.5 Risk Characterization for Fruits and Vegetables

Ingestion of fruits and vegetables that have been irrigated with impacted domestic well water may increase the risk of exposure to COCs. Risks were not quantitatively evaluated to assess potential risk because of the use of groundwater as an irrigation source for crops because VOCs are volatile and will dissipate and mix with the ambient air when applied to soil. When watering crops, especially through spray irrigation, the amount of VOCs in the water will be significantly lowered as it moves into the air. Therefore, only a small amount of VOCs is expected to be available to garden plants. Any VOCs that are remaining in the water can be taken up by plants; however, the plants will move the VOCs through their leaves into the air. Therefore, it is not anticipated that significant uptake of these chemicals would occur at levels that would be unsafe to those consuming vegetables grown with groundwater.

5.6 Total Human Health Risk

The total risk for a potential receptor was calculated by adding the groundwater HQ value with the VI HQ value to account for all exposure pathways evaluated in this SLRA. **Table 5-5** presents the total HQ values for TCE in 2023;[4] values are displayed to one significant digit. As seen, 10 of the 26 wells assessed in 2023 have HQ values that exceed the threshold of 1, with HQ values ranging from 2 to 10 for TCE, driven primarily by groundwater exposure (ingestion and inhalation while using groundwater). None of these wells are being used for domestic purposes at this time. Risk conclusions are, therefore, considered hypothetical, should groundwater be used from these wells for domestic purposes in the future.

5.7 Uncertainty Analysis

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for noncancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment.

Based on this preliminary SLRA, it appears TCE would be retained as a primary COPC in groundwater for a BHHRA because of groundwater ingestion if this pathway is complete for a location. However, groundwater is used as a drinking water source for a limited number of locations (**Section 5.1**), and all properties with groundwater TCE HQs greater than 1 are connected to City water supply, excluding the property containing MW-103S, which is not connected to City water but has the availability for a City connection. Similarly, based on historical groundwater concentrations, HQ values for TCE and possibly PCE were slightly greater than 1 with HQ values of 2 based on VI exposure. However, more recent sampling conducted in 2021, 2022, and 2023 indicates all VI HQs are less than or equal to 1, with the exception of MW-103S. The following sections describe the uncertainties associated with the estimated HQ values. AS discussed in **Section 5.4**, MW-103S is an offsite monitoring well and does not represent potential current residential exposure.

[4] PCE HQs for groundwater and VI were well below the level of concern for the maximum concentration detected in groundwater (5.2 µg/L). Therefore, PCE HQs are not presented in **Table 5-5**.

5.7.1 Exposure Assessment

Use of site-specific exposure assumptions and factors could result in reduced risks for constituents or their elimination from the list of COPCs. Potential risk associated with exposure to VOCs through VI was calculated using generic conceptual model assumptions and default exposure parameters, with the noted exceptions detailed in **Section 5.4**. EPA cautions that the calculated VISLs may be inappropriate where:

- Contaminant sources originate in landfills, where methane is generated in sufficient quantities to induce advective transport in the vadose zone.
- Vapor-forming chemicals can be released within an enclosed space and the density of the chemicals' vapor may result in significant advective transport of the vapors downward through cracks and openings in floors and into the vadose zone.
- Leaking vapors originate from pressurized gas transmission lines.

In addition, residential building construction and the presence of preferred vapor migration pathways can greatly affect the vapor intrusion process and resulting indoor air quality and must be thoroughly understood. The depth to groundwater and vadose soil characteristics may greatly reduce the actual risks and health hazards associated with VI.

5.7.2 Risk Characterization

It is important to note that no bright-line rule is established at an HQ of 1, and risk management decisions are made on a site-by-site basis. An HQ of 1 or less indicates that the receptor's exposure is equal to or less than an "allowable" exposure level, and adverse health effects are considered unlikely to occur. When the cumulative HQ is less than or equal to 1, a conclusion of "no significant risk of harm to human health" based on noncancer effects is appropriate. Chronic intakes that are greater than the RfC (i.e., an HQ greater than 1) indicate a possibility for adverse effects, at least in sensitive populations, and therefore may require further evaluation. However, whether such exposure actually produces adverse effects will (depending on the chemical) be a function of many factors, such as the accuracy of uncertainty factors applied to the NOAEL, the appropriateness of animal data used in models and extrapolated to humans, and the potential for the chemical to cause effects in organs or systems (e.g., reproductive and immune systems) that have not been adequately studied. It is generally accepted that the protective assumptions made by EPA in deriving RfCs will, in most cases, mean that exposures slightly in excess of the RfC will be associated with a low risk for adverse effects, with the probability of adverse effects increasing with increasing exposure. For TCE, uncertainty factors for studies included in the derivation of the RfC ranged from 10 to 1,000.

5.7.3 Pathways Not Evaluated Quantitatively

Contact with contaminated soil and ingestion of fruits and vegetables that have been irrigated with impacted domestic well water may increase the risk of exposure to COCs. This pathway was not evaluated in the SLRA because of lack of measured plant tissue data to adequately evaluate this pathway. Literature-based uptake equations may be identified as part of a BHHRA to quantitatively evaluate this exposure pathway. Lastly, it is expected that VOCs will volatilize and not be taken up into produce tissue, making this a potentially minor exposure pathway.

5.7.4 Conclusions

Risk assessment guidance (EPA 1989) stresses the importance of considering uncertainties in interpreting and applying the results of any risk assessment. Because of the uncertainties, this risk assessment should not be construed as presenting absolute risks or hazards. Rather, it is a health protective analysis intended to indicate the potential for adverse impacts to occur. Assumptions are made based on EPA's risk assessment guidance and relevant scientific literature. This risk assessment focuses on RME risks, which is the reasonable maximum exposure expected to occur. RME risks are used to determine whether unacceptable risks are present and to support risk management decisions. The overall risk to public health using RME is an upper-bound probability of adverse health effects; impacts are likely to be lower. It is also important to note that VI HQ estimates are based on conservative exposure assumptions (vapor intrusion modeling assumptions, depth to groundwater, thickness of the vadose zone, etc.).

One method for refining the exposure estimates would be to sample soil gas at a limited number of properties to refine exposure estimates and address potential uncertainties introduced by estimating indoor air levels from groundwater. If it is determined that completion of a BHHRA is necessary, collection and inclusion of soil gas data would aid in addressing these uncertainties and refine the estimation of risk for individual properties in the DWSIA.

5.8 Ecological Risk Evaluation

For the SLERA, risks were evaluated for ecological species that may be adversely impacted because of groundwater being used as a drinking water source and application of groundwater to plants. Risks were evaluated for terrestrial receptors only; aquatic and semiaquatic receptors were not evaluated because the habitat is not intentionally supportive of these receptors and exposure pathways for groundwater are not complete. **Figure 5-3** presents the complete exposure pathways for ecological receptors. The sections below present the ecological risk evaluation for complete exposure pathways.

5.8.1 Terrestrial Plant Exposures and Risks

Potential risks due to the use of groundwater as an irrigation source for crops were not evaluated because VOCs will dissipate and mix with the ambient air when applied to soil, and toxicity data are lacking to perform a quantitative evaluation. When watering crops, especially through spray irrigation, the amount of VOCs in the water will be significantly lowered as it moves into the air. Therefore, very little VOCs are expected to be available to garden plants. Any VOCs that are remaining in the water can be taken up by plants; however, the plants will move the VOCs through their leaves into the air. This volatilization is the partitioning of contaminants into the air spaces within a plant and subsequent diffusion into the ambient air, under the assumption that ambient air is less contaminated. For VOCs, volatilization from the plant, or phytovolatilization, can represent a major loss mechanism (Limmer and Burken 2016). Therefore, it is not anticipated that significant uptake of these chemicals would occur at levels that would be unsafe to those consuming vegetables grown with groundwater used for irrigation.

5.8.2 Terrestrial Bird/Mammal Exposures and Risks

Because agricultural-specific screening values are not available for the types of receptors that may be present, wildlife receptor-specific screening values have been used as surrogates as provided in Los Alamos National Laboratory (LANL) ECORISK Database (Release 4.3, 2022). The LANL ECORISK Database provides screening levels that are protective of birds and mammals in various functional feeding guilds (carnivores, herbivores, insectivores) for a variety of chemicals, including metals and VOCs. The screening levels are media- and receptor-specific values that may be used to screen environmental data. The LANL screening-level derivation process is similar to the procedures used to develop EPA's Ecological Soil Screening Levels (EcoSSL). The LANL ECORISK Database provides detailed documentation for the type of data collected and used to derive the screening levels, including the selected NOAEL and LOAEL toxicity reference values, dietary uptake factors, transfer factors, and exposure parameters. For chemicals where an EcoSSL has been derived, the NOAEL-based soil ecological screening levels are set equal to the EcoSSL values.

Table 5-6 presents a COPC selection for ecological receptors, considering data collected in 2023. The screening values selected for use in the COPC selection are based on the minimum NOAEL value available across all receptor groups provided in the LANL's ECORISK Database. As seen, comparison of the maximum concentration to the screening value for each chemical resulted in no COPCs being identified for ecological receptors. This is consistent with all the results from 2019 through 2022. Based on these findings, the use of groundwater as a drinking water source is unlikely to pose a risk to agricultural receptors when considering the magnitude of the difference between the most conservative screening values and the maximum concentration.

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Section 6

Conclusions and Recommendations

6.1 Results of Offsite and Domestic Well Monitoring

The following conclusions are based on the 2023 offsite monitoring event sampling results (**Tables 3-1** and **3-2**, **Appendix C**), statistical analysis (**Table 4-1**), and COC time series plots (**Appendix F**):

- City Monitoring Wells: None of the samples collected from the City monitoring wells exceeded groundwater criteria. TCE was detected in PA-1, PA-3, and PA-4. PCE was not detected in any of the City wells sampled. Statistically evaluated PCE and TCE data sets exhibited decreasing concentration trends. However, this analysis is limited by the fact that there is no available data for these wells between 2002 and 2017.

- Domestic Supply Wells: TCE exceeded the EPA MCL and IDGW primary standard in RW-2140H, RW-2172H, RW-2203H, RW-2237H, and RW-7677P. PCE did not exceed the MCL or IDGW primary standard in any domestic well. TCE was detected below standards in other domestic wells. The reductive daughter product cis-1,2-DCE was detected at low concentrations in RW-2140H, RW-2172H, RW-2203H, RW-2237H, and RW-7677P. Statistically evaluated PCE and TCE data sets exhibited decreasing trends or no significant trend.

- Bannock County Monitoring Wells: As reported under a separate cover (CDM Smith 2023b), PCE and TCE exceedances above the MCL persist in Cell 1 monitoring wells to the west, east, and downgradient of the remediation system. MW -116S is the only offsite monitoring well presented in this report, and TCE exceeded the EPA MCL and IDGW primary standard. For all available data, neither PCE nor TCE exhibited a statistically significant trend. For the truncated time frame (2017–2023), TCE exhibited a decreasing trend.

Collectively, the offsite trend data suggest that the extent of the COC plume and many areas within the plume have decreased in concentration since contamination was first discovered in 1992; thus, the plume appears to be retracting. This is likely the result of reduced COC discharge to the Lower PVA because of the FHML Cell 1 remediation system operation. Areas with decreasing trends are likely more directly downgradient of areas of the plume where containment has been more effective. However, locations with no significant trends suggest incomplete containment of the COC plume and that the COCs from FHML continue to discharge to the Lower PVA.

6.2 Screening-Level Risk Assessment

A screening-level evaluation of human and ecological risks was conducted using data collected in 2023. Human exposures, cancer risks, and noncancer health hazards associated with groundwater used as domestic tap water as well as VI were evaluated. Risk interpretation was focused on noncancer endpoints, as these are more sensitive than cancer endpoints. Ecological risk was evaluated through agricultural receptors and application of groundwater to plants for groundwater that may be used for drinking water.

For human exposure, residents were evaluated as potential receptors. For groundwater exposure pathways, HQ values exceeded the threshold of 1 for 9 of 26 wells evaluated, with HQ values ranging from 2 to 11 for TCE. For VI, all TCE HQ values were less than 1, excluding MW-103S with a TCE VI HQ of 2.

The total risk for a potential receptor was calculated by summing the groundwater HQ value with the VI HQ value to account for all exposure pathways evaluated in this SLRA. **Table 5-5** presents the total HQ values for TCE. Ten of the 26 wells have HQ values that exceed the threshold of 1, with HQ values ranging from 2 to 10 for TCE. However, none of these wells are being used for domestic purposes currently. Risk conclusions are, therefore, considered hypothetical, should groundwater be used from these wells for domestic purposes in the future.

To evaluate ecological risk, screening values were selected for COPCs based on the minimum NOAEL value available across all receptor groups provided in the ECORISK Database. Comparison of the maximum concentration to the screening value for each chemical resulted in no COPCs being identified for ecological receptors. Based on these findings, the use of groundwater as a drinking water source is unlikely to pose a risk to agricultural receptors when considering the magnitude of the difference between the most conservative screening values and the maximum concentration.

6.3 Recommendations for 2024 City and Domestic Well Monitoring

The results of the 2023 offsite groundwater monitoring activities were used to develop recommendations for additional activities to continue to evaluate the impacts of the VOC plume migrating from the FHML to the PVA and assess risk to human health and the environment.

6.3.1 2024 City and Domestic Well Sampling and Analysis

- Conduct a 2024 offsite groundwater monitoring event as detailed in **Table 6-1**, to include the sampling and analysis of field parameters and VOCs for the following (at a minimum):
    - Domestic supply wells located within the TCE plume extent as defined on **Figure 4-2**.
    - Any domestic well with a TCE exceedance of the standard within the last five years.
    - A subset of the domestic wells along the boundaries of the VOC plume in which VOCs have either not been detected previously or have been rarely detected to confirm the plume has not expanded.
    - Any additional domestic wells identified within the potential area of impact that have not been sampled previously to establish lateral and vertical offsite plume extent and assess any potential risk to human health or the environment.
    - Select City monitoring wells to bound the plume in the PVA.

- As more data becomes available, statistically evaluate more recent time frames for the Mann-Kendall trend analysis (i.e., recent time frames include six or more data points with more than 50% detected results).
- Based on the results of the side-by-side passive treatment study comparison, City monitoring wells (i.e., PA-1, PA-3, PA-4, and PA-8) will likely be recommended to change to passive sampling methods, starting with the 2024 sampling even (CDM Smith 2023c). Additionally, because the pump or other equipment within RW-2203H appears to be degrading, it is recommended to sample this well via passive sampling methods henceforth.

6.3.2 Evaluate Risk

- Assess the risks to human health and the environment based on past, present, and future groundwater COPC concentrations, refining the calculated risks based upon site-specific factors.
- Five properties were identified to have VI-based HQs for TCE approaching or equal to 1 in 2023 (**Table 5-4**): MW-103S, MW-116S, RW-2140H, RW-2172H, and RW-2237H. Therefore, the following is proposed:
    - Continue to collect groundwater samples from these locations.
    - If groundwater concentrations in future sampling efforts are elevated relative to the groundwater concentrations used in this risk evaluation, soil gas sampling could be beneficial in evaluating indoor air risks as soil gas data would allow for evaluation of a stronger line of evidence to determine potential VI risk.
- Determine if a BHHRA is necessary, based on results of future groundwater monitoring, and develop a time line for incorporating all pertinent data collected after completion of additional groundwater monitoring if it is determined to be required.
- Continue to verify that domestic wells in use for drinking water continue to remain below EPA MCL and IDGW primary drinking water standards.

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Section 7

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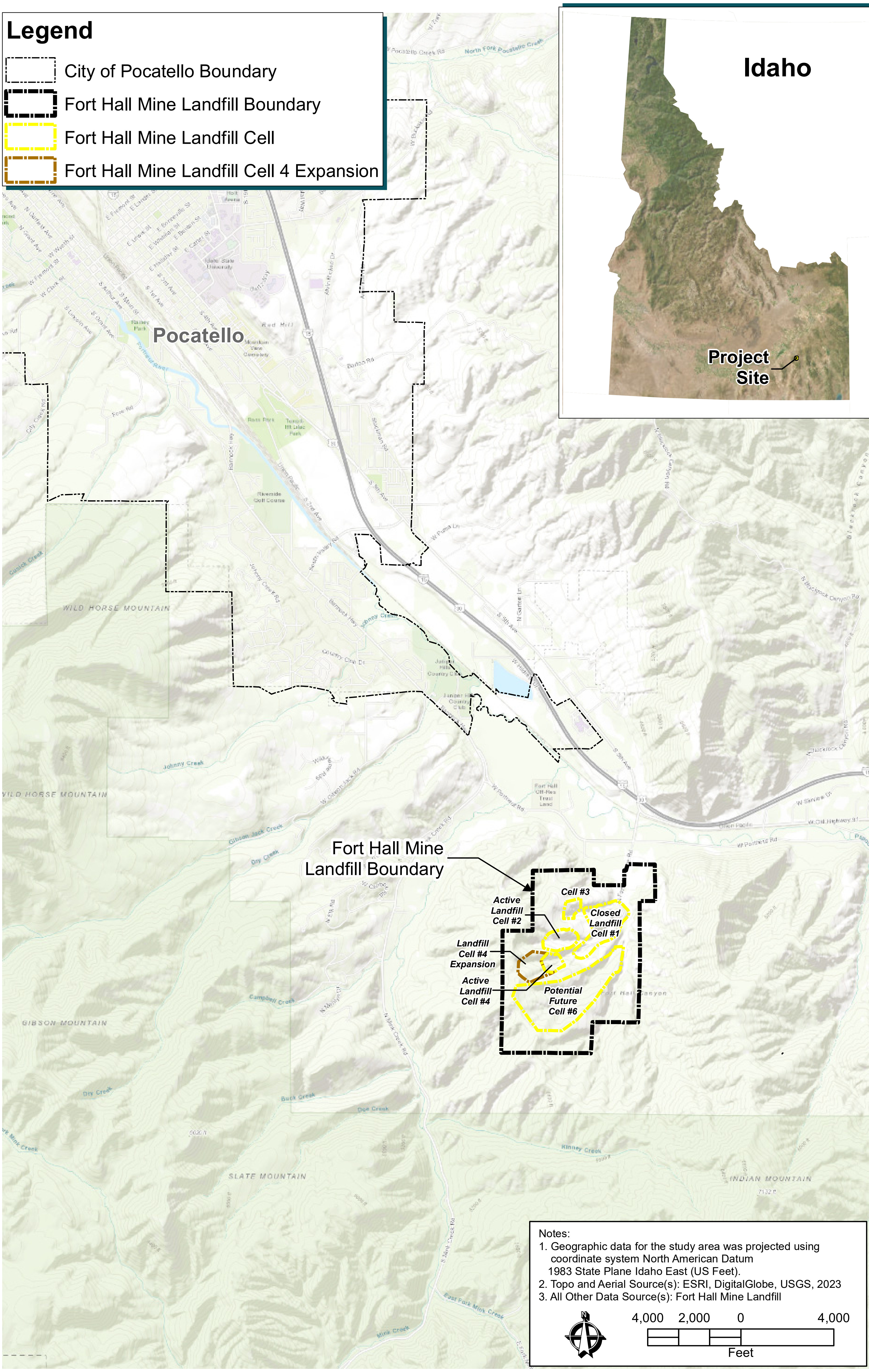
FIGURES



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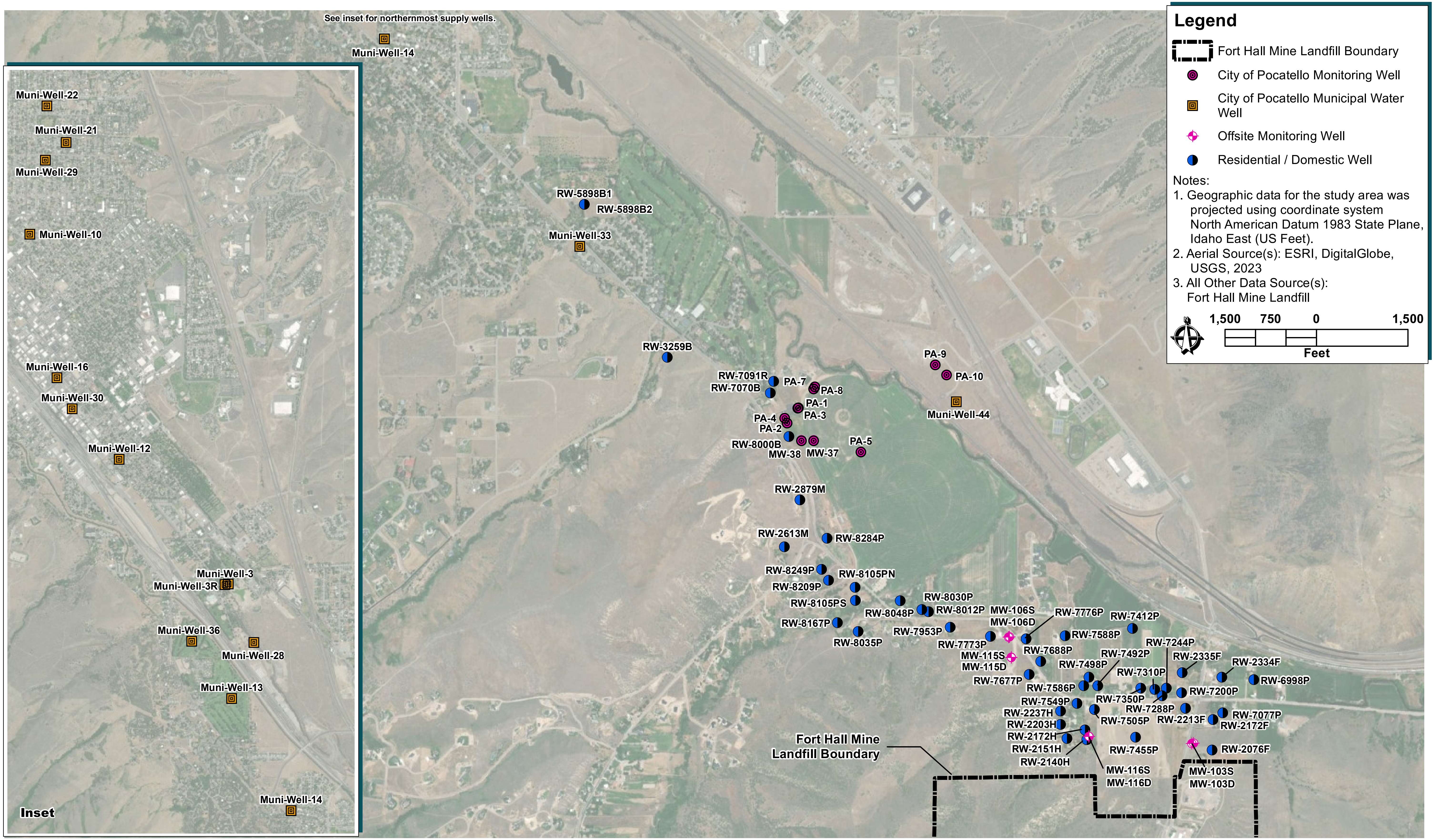
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 1-1
Site Location Map



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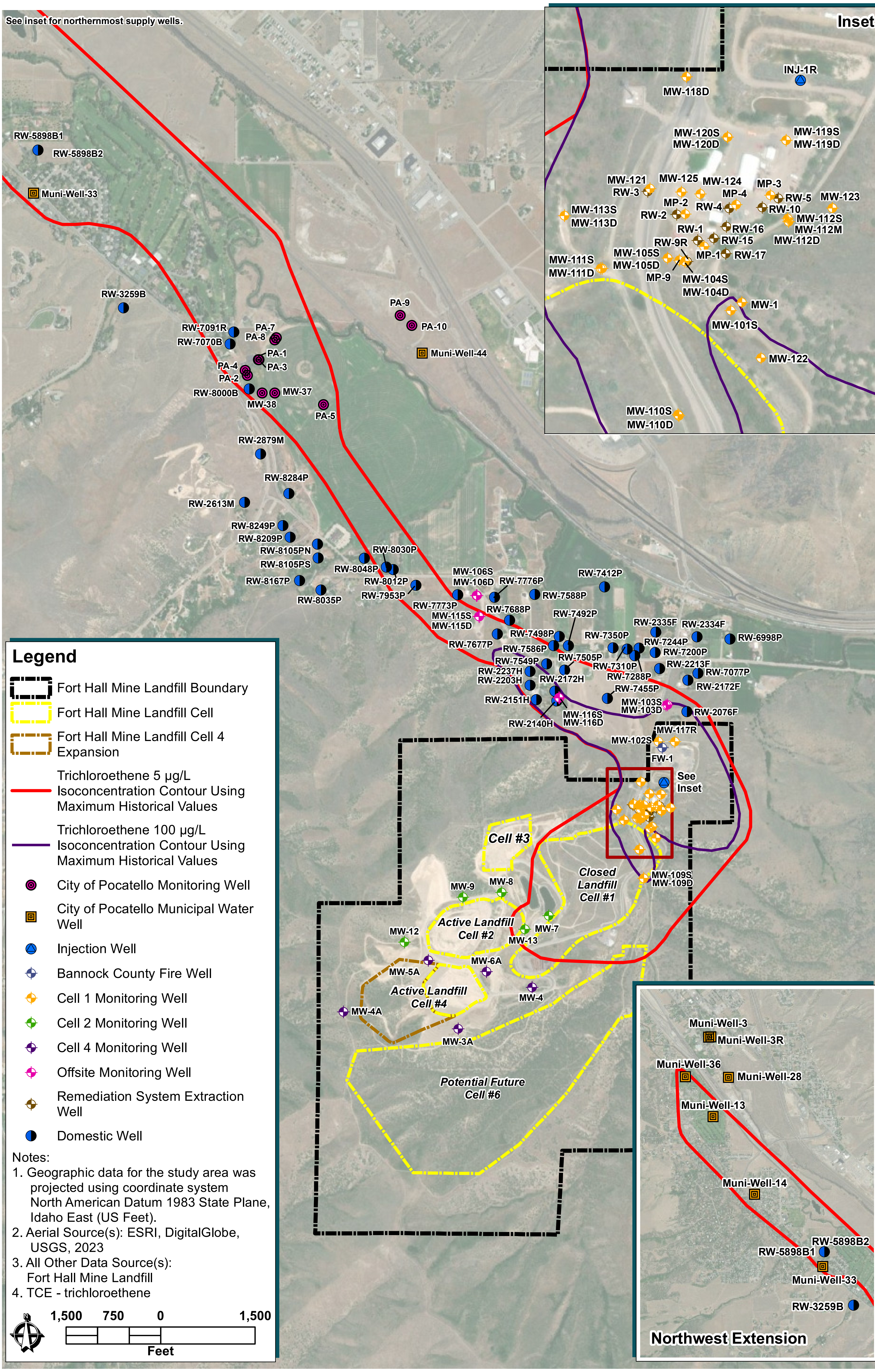
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 1-2
Offsite City and Domestic Groundwater Wells



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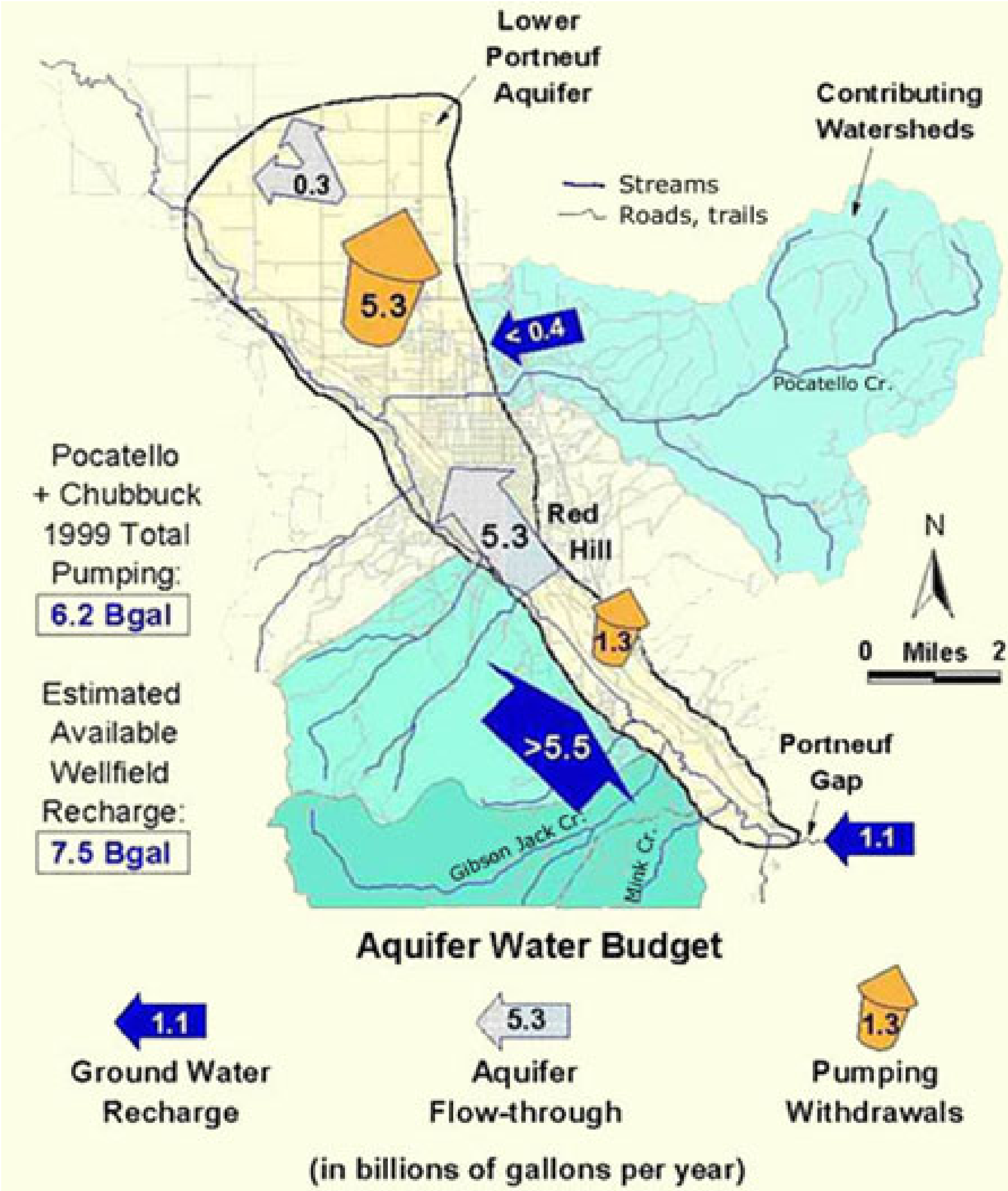
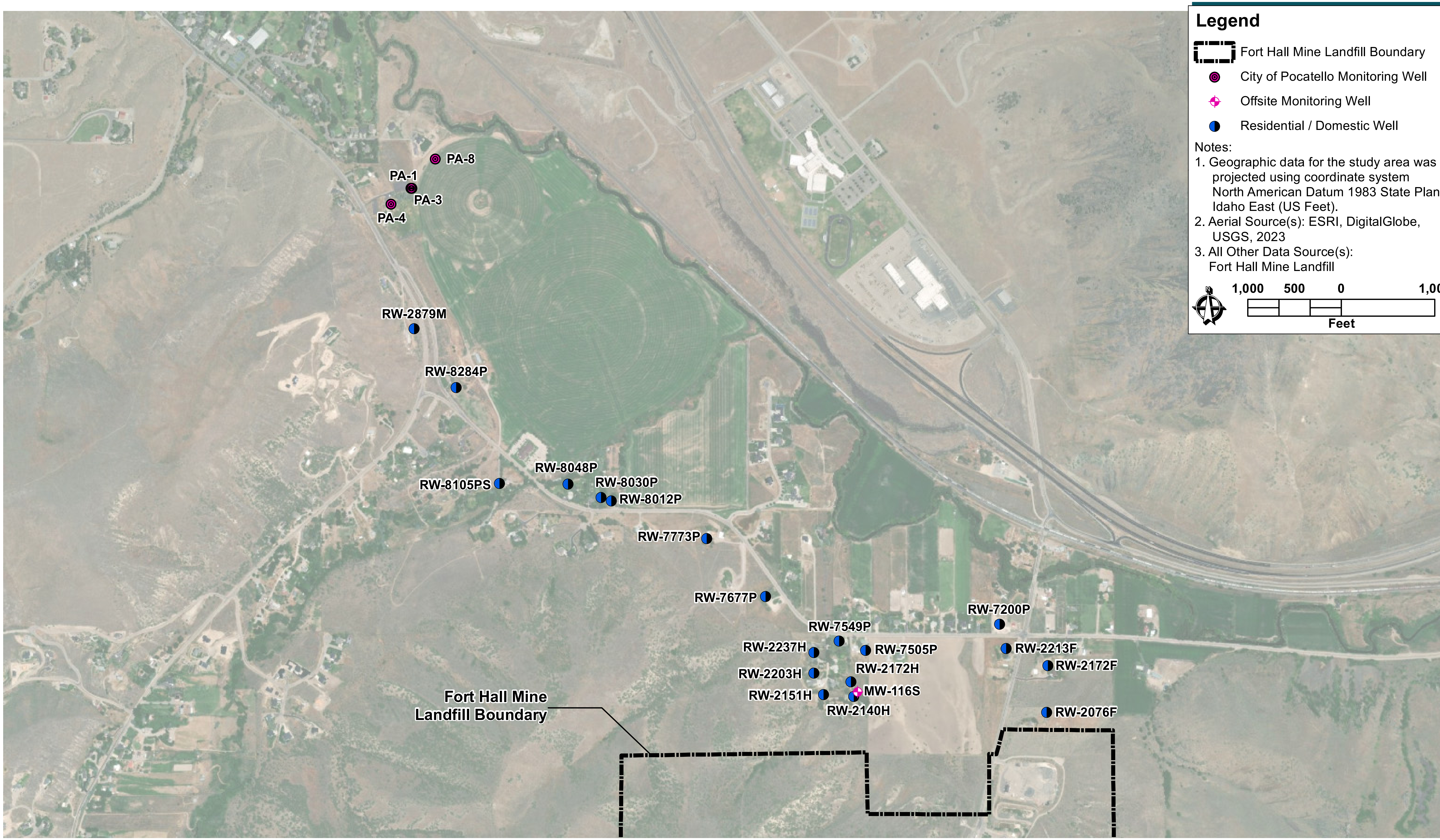
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 1-3
Historical Maximum TCE Plume



Source: C.W. Meehan. 2005. Geochemistry of the Southern Pocatello Aquifer and its Implications for Aquifer Recharge and Contamination Potential. Master of Science Thesis, Idaho State University.

Figure 1-4
Lower Portneuf Valley
Aquifer Water Budget



Legend

- Fort Hall Mine Landfill Boundary
- City of Pocatello Monitoring Well
- Offsite Monitoring Well
- Residential / Domestic Well

Notes:
1. Geographic data for the study area was projected using coordinate system North American Datum 1983 State Plane, Idaho East (US Feet).
2. Aerial Source(s): ESRI, DigitalGlobe, USGS, 2023
3. All Other Data Source(s): Fort Hall Mine Landfill

1,000 500 0 1,000
Feet

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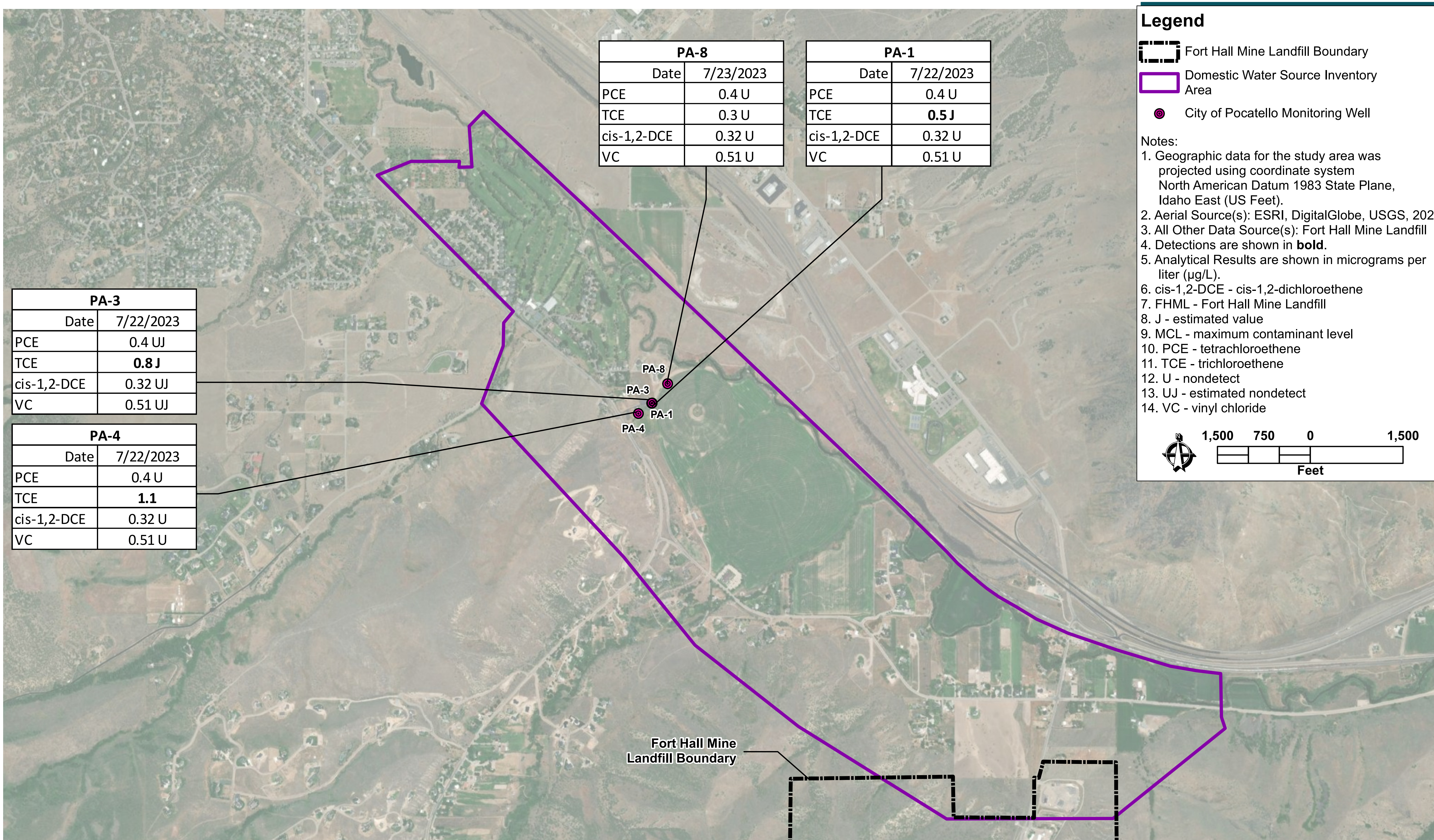
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 2-1
Offsite City, Domestic, and Monitoring Wells
Sampled in July 2023



PA-8	
Date	7/23/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

PA-1	
Date	7/22/2023
PCE	0.4 U
TCE	**0.5 J**
cis-1,2-DCE	0.32 U
VC	0.51 U

PA-3	
Date	7/22/2023
PCE	0.4 UJ
TCE	**0.8 J**
cis-1,2-DCE	0.32 UJ
VC	0.51 UJ

PA-4	
Date	7/22/2023
PCE	0.4 U
TCE	**1.1**
cis-1,2-DCE	0.32 U
VC	0.51 U

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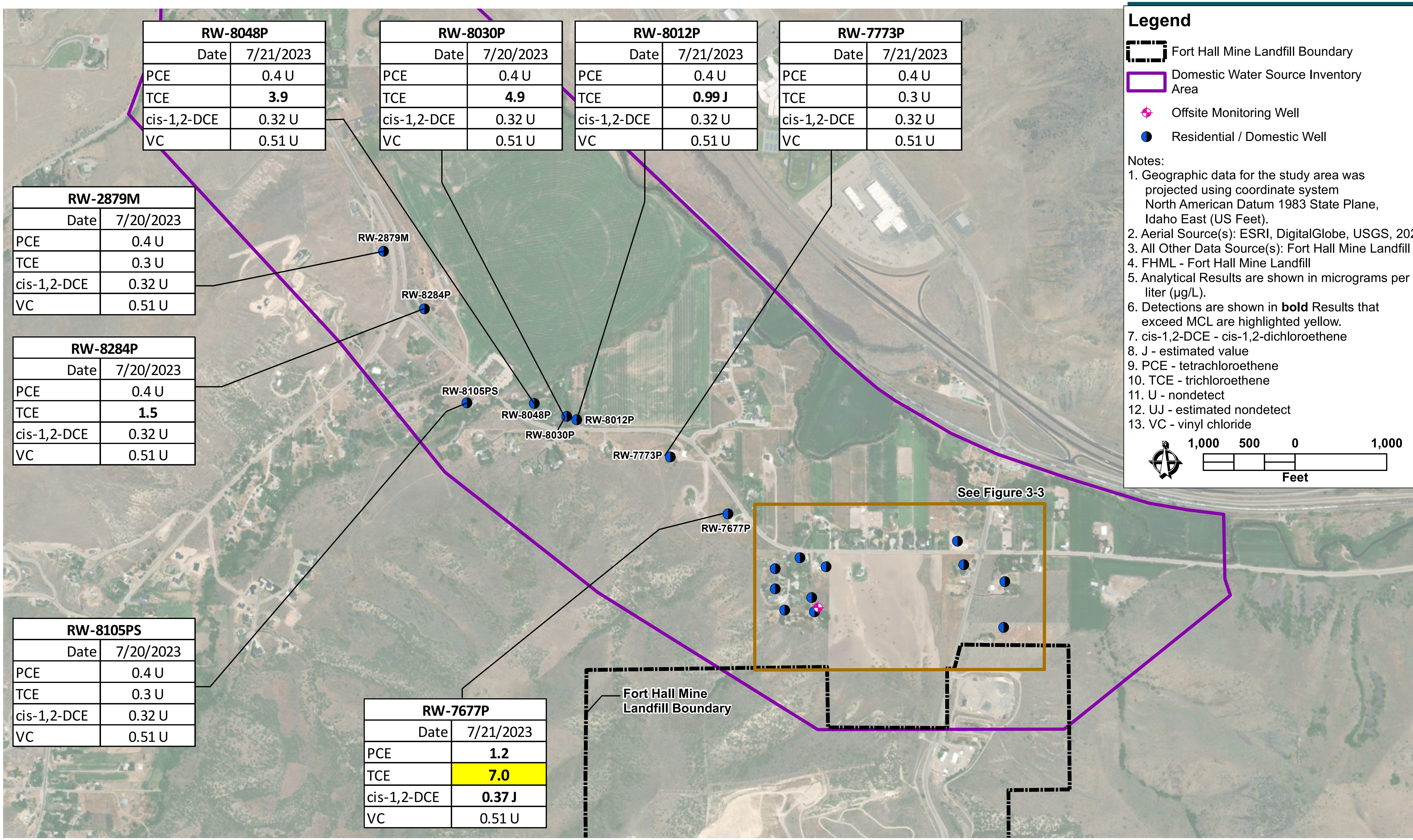
Figure 3-1
2023 Chlorinated Ethene Results
for City Monitoring Wells



RW-8048P	
Date	7/21/2023
PCE	0.4 U
TCE	**3.9**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-8030P	
Date	7/20/2023
PCE	0.4 U
TCE	**4.9**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-8012P	
Date	7/21/2023
PCE	0.4 U
TCE	**0.99 J**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-7773P	
Date	7/21/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-2879M	
Date	7/20/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-8284P	
Date	7/20/2023
PCE	0.4 U
TCE	**1.5**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-8105PS	
Date	7/20/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-7677P	
Date	7/21/2023
PCE	**1.2**
TCE	**7.0**
cis-1,2-DCE	**0.37 J**
VC	0.51 U

Legend

- Fort Hall Mine Landfill Boundary
- Domestic Water Source Inventory Area
- Offsite Monitoring Well
- Residential / Domestic Well

Notes:
1. Geographic data for the study area was projected using coordinate system North American Datum 1983 State Plane, Idaho East (US Feet).
2. Aerial Source(s): ESRI, DigitalGlobe, USGS, 2023
3. All Other Data Source(s): Fort Hall Mine Landfill
4. FHML - Fort Hall Mine Landfill
5. Analytical Results are shown in micrograms per liter (µg/L).
6. Detections are shown in **bold** Results that exceed MCL are highlighted yellow.
7. cis-1,2-DCE - cis-1,2-dichloroethene
8. J - estimated value
9. PCE - tetrachloroethene
10. TCE - trichloroethene
11. U - nondetect
12. UJ - estimated nondetect
13. VC - vinyl chloride

1,000 500 0 1,000
Feet

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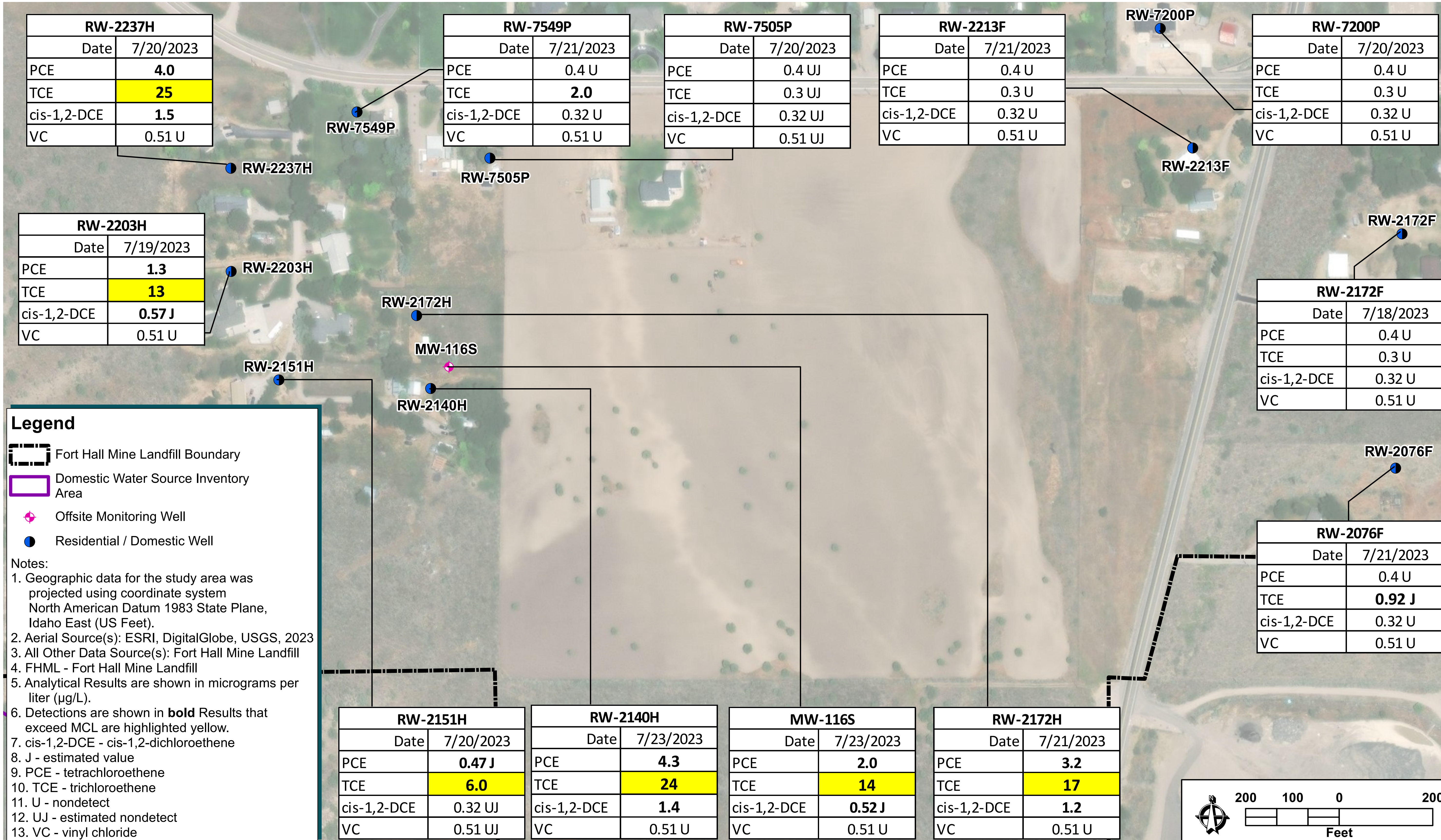
Figure 3-2
2023 Chlorinated Ethene Results for Domestic Wells North



RW-2237H	
Date	7/20/2023
PCE	**4.0**
TCE	**25**
cis-1,2-DCE	**1.5**
VC	0.51 U

RW-7549P	
Date	7/21/2023
PCE	0.4 U
TCE	**2.0**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-7505P	
Date	7/20/2023
PCE	0.4 UJ
TCE	0.3 UJ
cis-1,2-DCE	0.32 UJ
VC	0.51 UJ

RW-2213F	
Date	7/21/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-7200P	
Date	7/20/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-2203H	
Date	7/19/2023
PCE	**1.3**
TCE	**13**
cis-1,2-DCE	**0.57 J**
VC	0.51 U

RW-2172F	
Date	7/18/2023
PCE	0.4 U
TCE	0.3 U
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-2076F	
Date	7/21/2023
PCE	0.4 U
TCE	**0.92 J**
cis-1,2-DCE	0.32 U
VC	0.51 U

RW-2151H	
Date	7/20/2023
PCE	**0.47 J**
TCE	**6.0**
cis-1,2-DCE	0.32 UJ
VC	0.51 UJ

RW-2140H	
Date	7/23/2023
PCE	**4.3**
TCE	**24**
cis-1,2-DCE	**1.4**
VC	0.51 U

MW-116S	
Date	7/23/2023
PCE	**2.0**
TCE	**14**
cis-1,2-DCE	**0.52 J**
VC	0.51 U

RW-2172H	
Date	7/21/2023
PCE	**3.2**
TCE	**17**
cis-1,2-DCE	**1.2**
VC	0.51 U

Legend

- Fort Hall Mine Landfill Boundary
- Domestic Water Source Inventory Area
- Offsite Monitoring Well
- Residential / Domestic Well

Notes:
1. Geographic data for the study area was projected using coordinate system North American Datum 1983 State Plane, Idaho East (US Feet).
2. Aerial Source(s): ESRI, DigitalGlobe, USGS, 2023
3. All Other Data Source(s): Fort Hall Mine Landfill
4. FHML - Fort Hall Mine Landfill
5. Analytical Results are shown in micrograms per liter (µg/L).
6. Detections are shown in **bold** Results that exceed MCL are highlighted yellow.
7. cis-1,2-DCE - cis-1,2-dichloroethene
8. J - estimated value
9. PCE - tetrachloroethene
10. TCE - trichloroethene
11. U - nondetect
12. UJ - estimated nondetect
13. VC - vinyl chloride

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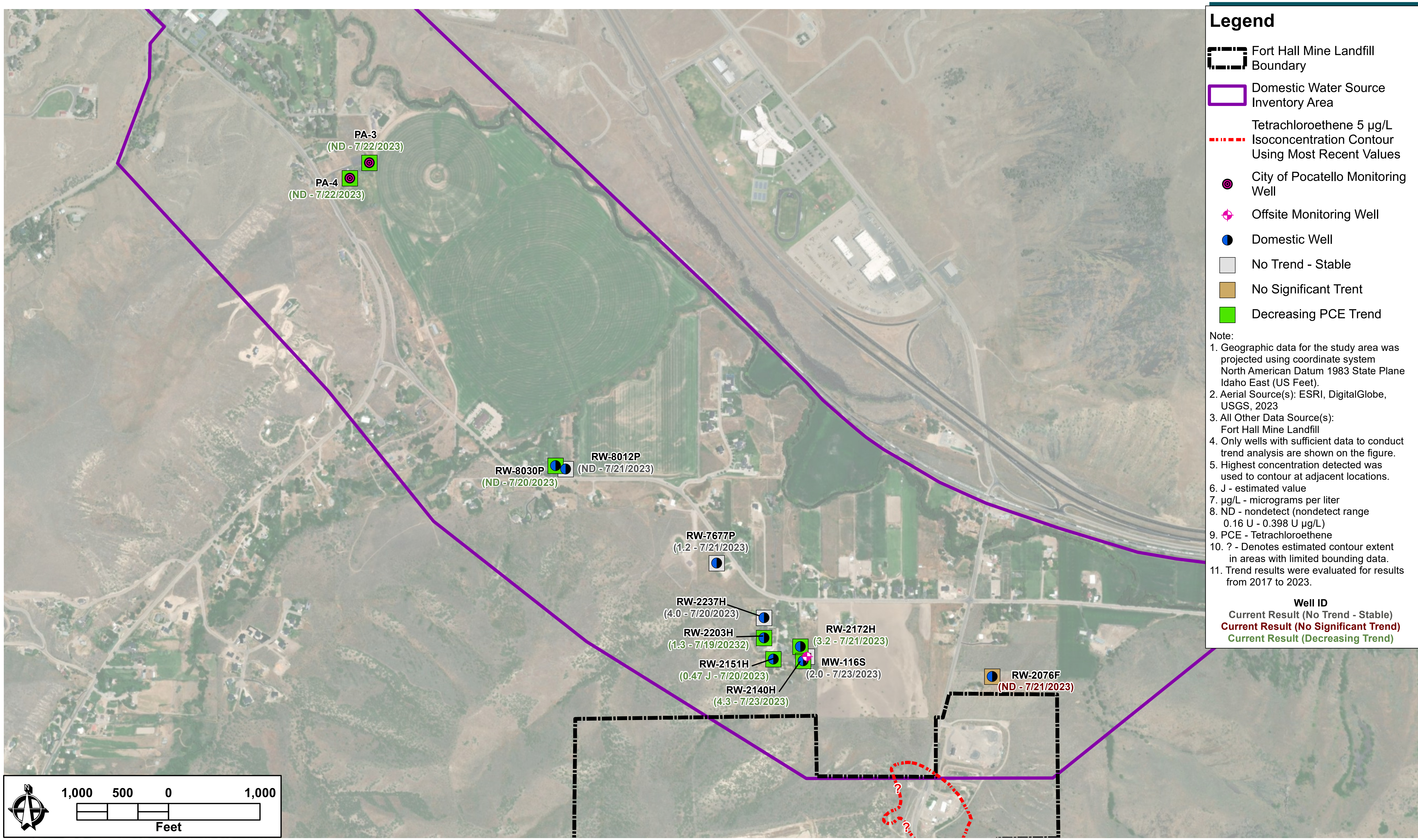
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 3-3
2023 Chlorinated Ethene Results for Domestic Wells South



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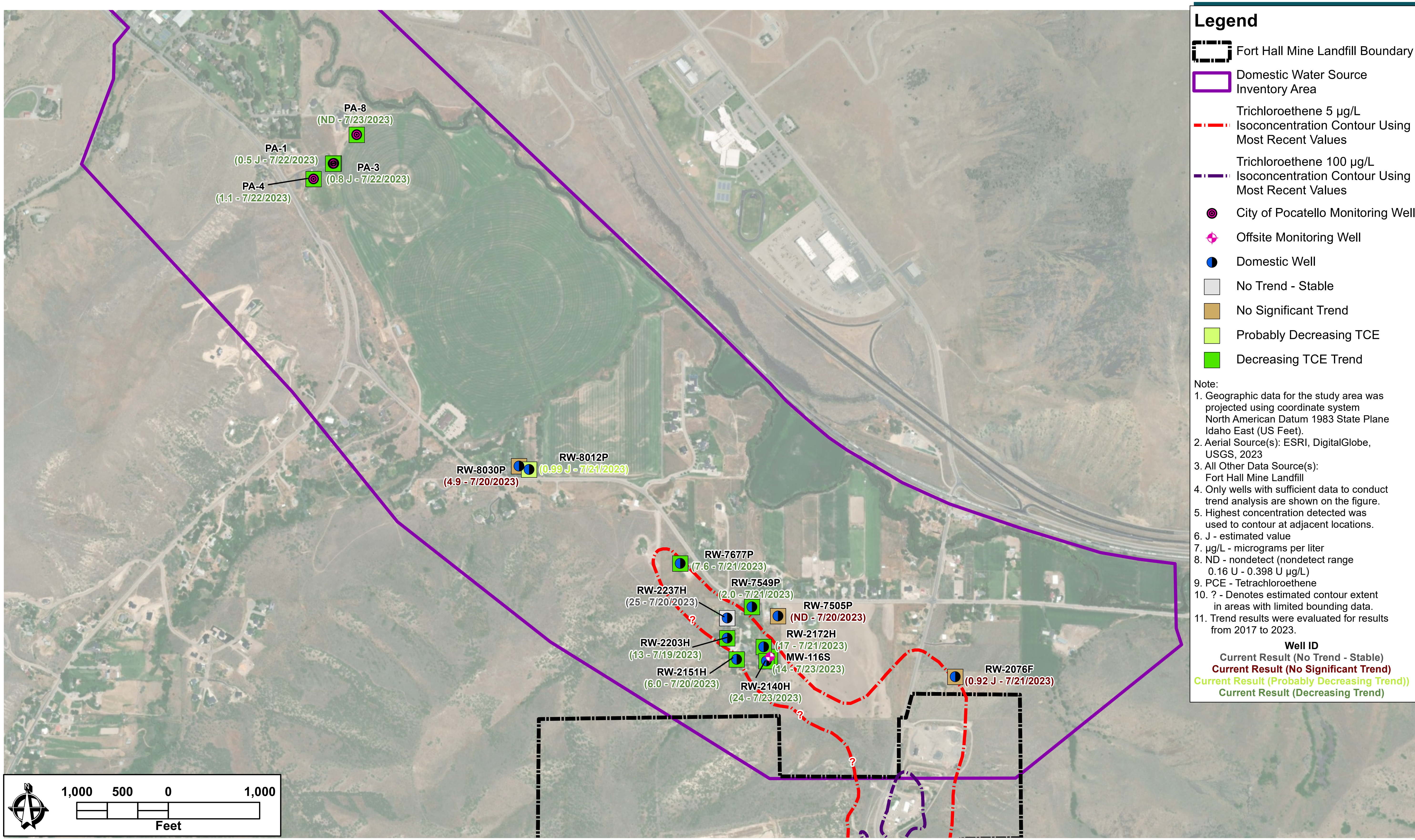
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 4-1
Tetrachloroethene: Current Plume Extent and Trends Analysis



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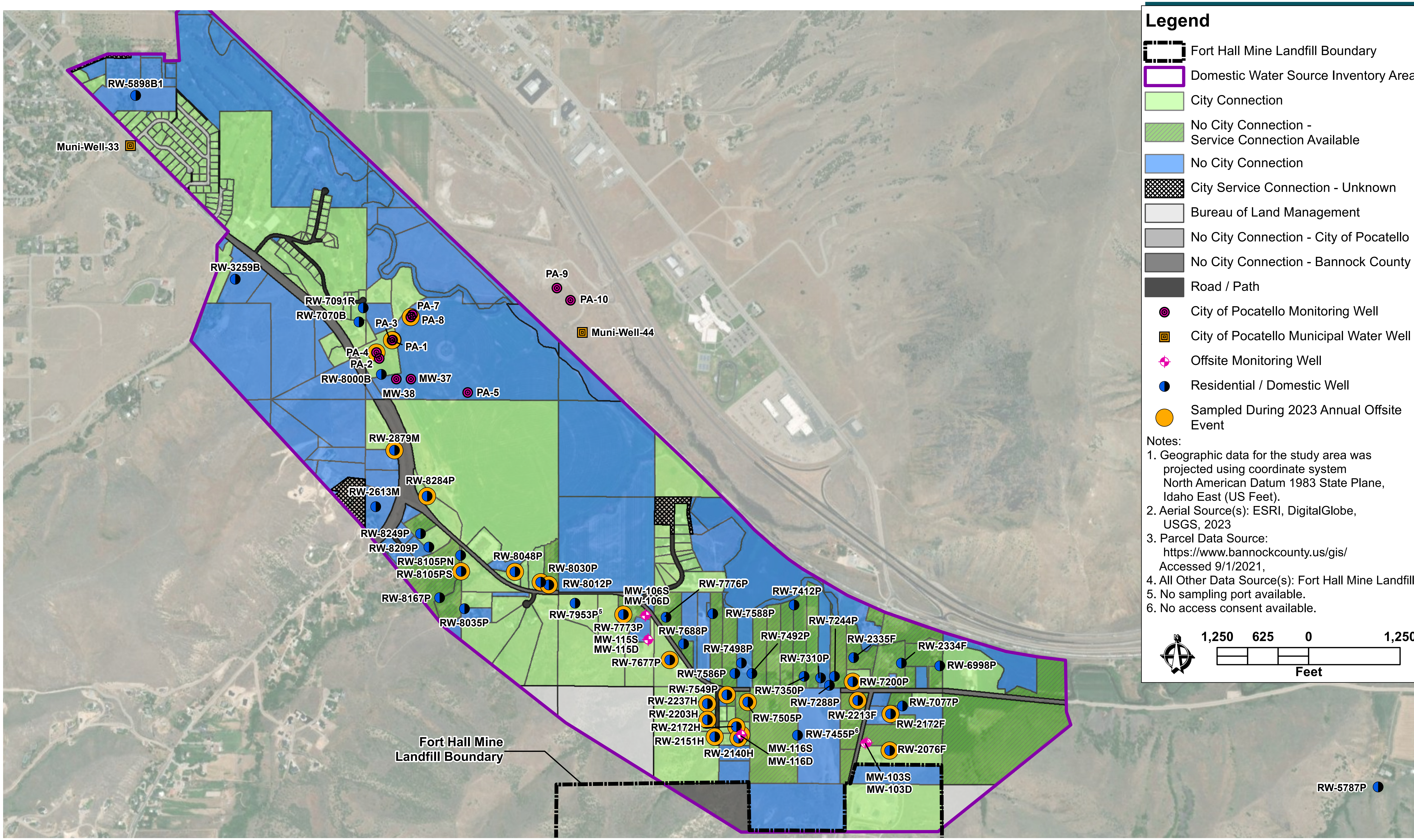
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 4-2
Trichloroethene: Current Plume Extent and Trends Analysis



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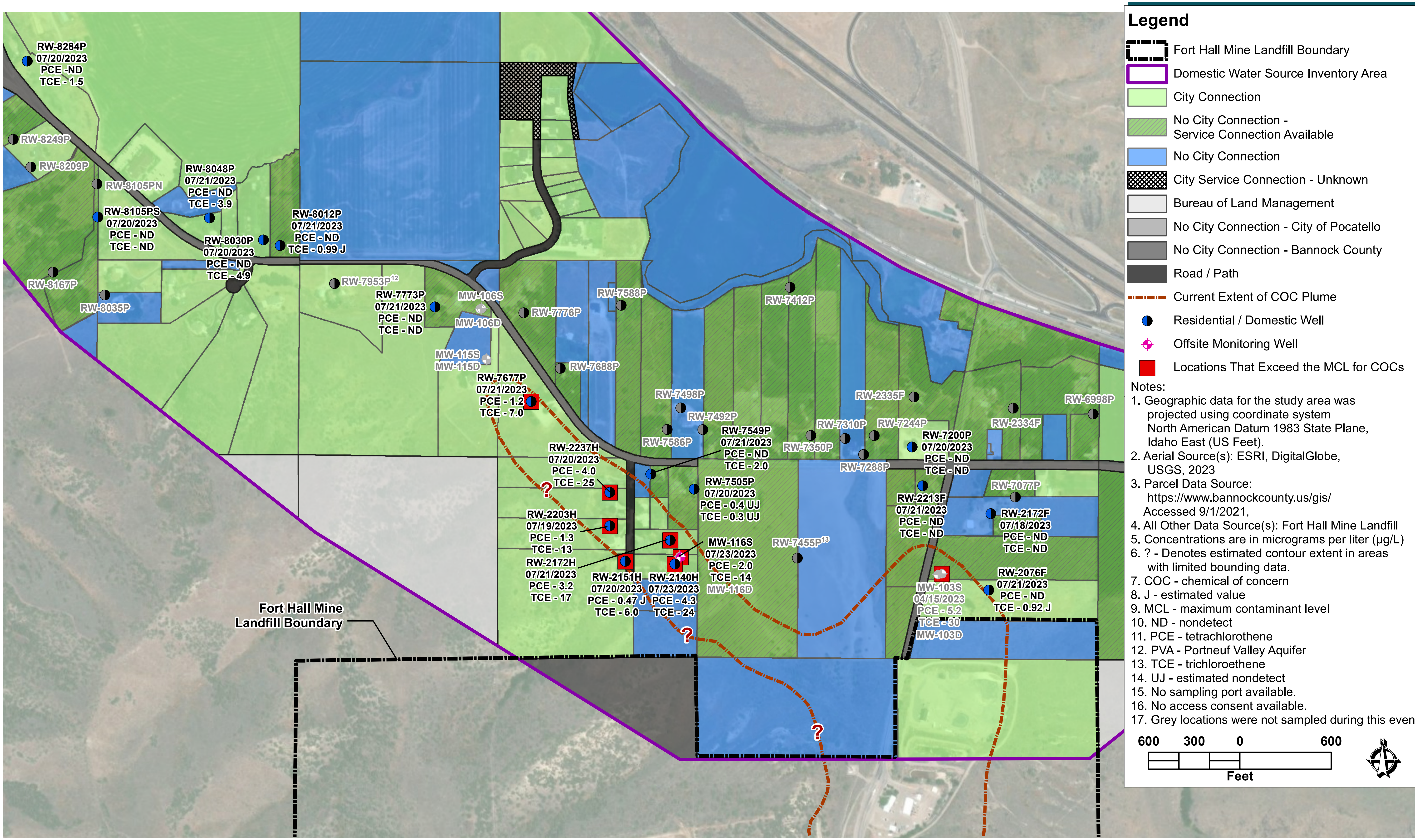
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 5-1
Domestic Water Source Inventory Area
Parcel and Well Information



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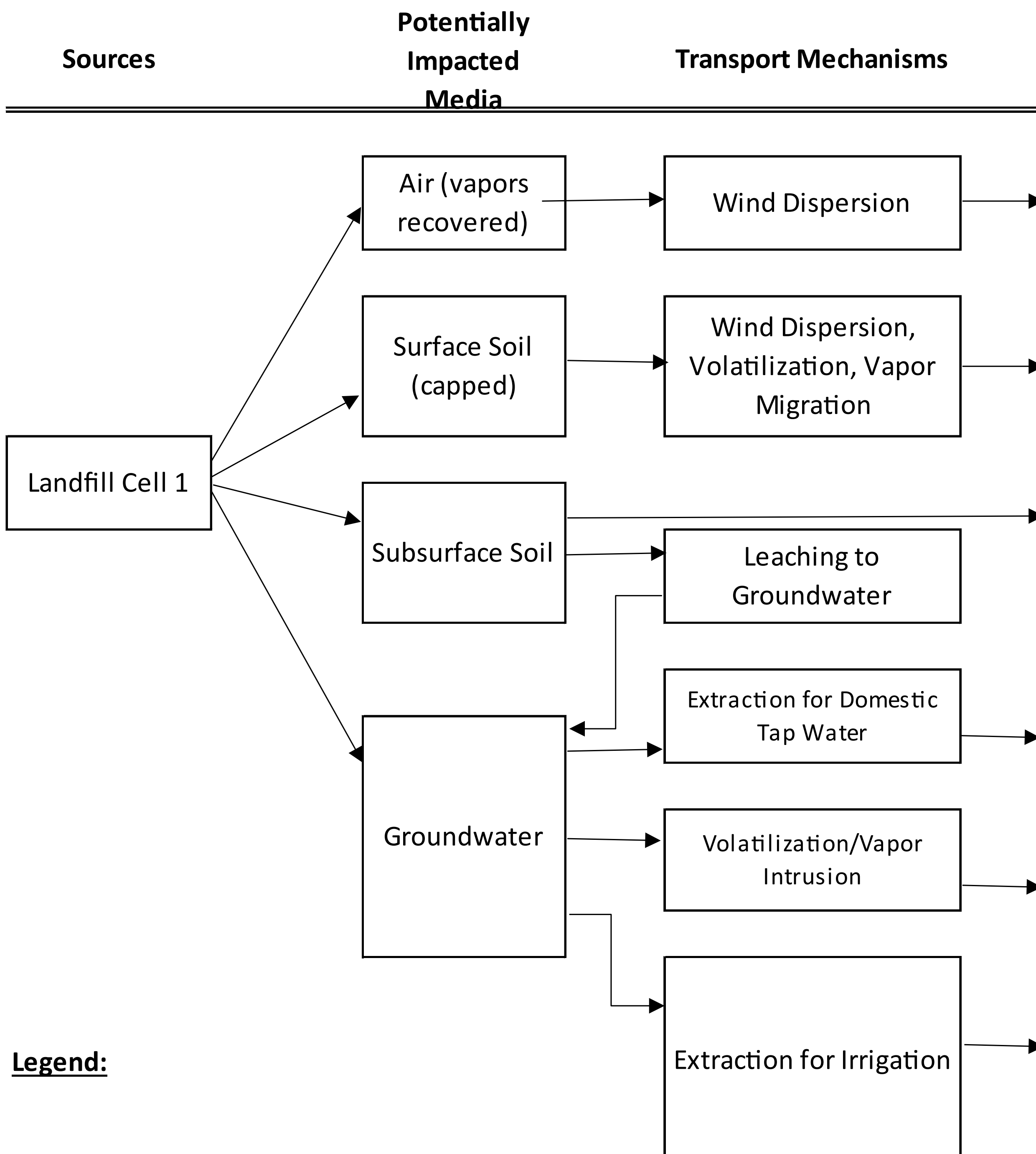
2023 Annual Offsite Groundwater Monitoring Report
Fort Hall Mine Landfill, Bannock County, Idaho

Figure 5-2
Lower PVA Domestic Water Source Inventory Area
Parcel and Well Information Showing Current Trichloroethene and Tetrachloroethene Results



Exposure Routes	Human Health Receptors	Ecological Receptors		
	Residents	Plants	Soil Invertebrates	Birds, Mammals
Inhalation (Indoors)				
Inhalation (Outdoors)				X
Inhalation				
Dermal Absorption		X	X	●
Incidental Ingestion				
Inhalation	●			
Dermal Absorption	●			X
Incidental Ingestion	●			
Inhalation	●			
Dermal Absorption	●			
Incidental Ingestion	●			
Inhalation (Indoors)	●			
Water Ingestion, mist inhalation	X	●	●	●
Ingestion (garden crops/plants)	X	X	X	X
Dermal Absorption (water, plants)	X	X	X	X

Legend:

●	Pathway complete and significant
X	Pathway is complete, but is judged to be minor compared to other exposure pathways
	Pathway not complete

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Figure 5-3
Site Conceptual Exposure Model Pathway

TABLES

Table 2-1
Offsite Well Completion Details
Fort Hall Mine Landfill

Well ID	Easting^ (x-coordinate)	Northing^ (y-coordinate)	Elevation (feet msl)	Total Well Depth (feet bgs)	Screen Start~ (feet bgs)	Screen End (feet bgs)	Well Diameter (in)
Bannock County Offsite Monitoring Wells							
MW-116S*	601412.65	410222.65	4535.81	73.5	78	93	6
City of Pocatello Monitoring Wells							
MW-37	596895.44	415075.61	4503	119	57	107	18
MW-38 (shallow)	596694.57	415075.59	4501	135	60	100	18
MW-38 (middle)	596694.57	415075.59	4501	135	105	115	18
MW-38 (deep)	596694.57	415075.59	4501	135	121	130	18
PA-1*	596644.63	415607.75	4502.96	149	128.5	148.5	4
PA-3*	596636.44	415606.15	4503.23	68	47.5	67.5	4
PA-4 (shallow)	596422.76	415438.08	4518.65	145	64.5	74.5	4
PA-4 (middle)*	596422.76	415438.08	4518.65	145	99.5	109.5	4
PA-4 (deep)	596422.76	415438.08	4518.65	145	134.5	145.5	4
PA-5	597670.68	414891.60	4498	86.5	36	86.5	4
PA-7	596917.81	415954.19	4488	176.5	171	176.5	4
PA-8 (shallow)	596893.98	415920.84	4490	127	37	47	4
PA-8 (middle)*	596893.98	415920.84	4490	127	77	87	4
PA-8 (deep)	596893.98	415920.84	4490	127	117	127	4
PA-9 (shallow)	598890.52	416316.33	4482	98	57.5	67.5	4
PA-9 (deep)	598890.52	416316.33	4482	98	87.5	98	4
PA-10	599076.35	416149.56	4485	62	22	62	4
City of Pocatello Municipal Supply Wells							
Muni-Well-14	589854.12	421658.16	4470	82	Unknown	Unknown	12
Muni-Well-33	593063.94	418259.59	4510	115	56	115	12
Domestic Supply Wells							
RW-2076F*	603437.23	410006.10	4568	89	N/A	N/A	6
RW-2140H*	601376.86	410184.78	4557	195	195	195	8
RW-2151H*	601048.98	410194.52	4571	180	123	180	8
RW-2172F*	603451.12	410506.72	4545	110	N/A	N/A	6
RW-2172H*	601343.83	410331.91	4552	165	100	113	8
RW-2203H*	600946.89	410582.10	4542	Unknown	Unknown	Unknown	6
RW-2213F*	603003.31	410689.99	4533	Unknown	Unknown	Unknown	8
RW-2237H*	600946.28	410646.63	4532	100	Unknown	Unknown	9
RW-2879M*	596669.00	414104.78	4604	205	110	110	6
RW-5898B1	593134.42	418944.16	4487	100	100	100	10
RW-7070B	596184.00	415892.25	4523	Unknown	Unknown	Unknown	8
RW-7091R	596242.44	416046.04	4505	100	110	110	6
RW-7200P*	602934.13	410945.27	4512	133	133	138	6
RW-7244P	602684.69	411018.74	4513	80	N/A	N/A	6
RW-7350P	602268.67	411019.73	4527	Unknown	Unknown	Unknown	Unknown
RW-7505P*	601500.56	410668.29	4536	Unknown	Unknown	Unknown	Unknown
RW-7549P*	601215.93	410767.15	4524	Unknown	Unknown	Unknown	8
RW-7586P	601324.00	411058.45	4516	110	90	110	6
RW-7588P	601021.80	411873.88	4495	70	Unknown	Unknown	8
RW-7677P*	600430.68	411242.85	4523	59	Unknown	Unknown	6
RW-7688P	600621.78	411461.05	4515	79	Unknown	Unknown	6
RW-7773P*	599798.81	411863.98	4528	120	Unknown	Unknown	6
RW-8000B	596489.98	415079.60	4516	Unknown	Unknown	Unknown	Unknown
RW-8012P*	598779.95	412267.43	4521	90	80	90	8
RW-8030P*	598670.00	412304.15	4521	92	Unknown	Unknown	8
RW-8035P	597627.73	411942.38	4569	170	Unknown	Unknown	8
RW-8048P*	598316.55	412447.03	4523	150	130	150	6
RW-8105PS*	597583.43	412452.72	4539	Unknown	80	96	8
RW-8209P	597141.45	412781.87	4562	Unknown	140 and 185	150 and 195	8
RW-8249P	597026.53	412964.39	4575	267	247	267	6
RW-8284P*	598141.93	412556.97	4524	100	Unknown	Unknown	Unknown

Notes:
^Coordinate system is Idaho State Plane East.
~If the screen start and end are the same, the well is expected to be open hole.
*Sampled during the 2023 annual offsite event

Abbreviations:
feet bgs = feet below ground surface
feet msl = feet above mean sea level
in = inches

Table 2-2
2023 Offsite Well Sample Collection Information
Fort Hall Mine Landfill

Well ID	Sampling Method	Field Parameters*	VOCs (Method 8260D)	Pump Depth (feet bgs)	Minimum Purge Volume (gal)	2023 Purge Volume~ (gal)
Bannock County Offsite Monitoring Wells						
MW-116S	Low flow	1	1	85	0.7	6.2
City of Pocatello Monitoring Wells						
PA-1	Low flow	1	1	139	1.2	2.0
PA-3	Low flow	1	1	58	0.6	2.5
PA-4 (middle)	Low flow	1	1	105	0.9	5.0
PA-8 (middle)	Low flow	1	1	82	0.7	6.5
Domestic Supply Wells						
RW-2076F	Tap	1	1	Unknown	113	113
RW-2140H	Tap	1	1	Unknown	400	> 400
RW-2151H	Tap	1	1	Unknown	300	300
RW-2172F	Tap	1	1	Unknown	100	100
RW-2172H	Tap	1	1	Unknown	300	300
RW-2203H	Low-flow	1	1	73	0.8	10.3
RW-2213F	Tap	1	1	Unknown	200	200
RW-2237H	Tap	1	1	Unknown	300	300
RW-2879M	Tap	1	1	Unknown	300	300
RW-7200P	Tap	1	1	Unknown	90	90
RW-7505P	Tap	1	1	Unknown	300	300
RW-7549P	Tap	1	1	Unknown	300	300
RW-7677P	Tap	1	1	Unknown	100	100
RW-7773P	Tap	1	1	Unknown	100	100
RW-8012P	Tap	1	1	Unknown	200	200
RW-8030P	Tap	1	1	Unknown	200	200
RW-8048P	Tap	1	1	Unknown	300	300
RW-8105PS	Tap	1	1	Unknown	200	200
RW-8284P	Tap	1	1	Unknown	300	300

Notes:
*Field parameters include pH, oxidation reduction potential, turbidity, dissolved oxygen, specific conductivity, and temperature
~Calculated for wells sampled via low flow methods by multiplying the total purge time by the flow rate. Equal to minimum purge volume for domestic wells.

Abbreviations:
feet bgs = feet below ground surface
gal = gallons
VOCs = volatile organic compounds

Tables Notes

Results greater than the MCL

Underline indicates values greater than IDGW Standard (or outside range for pH)

Bold indicates detected values

Italics indicates nondetected values

EPA = U.S. Environmental Protection Agency
ID GW = Idaho Groundwater Standards
J = Result is estimated
MCL = maximum contaminant level
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter
mV = millivolts
ntu = Nephelometric Turbidity Unit
su = standard unit
U = Analyte was not detected at the associated value
UJ = The non-detection at the associated value is an estimate
VOCs = volatile organic compounds

Table 3-1
City Monitoring Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	PA-1-20230722		PA-1-Q-20230722		PA-3-20230722		PA-4-100-110-20230722		PA-8-77-87-20230723	
				Well ID	PA-1		PA-1		PA-3		PA-4		PA-8	
				Sample Date	2023-07-22		2023-07-22		2023-07-22		2023-07-22		2023-07-23	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters														
Dissolved Oxygen	--	--	--	mg/L	**7.81**		**7.81**		**8.25**		**8.41**		--	
Oxidation-Reduction Potential	--	--	--	mV	**-63.6**		**-63.6**		**-88.3**		**-130**		**-164.7**	
Specific Conductance	--	--	--	µS/cm	**756**		**756**		**841**		**807**		**462**	
Temperature	--	--	--	Celsius	**12.25**		**12.25**		**13.52**		**14.92**		**11.52**	
Turbidity	--	--	--	ntu	**0.36**		**0.36**		**0.16**		**1.19**		**5.09**	
pH	--	--	6.5 - 8.5	su	**7.34**		**7.34**		**7.22**		**6.95**		**8.12**	
VOCs														
Trichloroethene	5	5	--	µg/L	**0.5**	J	**0.5**	J	**0.8**	J	**1.1**		*0.3*	U

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-2076F-20230721		RW-2140H-20230723		RW-2151H-20230720	
				Well ID	RW-2076F		RW-2140H		RW-2151H	
				Sample Date	2023-07-21		2023-07-23		2023-07-20	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**8.44**		--		**7.95**	
Oxidation-Reduction Potential	--	--	--	mV	**58.5**		**124**		**13.1**	
Specific Conductance	--	--	--	µS/cm	**745**		**1200**		**814**	
Temperature	--	--	--	Celsius	**14.43**		**17.99**		**12.75**	
Turbidity	--	--	--	ntu	**1.94**		**1.29**		**16.3**	
pH	--	--	6.5 - 8.5	su	**7.39**		**7.07**		**7.71**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	**4.3**		**0.47**	J
Trichloroethene	5	5	--	µg/L	**0.92**	J	**24**		**0.3**	
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	**1.4**		*0.32*	UJ

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-2172F-20230718		RW-2172H-20230721		RW-2203H-20230719	
				Well ID	RW-2172F		RW-2172H		RW-2203H	
				Sample Date	2023-07-18		2023-07-21		2023-07-19	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**7.3**		**10.13**		**11.07**	
Oxidation-Reduction Potential	--	--	--	mV	**28.1**		**-0.8**		**32.2**	
Specific Conductance	--	--	--	µS/cm	**724**		**1173**		**981**	
Temperature	--	--	--	Celsius	**14.72**		**12.37**		**14.09**	
Turbidity	--	--	--	ntu	**0.63**		**0.7**		**124**	
pH	--	--	6.5 - 8.5	su	**7.6**		**7.46**		**7.37**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	**3.2**		**1.3**	
Trichloroethene	5	5	--	µg/L	*0.3*	U	**17**		**13**	
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	**1.2**		**0.57**	J

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-2213F-20230721		RW-2237H-20230720		RW-2879M-20230720	
				Well ID	RW-2213F		RW-2237H		RW-2879M	
				Sample Date	2023-07-21		2023-07-20		2023-07-20	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**7.14**		**9.29**		**7.89**	
Oxidation-Reduction Potential	--	--	--	mV	**-30.7**		**-142.8**		**18.3**	
Specific Conductance	--	--	--	µS/cm	**703**		**1120**		**1605**	
Temperature	--	--	--	Celsius	**14.27**		**14.01**		**15.25**	
Turbidity	--	--	--	ntu	**3.2**		**0.84**		**6.32**	
pH	--	--	6.5 - 8.5	su	**7.47**		**7.06**		**7.33**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	**4**		*0.4*	U
Trichloroethene	5	5	--	µg/L	*0.3*	U	**25**		*0.3*	U
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	**1.5**		*0.32*	U

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-7200P-20230720		RW-7505P-20230720		RW-7505P-Q-20230720	
				Well ID	RW-7200P		RW-7505P		RW-7505P	
				Sample Date	2023-07-20		2023-07-20		2023-07-20	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**8.76**		**9.1**		**9.1**	
Oxidation-Reduction Potential	--	--	--	mV	**57.9**		**37.8**		**37.8**	
Specific Conductance	--	--	--	µS/cm	**708**		**708**		**708**	
Temperature	--	--	--	Celsius	**15.04**		**12.68**		**12.68**	
Turbidity	--	--	--	ntu	**1.02**		**2.13**		**2.13**	
pH	--	--	6.5 - 8.5	su	**7.62**		**7.66**		**7.66**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	*0.4*	UJ	*0.4*	U
Trichloroethene	5	5	--	µg/L	*0.3*	U	*0.3*	UJ	*0.3*	U
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	*0.32*	UJ	*0.32*	U

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-7549P-20230721		RW-7677P-20230721		RW-7773P-20230721	
				Well ID	RW-7549P		RW-7677P		RW-7773P	
				Sample Date	2023-07-21		2023-07-21		2023-07-21	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**8.3**		**12.18**		**10.45**	
Oxidation-Reduction Potential	--	--	--	mV	**-22.7**		**-79.2**		**20.3**	
Specific Conductance	--	--	--	µS/cm	**756**		**864**		**705**	
Temperature	--	--	--	Celsius	**13.19**		**14.64**		**13.43**	
Turbidity	--	--	--	ntu	**3.14**		**1.16**		**1.9**	
pH	--	--	6.5 - 8.5	su	**7.48**		**6.88**		**7**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	**1.2**		*0.4*	U
Trichloroethene	5	5	--	µg/L	**2**		**7**		*0.3*	U
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	**0.37**	J	*0.32*	U

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	RW-8012P-20230721		RW-8030P-20230720		RW-8048P-20230721	
				Well ID	RW-8012P		RW-8030P		RW-8048P	
				Sample Date	2023-07-21		2023-07-20		2023-07-21	
				Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier
Field Parameters										
Dissolved Oxygen	--	--	--	mg/L	**9.11**		**9.4**		**10.32**	
Oxidation-Reduction Potential	--	--	--	mV	**-85.2**		**50.9**		**-12.5**	
Specific Conductance	--	--	--	µS/cm	**778**		**826**		**990**	
Temperature	--	--	--	Celsius	**16.07**		**11.97**		**12.82**	
Turbidity	--	--	--	ntu	**0.09**		**1.07**		**1.46**	
pH	--	--	6.5 - 8.5	su	**6.93**		**7.59**		**6.62**	
VOCs										
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	*0.4*	U	*0.4*	U
Trichloroethene	5	5	--	µg/L	**0.99**	J	**4.9**		**3.9**	
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	*0.32*	U	*0.32*	U

Table 3-2
Domestic Supply Wells
Detected VOCs and Field Parameter Results

				Sample Name	RW-8105PS-20230720		RW-8284P-20230720	
				Well ID	RW-8105PS		RW-8284P	
		ID GW -	ID GW -	Sample Date	2023-07-20		2023-07-20	
Analyte	EPA MCL	PRIMARY	SECONDARY	Unit	Result	Qualifier	Result	Qualifier
Field Parameters								
Dissolved Oxygen	--	--	--	mg/L	**2.51**		**8.15**	
Oxidation-Reduction Potential	--	--	--	mV	**-208.1**		**-177.4**	
Specific Conductance	--	--	--	µS/cm	**854**		**846**	
Temperature	--	--	--	Celsius	**11.12**		**16.26**	
Turbidity	--	--	--	ntu	**1.13**		**10.6**	
pH	--	--	6.5 - 8.5	su	**7.04**		**7.21**	
VOCs								
Tetrachloroethene	5	5	--	µg/L	*0.4*	U	*0.4*	U
Trichloroethene	5	5	--	µg/L	*0.3*	U	**1.5**	
cis-1,2-Dichloroethene	70	70	--	µg/L	*0.32*	U	*0.32*	U

Table 3-3
Bannock County Offsite Monitoring Wells
Detected VOCs and Field Parameter Results

Analyte	EPA MCL	ID GW - PRIMARY	ID GW - SECONDARY	Sample Name	MW-116S-20230723	
				Well ID	MW-116S	
				Sample Date	2023-07-23	
				Unit	Result	Qualifier
Field Parameters						
Dissolved Oxygen	--	--	--	mg/L	**0.12**	
Oxidation-Reduction Potential	--	--	--	mV	**92**	
Specific Conductance	--	--	--	µS/cm	**1051**	
Temperature	--	--	--	Celsius	**13.54**	
Turbidity	--	--	--	ntu	**1.49**	
pH	--	--	6.5 - 8.5	su	**6.91**	
VOCs						
Tetrachloroethene	5	5	--	µg/L	**2**	
Trichloroethene	5	5	--	µg/L	**<u>14</u>**	
cis-1,2-Dichloroethene	70	70	--	µg/L	**0.52**	J

Table 4-1
City Monitoring Well Statistical Results - PCE and TCE
2023 Annual Off-Site GW Monitoring Report
Fort Hall Mine Landfill

General									Trend analysis								
Well ID	Chemical Name	Unit	Min Date	Max Date	Latest Result	Last Q	Dataset n	ND %	TS Slope	TS Intercept	p-value	Confidence Level	S	sd(S)	Z	COV	Direction
PA-1-128.5-148.5	Tetrachloroethene	µg/L	04/25/1994	07/22/2023	0.4	U	9	55.6	NC	NC	NC	NC	NC	NC	NC	0.837	NC
PA-3-47.5-67.5	Tetrachloroethene	µg/L	04/25/1994	07/22/2023	0.4	UJ	9	44.4	-0.0000594	1.33	0.00594	99.4%	-25	9.54	-2.52	0.566	Decreasing
PA-4-99.5-109.5	Tetrachloroethene	µg/L	04/25/1994	07/22/2023	0.4	U	8	25	-0.000135	3.01	0.0124	98.8%	-19	8.02	-2.24	0.732	Decreasing
PA-8-77-87	Tetrachloroethene	µg/L	04/25/1994	07/23/2023	0.4	U	7	71.4	NC	NC	NC	NC	NC	NC	NC	0.602	NC
PA-1-128.5-148.5	Trichloroethene	µg/L	04/25/1994	07/22/2023	0.5	J	12	0	-0.000834	16.8	0.0000593	100.0%	-57	14.6	-3.85	1.01	Decreasing
PA-3-47.5-67.5	Trichloroethene	µg/L	04/25/1994	07/22/2023	0.8	J	14	0	-0.000895	18.2	0.000183	100.0%	-66	18.2	-3.56	0.78	Decreasing
PA-4-99.5-109.5	Trichloroethene	µg/L	04/25/1994	07/22/2023	1.1		8	0	-0.00182	36.5	0.000991	99.9%	-26	8.08	-3.09	1.08	Decreasing
PA-8-77-87	Trichloroethene	µg/L	04/25/1994	07/23/2023	0.3	U	8	37.5	-0.000496	9.66	0.00305	99.7%	-23	8.02	-2.74	1.31	Decreasing

Notes
Well ID includes the well name and the sampled screen interval in feet below ground surface.

Acronyms and Abbreviations
% - percent
COV - coefficient of variation
J - estimated result
n - dataset result count
ND - nondetect
p-value - probability that S would occur without a statistically significant trend
Q - qualifier
S - Mann Kendall S statistic, the number that represents all samples and direction of trend in the Mann-Kendall analysis
sd(S) - Standard deviation of S
TS - Theil Sen
U - nondetect result (value equals MDL)
UJ - estimated nondetect result
Z - The standardized S statistic
µg/L - micrograms per liter

Table 4-2
Domestic Well Statistical Results - PCE and TCE
2023 Annual Off-Site GW Monitoring Report
Fort Hall Mine Landfill

General									Trend analysis								
Well ID	Chemical Name	Unit	Min Date	Max Date	Latest Result	Last Q	Dataset n	ND %	TS Slope	TS Intercept	p-value	Confidence Level	S	sd(S)	Z	COV	Direction
RW-2076F	Tetrachloroethene	µg/L	08/02/2017	07/21/2023	0.4	U	7	42.9	1.28E-05	4.36	0.44	56.0%	2	6.58	0.152	0.849	No Trend
RW-2076F	Trichloroethene	µg/L	08/02/2017	07/21/2023	0.92	J	7	0	0.000152	21.1	0.5	50.0%	1	6.66	0	0.902	No Trend
RW-2140H	Tetrachloroethene	µg/L	09/28/1992	07/23/2023	4.3		15	0	-0.000202	8.25	0.0371	96.3%	-37	20.1	-1.79	0.349	Decreasing
RW-2140H	Trichloroethene	µg/L	09/28/1992	07/23/2023	24		16	0	-0.00459	113	0.000495	100.0%	-74	22.2	-3.29	0.621	Decreasing
RW-2140H	Tetrachloroethene	µg/L	08/11/2017	07/23/2023	4.3		7	0	-0.000834	20.2	0.0358	96.4%	-13	6.66	-1.8	0.417	Decreasing
RW-2140H	Trichloroethene	µg/L	08/11/2017	07/23/2023	24		7	0	-0.00569	133	0.0474	95.3%	-12	6.58	-1.67	0.429	Decreasing
RW-2151H	Tetrachloroethene	µg/L	09/28/1992	07/20/2023	0.47	J	13	15.4	-0.0012	23.6	0.00112	99.9%	-51	16.4	-3.05	1.14	Decreasing
RW-2151H	Trichloroethene	µg/L	09/28/1992	07/20/2023	6		13	0	-0.014	269	0.00031	100.0%	-57	16.4	-3.42	1.19	Decreasing
RW-2172F	Tetrachloroethene	µg/L	12/15/1993	07/18/2023	0.4	U	7	85.7	NC	NC	NC	NC	NC	NC	NC	0.322	NC
RW-2172H	Tetrachloroethene	µg/L	09/28/1992	07/21/2023	3.2		10	0	-0.00105	24.3	0.00269	99.7%	-32	11.1	-2.78	0.689	Decreasing
RW-2172H	Trichloroethene	µg/L	09/28/1992	07/21/2023	17		10	0	-0.0115	239	0.000836	99.9%	-36	11.1	-3.14	0.928	Decreasing
RW-2203H	Tetrachloroethene	µg/L	09/28/1992	07/19/2023	1.3		11	0	-0.00136	29	0.0061	99.4%	-33	12.8	-2.51	1.01	Decreasing
RW-2203H	Trichloroethene	µg/L	09/28/1992	07/19/2023	13		11	0	-0.0112	233	0.00116	99.9%	-40	12.8	-3.05	1.02	Decreasing
RW-2237H	Tetrachloroethene	µg/L	09/28/1992	07/20/2023	4		8	0	-2.49E-05	2.07	0.309	69.1%	-5	8.02	-0.499	0.808	No Trend - Stable
RW-2237H	Trichloroethene	µg/L	09/28/1992	07/20/2023	25		8	0	-0.000777	23.7	0.106	89.4%	-11	8.02	-1.25	0.708	No Trend - Stable
RW-7505P	Tetrachloroethene	µg/L	12/15/1993	07/20/2023	0.4	UJ	7	85.7	NC	NC	NC	NC	NC	NC	NC	0.326	NC
RW-7505P	Trichloroethene	µg/L	09/28/1992	07/20/2023	0.3	UJ	11	36.4	-1.26E-05	0.518	0.155	84.5%	-14	12.8	-1.02	1.31	No Trend
RW-7549P	Tetrachloroethene	µg/L	09/23/1993	07/21/2023	0.4	U	8	75	NC	NC	NC	NC	NC	NC	NC	0.592	NC
RW-7549P	Trichloroethene	µg/L	09/28/1992	07/21/2023	2		18	22.2	-0.000054	1.34	0.0285	97.2%	-51	26.3	-1.9	1.17	Decreasing
RW-7677P	Tetrachloroethene	µg/L	03/22/1994	07/21/2023	1.2		9	0	-9.01E-05	2.83	0.262	73.8%	-7	9.4	-0.639	0.915	No Trend - Stable
RW-7677P	Trichloroethene	µg/L	10/23/1992	07/21/2023	7		13	0	-0.00122	28.3	0.00979	99.0%	-39	16.3	-2.33	0.88	Decreasing
RW-8012P	Tetrachloroethene	µg/L	06/17/1997	07/21/2023	0.4	U	8	50	-6.43E-05	1.57	0.353	64.7%	-4	7.96	-0.377	0.798	No Trend - Stable
RW-8012P	Trichloroethene	µg/L	06/13/1995	07/21/2023	0.99	J	11	27.3	-0.000172	3.95	0.0922	90.8%	-18	12.8	-1.33	1.89	Probably Decreasing
RW-8030P	Tetrachloroethene	µg/L	08/20/1992	07/20/2023	0.4	U	37	2.7	0	1.5	0.361	63.9%	28	73.5	0.368	0.373	No Trend
RW-8030P	Tetrachloroethene	µg/L	08/01/2017	07/20/2023	0.4	U	6	16.7	-0.000803	16.1	0.0121	98.8%	-13	5.32	-2.26	0.7	Decreasing
RW-8030P	Trichloroethene	µg/L	08/01/2017	07/20/2023	4.9		6	0	-0.00196	42.4	0.0664	93.4%	-9	5.32	-1.5	0.65	Probably Decreasing
RW-8048P	Tetrachloroethene	µg/L	06/22/2020	07/21/2023	0.4	U	4	75	NC	NC	NC	NC	NC	NC	NC	0.355	NC
RW-8048P	Trichloroethene	µg/L	06/22/2020	07/21/2023	3.9		4	0	NC	NC	NC	NC	NC	NC	NC	0.312	NC
RW-8284P	Tetrachloroethene	µg/L	06/23/2019	07/20/2023	0.4	U	5	40	NC	NC	NC	NC	NC	NC	NC	0.412	NC
RW-8284P	Trichloroethene	µg/L	06/23/2019	07/20/2023	1.5		5	0	NC	NC	NC	NC	NC	NC	NC	0.582	NC

Notes

Shading denotes a data set evaluated for a truncated timeframe.

Acronyms and Abbreviations

% - percent
COV - coefficient of variation
J - estimated result
n - dataset result count
ND - nondetect
p-value - probability that S would occur without a statistically significant trend
Q - qualifier
S - Mann Kendall S statistic, the number that represents all samples and direction of trend in the Mann-Kendall analysis
sd(S) - Standard deviation of S
TS - Theil Sen
U - nondetect result
Z - The standardized S statistic
µg/L - micrograms per liter

Table 4-3
Offsite Monitoring Well Statistical Results - PCE and TCE
2023 Annual Off-Site GW Monitoring Report
Fort Hall Mine Landfill

General									Trend analysis								
Well ID	Chemical Name	Unit	Min Date	Max Date	Latest Result	Last Q	Dataset n	ND %	TS Slope	TS Intercept	p-value	Confidence Level	S	sd(S)	Z	COV	Direction
MW-116S	Tetrachloroethene	µg/L	01/07/2000	07/23/2023	2		23	0	0.00003	1.67	0.225	77.5%	29	NC	NC	0.667	No Trend
MW-116S	Tetrachloroethene	µg/L	08/11/2017	07/23/2023	2		10	0	-0.000573	13.4	0.142	85.8%	-13	11.2	-1.07	0.401	No Trend - Stable
MW-116S	Trichloroethene	µg/L	01/07/2000	07/23/2023	14		28	0	-0.000401	23.8	0.332	66.8%	-23	48.4	-0.454	0.678	No Trend - Stable
MW-116S	Trichloroethene	µg/L	08/11/2017	07/23/2023	14		10	0	-0.00719	158	0.044	95.6%	-20	11.1	-1.71	0.333	Decreasing

Notes
Shading denotes a data set evaluated for a truncated timeframe.

Acronyms and Abbreviations
% - percent
COV - coefficient of variation
n - dataset result count
ND - nondetect
p-value - probability that S would occur without a statistically significant trend
Q - qualifier
S - Mann Kendall S statistic, the number that represents all samples and direction of trend in the Mann-Kendall analysis
sd(S) - Standard deviation of S
TS - Theil Sen
Z - The standardized S statistic
µg/L - micrograms per liter

Table 5-1
Human Health Chemicals of Potential Concern Selection
Fort Hall Mine Landfill, Bannock County, Idaho

Chemical	MCL (µg/L)
1,1,1,2-Tetrachloroethane	NA
1,1,1-Trichloroethane	200
1,1,2,2-Tetrachloroethane	NA
1,1,2-Trichloroethane	5
1,1-Dichloroethane	NA
1,1-Dichloroethene	7
1,1-Dichloropropene	NA
1,2,3-Trichloropropane	NA
1,2,4-Trichlorobenzene	70
1,2-Dibromo-3-Chloropropane	0.2
1,2-Dibromoethane	0.05
1,2-Dichlorobenzene	600
1,2-Dichloroethane	5
1,2-Dichloropropane	5
1,3-Dichlorobenzene	NA
1,3-Dichloropropane	NA
1,4-Dichlorobenzene	75
2,2-Dichloropropane	NA
2-Butanone (MEK)	NA
2-Hexanone	NA
4-Methyl-2-pentanone (MIBK)	NA
Acetone	NA
Acetonitrile; methyl cyanide	NA
Acrolein	NA
Acrylonitrile	NA
Allyl chloride	NA
Benzene	5
Bromochloromethane	NA
Bromodichloromethane	80
Bromoform	80
Bromomethane	NA
Carbon disulfide	NA
Carbon tetrachloride	5
Chlorobenzene	100
Chlorodibromomethane	80
Chloroethane	NA
Chloroform	80
Chloromethane	NA
Chloroprene	NA
cis-1,2-Dichloroethene	70
cis-1,3-Dichloropropene	NA
Dibromomethane	NA
Dichlorodifluoromethane	NA
Ethyl methacrylate	NA
Ethylbenzene	700
Iodomethane	NA
Isobutanol; Isobutyl alcohol	NA
m,p-Xylene	NA

Table 5-1
Human Health Chemicals of Potential Concern Selection
Fort Hall Mine Landfill, Bannock County, Idaho

Chemical	MCL (µg/L)
Methacrylonitrile	NA
Methyl methacrylate	NA
Methylene Chloride	5
o-xylene (1,2-dimethylbenzene)	NA
Propionitrile; ethyl cyanide	NA
Styrene	100
Tetrachloroethene	5
Toluene	1000
trans-1,2-Dichloroethene	100
trans-1,3-Dichloropropene	NA
trans-1,4-Dichloro-2-butene	NA
Trichloroethene	5
Trichlorofluoromethane	NA
Vinyl acetate	NA
Vinyl chloride	2
Xylene (Total)	10000

Notes
Nondetects were evaluated at the method detecti

Acronyms/Abbreviations
µg/L - micrograms per liter
COPC - chemical of potential concern
MCL - maximum contaminant level
N - no
NA - not applicable
Y - yes

Table 5-2
Human Health Reasonable Maximum Exposure Parameters
Fort Hall Mine Landfill, Bannock County, Idaho

Parameter	Units	Adult	Child
Exposure Duration	years	20	6
Exposure Frequency	days	350	350
Air Exposure Time	hours/day	24	24
Drinking Water Ingestion Rate	L/day	2.5	0.78
Water Exposure Time	hours/event	0.71	0.54
Water Exposure Events		1	1
Body Weight	kilograms	80	15
Skin Surface Area	mg/cm^2	19,652	6,365
Averaging Time	days/year	365	365

Acronyms/Abbreviations

cm^2 - squared centimeter

L - liter

mg - milligrams

Table 5-3
Human Health Groundwater Non-cancer Hazard Evaluation
Fort Hall Mine Landfill, Bannock County, Idaho

Well ID	Groundwater Concentration (µg/L)									Groundwater HQ								
	TCE					PCE				TCE					PCE			
	2019	2020	2021	2022	2023	2019	2020	2021	2023	2019	2020	2021	2022	2023	2019	2020	2021	2023
MW-103S	NA	6.8	14	NA	30	NA	1.1	2.8	5.2	NA	2	5	NA	11	NA	0.03	0.07	0.1
MW-115S	NA	0.16	0.16	NA	0.45	NA	0.2	0.2	0.4	NA	0.1	0.1	NA	0.2	NA	0.005	0.005	0.01
MW-116S	31	26	27	19	14	3	3.7	4.2	2	11	9	10	7	5	0.07	0.09	0.1	0.05
PA-1	1.6	1.6	1.5	NA	0.5	0.2	0.2	0.2	0.4	0.6	0.6	0.5	NA	0.2	0.005	0.005	0.005	0.01
PA-3	1.7	2	1.2	NA	0.8	0.24	0.2	0.2	0.4	0.6	0.7	0.4	NA	0.3	0.006	0.005	0.005	0.01
PA-4	2.3	2.8	NA	1.8	1.1	0.25	0.63	NA	0.4	0.8	1.0	NA	0.6	0.4	0.006	0.02	NA	0.01
PA-8	0.45	0.32	0.16	0.33	0.3	0.2	0.2	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-2076F	NA	NA	29	NA	0.92	NA	NA	5.3	0.4	NA	NA	10	NA	0.3	NA	NA	0.1	0.01
RW-2140H	30	34	26	NA	24	4.6	6.1	4.5	4.3	11	12	9	NA	9	0.1	0.1	0.1	0.1
RW-2151H	12	5.8	14	0.79	6	1.8	0.2	2.7	0.47	4	2	5	0.3	2	0.04	0.005	0.07	0.01
RW-2172F	0.16	0.16	0.16	0.3	0.3	0.2	0.2	0.2	0.4	0.06	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-2172H	42	28	21	16	17	7	4.9	5.4	3.2	15	10	8	6	6	0.2	0.1	0.1	0.08
RW-2203H	31	33	NA	18	13	4.6	5.2	NA	1.3	11	12	NA	6	5	0.1	0.1	NA	0.03
RW-2213F	0.16	0.16	NA	NA	0.3	0.2	0.2	NA	0.4	0.06	0.1	NA	NA	0.1	0.005	0.005	NA	0.01
RW-2237H	NA	9.8	8.6	5.3	25	NA	1.9	1.2	4	NA	4	3	2	9	NA	0.05	0.03	0.1
RW-2879M	0.16	0.16	0.16	0.3	0.3	0.2	0.2	0.2	0.4	0.06	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-7200P	NA	NA	0.16	0.3	0.3	NA	NA	0.2	0.4	NA	NA	0.1	0.1	0.1	NA	NA	0.005	0.01
RW-7505P	0.29	0.16	0.16	0.35	0.3	0.2	0.2	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-7549P	0.26	0.16	0.16	0.3	2	0.2	0.2	0.2	0.4	0.09	0.1	0.1	0.1	0.7	0.005	0.005	0.005	0.01
RW-7677P	6.3	5.9	5.3	3.4	7	1.2	1.2	1.1	1.2	2	2	2	1	3	0.029	0.03	0.03	0.03
RW-7773P	0.16	0.16	0.16	0.3	0.3	0.2	0.2	0.2	0.4	0.06	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-8012P	2.2	0.16	0.16	0.3	0.99	0.79	0.2	0.2	0.4	0.8	0.1	0.1	0.1	0.4	0.02	0.005	0.005	0.01
RW-8030P	6	7.1	4.6	4	4.9	0.94	1.3	0.8	0.4	2	3	2	1	2	0.02	0.03	0.020	0.01
RW-8048P	NA	4	3.8	1.8	3.9	NA	0.71	0.2	0.4	NA	1	1	0.6	1.4	NA	0.02	0.005	0.01
RW-8105PS	0.16	0.16	0.16	0.3	0.3	0.2	0.2	0.2	0.4	0.06	0.1	0.1	0.1	0.1	0.005	0.005	0.005	0.01
RW-8284P	3.4	3.9	4.9	0.84	1.5	0.89	0.93	0.54	0.4	1	1	2	0.3	0.5	0.02	0.02	0.01	0.01

Acronyms/Abbreviations

µg/L - micrograms per liter
HQ - hazard quotient
ID - indentifier
NA - not available
PCE - tetrachloroethene
RSL - Regional Screening Level
TCE - trichloroethene
VI - vapor intrusion

Notes

Shading indicates HQ values greater than 1.

Table 5-4
Human Health Vapor Intrusion Non-cancer Hazard Evaluation
Fort Hall Mine Landfill, Bannock County, Idaho

Well ID	2022			
	TCE Groundwater Concentration (µg/L)	Calculated Indoor Air TCE Concentration (µg/m^3)	VI TCE Carcinogenic Risk	VI TCE HQ
MW-103S	NA	NA	NA	NA
MW-115S	NA	NA	NA	NA
MW-116S	19	2.15	4E-06	1
PA-1	NA	NA	NA	NA
PA-3	NA	NA	NA	NA
PA-4	1.8	0.20	4E-07	0.1
PA-8	0.33	0.04	8E-08	0.02
RW-2076F	NA	NA	NA	NA
RW-2140H	NA	NA	NA	NA
RW-2151H	0.79	0.09	2E-07	0.04
RW-2172F	0.30	0.03	7E-08	0.02
RW-2172H	16	1.81	4E-06	0.9
RW-2203H	18	2.04	4E-06	1
RW-2213F	NA	NA	NA	NA
RW-2237H	5.3	0.60	1E-06	0.3
RW-2879M	0.3	0.03	7E-08	0.02
RW-7200P	0.3	0.03	7E-08	0.02
RW-7505P	0.35	0.04	8E-08	0.02
RW-7549P	0.3	0.03	7E-08	0.02
RW-7677P	3.4	0.38	8E-07	0.2
RW-7773P	0.3	0.03	7E-08	0.02
RW-8012P	0.3	0.03	7E-08	0.02
RW-8030P	4	0.45	9E-07	0.2
RW-8048P	1.8	0.20	4E-07	0.1
RW-8105PS	0.3	0.03	7E-08	0.02
RW-8284P	0.84	0.09	2E-07	0.05

Groundwater temperture was set to 13.5 (^{o}C) in the VISL calculator.

µg/L - micrograms per liter
µg/m^3 - micrograms per cubic meter
HQ - hazard quotient
ID - indentifier
NA - not available
PCE - tetrachloroethene
TCE - trichloroethene
VI - vapor intrusion
VISL - vapor intrusion screening level

Table 5-5
Human Health Total Non-cancer Hazard Quotients - 2023
Fort Hall Mine Landfill, Bannock County, Idaho

Well ID	Groundwater HQ	VI HQ	Total HI
MW-103S	1E+01	2E+00	1E+01
MW-115S	2E-01	3E-02	2E-01
MW-116S	5E+00	8E-01	6E+00
PA-1	2E-01	3E-02	2E-01
PA-3	3E-01	5E-02	3E-01
PA-4	4E-01	6E-02	5E-01
PA-8	1E-01	2E-02	1E-01
RW-2076F	3E-01	5E-02	4E-01
RW-2140H	9E+00	1E+00	1E+01
RW-2151H	2E+00	3E-01	2E+00
RW-2172F	1E-01	2E-02	1E-01
RW-2172H	6E+00	1E+00	7E+00
RW-2203H	5E+00	7E-01	5E+00
RW-2213F	1E-01	2E-02	1E-01
RW-2237H	9E+00	1E+00	1E+01
RW-2879M	1E-01	2E-02	1E-01
RW-7200P	1E-01	2E-02	1E-01
RW-7505P	1E-01	2E-02	1E-01
RW-7549P	7E-01	1E-01	8E-01
RW-7677P	3E+00	4E-01	3E+00
RW-7773P	1E-01	2E-02	1E-01
RW-8012P	4E-01	6E-02	4E-01
RW-8030P	2E+00	3E-01	2E+00
RW-8048P	1E+00	2E-01	2E+00
RW-8105PS	1E-01	2E-02	1E-01
RW-8284P	5E-01	9E-02	6E-01

Table 5-6
Ecological Chemicals of Potential Concern Selection
Fort Hall Mine Landfill, Bannock County, Idaho

Chemical	CAS	Screening Value (µg/L)
1,1,1,2-Tetrachloroethane	630-20-6	NA
1,1,1-Trichloroethane	71-55-6	4400000
1,1,2,2-Tetrachloroethane	79-34-5	NA
1,1,2-Trichloroethane	79-00-5	NA
1,1-Dichloroethane	75-34-3	1700000
1,1-Dichloroethene	75-35-4	130000
1,1-Dichloropropene	563-58-6	NA
1,2,3-Trichloropropane	96-18-4	NA
1,2,4-Trichlorobenzene	120-82-1	6600
1,2-Dibromo-3-Chloropropane	96-12-8	NA
1,2-Dibromoethane	106-93-4	NA
1,2-Dichlorobenzene	95-50-1	NA
1,2-Dichloroethane	107-06-2	19000
1,2-Dichloropropane	78-87-5	NA
1,3-Dichlorobenzene	541-73-1	NA
1,3-Dichloropropane	142-28-9	NA
1,4-Dichlorobenzene	106-46-7	11000
2,2-Dichloropropane	594-20-7	NA
2-Butanone (MEK)	78-93-3	7900000
2-Hexanone	591-78-6	NA
4-Methyl-2-pentanone (MIBK)	108-10-1	NA
Acetone	67-64-1	44000
Acetonitrile; methyl cyanide	75-05-8	NA
Acrolein	107-02-8	NA
Acrylonitrile	107-13-1	NA
Allyl chloride	107-05-1	NA
Benzene	71-43-2	110000
Bromochloromethane	74-97-5	NA
Bromodichloromethane	75-27-4	NA
Bromoform	75-25-2	NA
Bromomethane	74-83-9	NA
Carbon disulfide	75-15-0	NA
Carbon tetrachloride	56-23-5	NA
Chlorobenzene	108-90-7	260000
Chlorodibromomethane	124-48-1	NA
Chloroethane	75-00-3	NA
Chloroform	67-66-3	67000
Chloromethane	74-87-3	NA
Chloroprene	126-99-8	NA
cis-1,2-Dichloroethene	156-59-2	NA
cis-1,3-Dichloropropene	10061-01-5	NA
Dibromomethane	74-95-3	NA
Dichlorodifluoromethane	75-71-8	NA
Ethyl methacrylate	97-63-2	NA
Ethylbenzene	100-41-4	NA
Iodomethane	74-88-4	NA
Isobutanol; Isobutyl alcohol	78-83-1	NA
m,p-Xylene	NA	NA

Table 5-6
Ecological Chemicals of Potential Concern Selection
Fort Hall Mine Landfill, Bannock County, Idaho

Chemical	CAS	Screening Value (µg/L)
Methacrylonitrile	126-98-7	NA
Methyl methacrylate	80-62-6	NA
Methylene Chloride	75-09-2	26000
o-xylene (1,2-dimethylbenzene)	95-47-6	NA
Propionitrile; ethyl cyanide	107-12-0	NA
Styrene	100-42-5	NA
Tetrachloroethene	127-18-4	8900
Toluene	108-88-3	110000
trans-1,2-Dichloroethene	156-60-5	NA
trans-1,3-Dichloropropene	10061-02-6	NA
trans-1,4-Dichloro-2-butene	110-57-6	NA
Trichloroethene	79-01-6	440000
Trichlorofluoromethane	75-69-4	NA
Vinyl acetate	108-05-4	NA
Vinyl chloride	75-01-4	NA
Xylene (Total)	1330-20-7	9400

Nondetects were evaluated at the method detection limit foı

µg/L - micrograms per liter
COPC - chemical of potential concern
MCL - maximum contaminant level
N - no
NA - not applicable
Y - yes

Table 6-1
2024 Annual Offsite Sampling Plan
2023 Annual Off-Site GW Monitoring Report
Fort Hall Mine Landfill

Well ID	Easting^ (x-coordinate)	Northing^ (y-coordinate)	Elevation (feet msl)	Screen Start (feet bgs)	Screen End (feet bgs)	Minimum Purge Volume (gallons)	Field parameters*	VOCs (8260D)	Sample plan starting 2023	Sampled in 2023	Sampling Method
City of Pocatello Municipal Supply Wells											
Muni-Well-14	589854.12	421658.16	4470	Unknown	Unknown	5000	1	1	Include - Biannual	No	tap
Muni-Well-33	593063.94	418259.59	4510	56	115	5000	1	1	Include - Biannual	No	tap
City of Pocatello Monitoring Wells											
PA-1	596644.63	415607.75	4503	128.5	148.5	1.2	1	1	Include - Annual	Yes	Hydrasleeve
PA-3	596636.44	415606.15	4503.23	47.5	67.5	0.6	1	1	Include - Annual	Yes	Hydrasleeve
PA-4	596422.76	415438.08	4518.65	100	110	0.9	1	1	Include - Annual	Yes	Hydrasleeve
PA-8	596893.98	415920.84	4489.87	77	87	0.7	1	1	Include - Annual	Yes	Hydrasleeve
Domestic Supply Wells											
RW-2076F	603437.23	410006.10	4568	N/A	N/A	113	1	1	Include - Annual	Yes	tap
RW-2140H	601376.86	410184.78	4557	N/A	N/A	400	1	1	Include - Annual	Yes	tap
RW-2151H	601048.98	410194.52	4571	123	180	300	1	1	Include - Annual	Yes	tap
RW-2172F	603451.12	410506.72	4545	N/A	N/A	100			Include - Biannual	Yes	tap
RW-2172H	601343.83	410331.91	4552	100	113	300	1	1	Include - Annual	Yes	tap
RW-2203H	600946.89	410582.10	4542	Unknown	Unknown	0.8	1	1	Include - Annual	Yes	Hydrasleeve
RW-2213F	603003.31	410689.99	4533	Unknown	Unknown	200	1	1	Include - Annual	Yes	tap
RW-2237H	600946.28	410646.63	4532	Unknown	Unknown	300	1	1	Include - Annual	Yes	tap
RW-7200P	602934.13	410945.27	4512	133	138	275			Include - Biannual	Yes	tap
RW-7505P	601500.56	410668.29	4536	Unknown	Unknown	300	1	1	Include - Annual	Yes	tap
RW-7549P	601215.93	410767.15	4524	Unknown	Unknown	300			Include - Biannual	Yes	tap
RW-7677P	600430.68	411242.85	4523	Unknown	Unknown	100	1	1	Include - Annual	Yes	tap
RW-7773P	599798.81	411863.98	4528	Unknown	Unknown	100			Include - Biannual	Yes	tap
RW-8012P	598779.95	412267.43	4521	80	90	200			Include - Biannual	Yes	tap
RW-8030P	598670.00	412304.15	4521	Unknown	Unknown	200	1	1	Include - Annual	Yes	tap
RW-8048P	598316.55	412447.03	4523	130	150	300	1	1	Include - Annual	Yes	tap
RW-8284P	598141.93	412556.97	4524	Unknown	Unknown	300	1	1	Include - Annual	Yes	tap

Notes

Domestic well sampling is contingent upon continued consent to access.

Offsite Bannock County monitoring wells are usually sampled with the semiannual spring and fall groundwater sampling events. Sampling planning for these wells will be presented in associated monitoring reports.

^Coordinate system is Idaho State Plane East

Abbreviations

bgs - below ground surface

msl - mean sea level

VOC - volatile organic compound