2019 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

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May 2019

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2019 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

1.0 INTRODUCTION

This Corrective Action Monitoring Plan (CAMP) summarizes groundwater and surface water monitoring activities to be conducted in 2019 at the former East Helena smelter site or Facility[1] (the Facility) and the surrounding area (Figure 1-1), encompassing two groundwater plumes and the associated groundwater and surface water monitoring network. The primary goal of the 2019 CAMP is to provide for collection of groundwater and surface water monitoring data to evaluate the effectiveness of Interim Measures (IMs) and associated Institutional Controls (ICs) implemented to date as remedies at the Facility. The IMs and associated ICs have been developed to protect human health and the environment, by reducing mass loading of contaminants (primarily arsenic and selenium) to groundwater and surface water from Facility-related sources and subsequent offsite migration (IMs), and by mitigating potential exposures to contaminated soil and groundwater (ICs).

The 2019 CAMP describes the Facility-related comprehensive seasonal groundwater and surface water monitoring activities for 2019; it identifies specific monitoring objectives and performance evaluation data analysis techniques, and describes the number, type and location of samples to be collected to address objectives, as well as the sampling and analytical methodologies to be employed. The CAMP is intended to be utilized in association with other Facility planning and guidance documents, including the Quality Assurance Project Plan (QAPP) for Environmental Data Collection Activities (Hydrometrics, 2015), and the Data Management Plan (DMP) for Environmental Data Collection Activities (Hydrometrics, 2011). These documents include detailed discussions of the project and Facility history and background, as well as requirements for data review, reporting, and management. Brief summaries are provided in this CAMP for context.

[1] The former smelter site or Facility refers to the approximately 142 acres previously occupied by the East Helena Lead Smelter.

1.1 PROJECT BACKGROUND

The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust (Custodial Trust), is currently conducting Resource Conservation and Recovery Act (RCRA) Corrective Actions at the Facility pursuant to the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012) for the East Helena Facility, under the oversight of the EPA.

RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) evaluations have delineated soils and non-native fill material (i.e., slag, ore, concentrates, demolition debris) located in the operating areas of the former smelter that contain elevated concentrations of a number of contaminants, primarily arsenic, selenium, and certain trace metals. Contaminants within site soils and fill material are the result of more than a century of ore handling and processing; storage and disposal of smelting wastes and byproducts; and periodic releases of high contaminant-concentration plant process waters. The contaminated soils/fill represent the major current and/or historic sources of contaminant loading to groundwater. Loading of contaminants to groundwater has resulted in the generation and migration of groundwater plumes (primarily arsenic and selenium) from the former smelter to the north and northwest.

CMS evaluations were completed in 2016, and the Public Review Draft of the CMS Report (CH2M, 2018) was submitted to the US Environmental Protection Agency (EPA) in 2018 and has undergone public review. The CMS Report includes a summary of the IMs and associated ICs implemented to date at the Facility, as well as an assessment of current IM performance in terms of reducing contaminant mass loading to groundwater and preventing or reducing potential impacts to surface water. Groundwater- and surface water-related IMs implemented to date include the Speiss-Dross slurry wall (implemented by Asarco), and four interrelated IMS implemented by the Custodial Trust: (1) an evapotranspiration (ET) cover system, (2) South Plant Hydraulic Control (SPHC), (3) targeted source removal, and (4) Corrective Action Management Units (CAMUs). Groundwater-related ICs consist of a Custodial Trust-implemented well abandonment program and deed restrictions on Trust-owned property to prohibit groundwater use, as well as ICs administered by other entities, including groundwater use restrictions in the City of East Helena and in the East Valley Controlled Groundwater Area (EVCGWA).

Following final EPA approval of the CMS Report and the final remedies recommended in the report, a Corrective Measures Implementation (CMI) Work Plan will be developed, including a long-term monitoring component to guide final remedy performance monitoring, evaluation, and reporting requirements. Prior to completion of the CMI Work Plan, however, annual CAMPs (such as this 2019 CAMP) will be prepared to guide groundwater and surface water monitoring to be conducted at the Facility, and the associated data evaluations to be completed to support ongoing assessment of IM and IC performance. Information collected under the 2019 and previous CAMPs will be used in preparation of the CMI Work Plan and the final remedy performance monitoring program, to help develop monitoring objectives, to optimize the monitoring scope and network, and to select appropriate data evaluation techniques.

1.2 2019 MONITORING PROGRAM OBJECTIVES

As described above, the overall goal of the 2019 East Helena CAMP is to provide for collection of groundwater and surface water monitoring data to evaluate the effectiveness of IMs and ICs implemented to date as remedies at the Facility. The IMs and ICs are intended to reduce mass loading and migration of contaminants in groundwater and surface water, and to prevent exposure to contaminated media.

To achieve this overall goal, the 2019 CAMP includes data collection to support the following objectives:

(1) Assessment of sitewide groundwater level trends and groundwater flow directions;
(2) Assessment of groundwater quality trends at specific wells located in both Facility source areas and downgradient areas;
(3) Assessment of arsenic and selenium plume geometry and stability;
(4) Evaluation of residential/public water supply well water quality in the area of former smelter site impacts;
(5) Evaluation of surface water flow and quality trends, from upstream of the Facility through the Prickly Pear Creek realignment area, and downstream to Canyon Ferry Road; and
(6) Continued evaluation of groundwater chemistry in CAMU area wells.

Assessment of groundwater level trends, groundwater quality trends, and arsenic and selenium plume geometry and stability (objectives (1), (2), and (3) above) will be addressed through a remedy performance monitoring data evaluation program appropriate to the remediation phase of a RCRA Corrective Action remediation project. A discussion of the performance monitoring data evaluation methods, including the monitoring wells selected for the performance monitoring, is presented in Section 2. The CAMP performance monitoring and data evaluation strategy outlined in Section 2 is intended to provide a template (with appropriate modifications) for the final remedy performance monitoring to be included in the CMI Work Plan.

In addition to the objectives outlined above, data collected through the 2019 CAMP will also support additional data uses as needed. For example, data collected through the 2019 CAMP may be used to support implementation and administration of the EVCGWA, and to support permitting of a proposed East Helena public water supply well to be completed near the East

Helena wastewater treatment plant. If supplemental data collection is necessary in 2019, additional monitoring to be conducted at the Facility will be documented in supplemental, focused work plans and/or technical memoranda as appropriate.

The 2019 CAMP details monitoring program objectives and activities for the current year, and fulfills requirements of the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012). The CAMP is structured as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Remediation Phase Performance Monitoring Data Evaluation Program;
- Section 3.0 – Sampling Locations and Frequency;
- Section 4.0 – Sampling Methods;
- Section 5.0 – Sample Handling and Documentation;
- Section 6.0 – Laboratory Analytical Procedures and Reporting; and
- Section 7.0 – References.

2.0 REMEDIATION PHASE PERFORMANCE MONITORING DATA EVALUATION PROGRAM

In their *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action* (EPA, 2004), EPA defines performance monitoring as "the periodic measurement of physical and/or chemical parameters to evaluate whether a remedy is performing as expected." More recently published EPA guidance on groundwater remediation completion strategies (EPA, 2013, 2014a, 2014b) includes a discussion of recommended remedy evaluation (performance monitoring) strategies. EPA recommends evaluating groundwater data and information on a well-by-well basis to monitor remedial action effectiveness during two distinct phases of groundwater restoration activities (EPA, 2013), including:

1. The *remediation phase*, referring to the phase of the remedy where remedial activities are being actively implemented and groundwater data are used to monitor progress toward groundwater cleanup levels specified in a remedy decision document. The remediation phase is typically completed when monitoring data and evaluations demonstrate that the groundwater has reached the cleanup levels for all Contaminants of Concern (COCs) set forth in the Record of Decision (ROD), or in the case of the East Helena project the EPA Decision Document; and
2. The *attainment monitoring phase*, occurring after the remediation monitoring phase is complete and groundwater has reached cleanup levels for all COCs.

The East Helena Facility is currently in the remediation phase. During this phase, groundwater data "typically are collected to evaluate contaminant migration and changes in COC concentration over time" (EPA, 2014a), to address the following questions:

- Are groundwater elevations and flow directions as expected and have temporal and seasonal influences been assessed and considered?
- Are there changes (trends) in groundwater COC concentrations?
- Is there evidence of attenuation, degradation, and/or stabilization of COCs?
- Is the spatial (lateral and vertical) extent of contaminated groundwater changing?

The following performance monitoring data evaluation methods will be used to address these questions, which correspond to objectives (1), (2), and (3) in Section 1.2:

1. Groundwater elevation and COC trend analysis (Section 2.1). Trend analysis of groundwater elevations (and associated flow directions) and contaminant concentrations throughout the project area will allow direct assessment of changes in concentration and groundwater elevations over time.

2. Plume Stability analysis (Section 2.2). Plume stability analyses will allow evaluation of any changes in the spatial extent of the arsenic and selenium plumes both within and in the area downgradient of former smelter site source areas, as well as an integrated assessment of changes in concentrations averaged from multiple wells (as opposed to the individual well trend analysis).

As noted above, the 2019 performance monitoring program addresses the current remediation phase of performance monitoring. The remediation phase program relies on empirical, analytical, and statistical methods as appropriate. The specific data evaluation techniques to be used as performance monitoring tools are described below. The 2019 performance monitoring results will be summarized in a 2019 Water Resources Monitoring Report. The CAMP performance monitoring and data evaluation strategy outlined in this section is also intended to provide a template (with appropriate modifications) for the final remedy performance monitoring to be included in the CMI Work Plan. Groundwater data collected in 2019 will be utilized along with historic information in developing the CMI Work Plan performance monitoring objectives, scope, and data evaluation procedures.

2.1 TREND ANALYSIS

As recommended in EPA guidance (EPA, 2014a), trend analyses will be conducted at selected monitoring wells for the primary COCs at the Facility (arsenic and selenium), along with the indicator geochemical parameters sulfate and chloride (sulfate and chloride are relatively conservative indicators of historic smelter groundwater quality impacts). Groundwater elevation trends (hydrographs) comparing pre-IM and post-IM groundwater elevations will also be prepared to evaluate IM effectiveness in terms of reducing groundwater elevations and groundwater interaction with contaminated soils.

The 2019 remediation phase concentration trend analysis performance monitoring will focus on wells in two primary areas of interest:

(1) The main former smelter site source areas, including the West Selenium area, North Plant Site Arsenic area, Slag Pile, and Former Acid Plant areas, to evaluate the source area groundwater quality response to remedial measures;
(2) Wells along the downgradient and lateral perimeters of the selenium and arsenic plumes (with a focus on the western plume boundaries to monitor the westward plume shift observed in prior years) to evaluate the downgradient groundwater quality response to remedial measures.

The monitoring wells selected for concentration trend analysis are summarized in Table 2-1, along with the area targeted by each well. Twenty-two wells have been selected for concentration trend analysis, to be sampled during both the spring and fall 2019 monitoring events. Well locations are shown on Exhibit 1. Groundwater elevation trend analysis will be based on data collected during the spring and fall 2019 comprehensive sitewide water level monitoring events.

Temporal trend plots of arsenic, selenium, sulfate, and chloride concentrations, along with groundwater levels, will be prepared and updated as data are collected in 2019, to provide an ongoing delineation of contaminant concentration and water level trends. Trend analyses will be conducted for the post-operational data set (data collected in 2002 and subsequent years) at each well, including the following two periods:

1. RCRA Facility Investigation (RFI) period (2002-2011); and
2. RCRA Interim Measure/Corrective Measure implementation period (2012-present).

In addition to the preparation and visual inspection of trend plots, statistical trend testing may be used to test for statistically significant water level, arsenic, selenium, sulfate, and/or chloride trends over time at selected wells, although based on recent trends visual analysis is expected to be sufficient for the remediation phase. If warranted based on visual examination of trends through 2019, nonparametric or parametric statistical tests for trend (e.g., Mann-Kendall tests or linear regression tests) may also be conducted as a more quantitative measure of trends in the 2019 monitoring report. Appropriate statistical methods for evaluating trends in groundwater data, including Mann-Kendall and linear regression testing, are discussed in EPA's *Unified Guidance* (EPA, 2009). Software that would be used to conduct trend analysis may include EPA's ProUCL Version 5.0 (Singh and Maichle, 2013), Groundwater Statistics Tool (EPA, 2014c), the Mann-Kendall Toolkit (GSI, 2012) or similar calculation tools. Note that, during remediation phase performance monitoring, changes in concentration at individual wells are expected to be more visually apparent and may be variable as contaminant loading to groundwater from source areas decreases and the groundwater system adjusts to a new post-IM steady state condition. Statistical trend testing (or other statistical tests) will be more explicitly incorporated into the CMI Work Plan and the attainment phase performance monitoring program, in order to determine whether concentrations at individual monitoring wells meet remediation target levels.

2.2 PLUME STABILITY ANALYSIS

The second component of groundwater remedy performance evaluation will consist of a plume stability analysis for the primary groundwater COCs, arsenic and selenium. While contaminant concentration trends at individual wells within and downgradient of the primary source areas on the former smelter site may show varying trends (increasing or decreasing), particularly during the remediation phase of remedy monitoring, evaluation of plume stability will allow an additional comprehensive assessment of plume characteristics in these areas, and any changes over time in metrics such as plume area, average plume concentration, and plume concentration centroid location.

Consistent with previous plume stability evaluations conducted for East Helena groundwater data, the calculation methods for arsenic and selenium plume stability will be based on methods outlined in Ricker (2008). In general, the procedure involves the following steps:

1. Define the areas for which plume characteristics will be calculated. For the purposes of remediation phase performance evaluation monitoring, arsenic and selenium plume areas on the former smelter site and in the near downgradient area in the City of East Helena/Lamping Field have been selected, to allow integration of results from multiple monitoring points into a single analytically-derived measure of plume characteristics. The plume stability evaluation areas on and downgradient of the former smelter site are shown on Figure 2-1.
2. Select a representative set of monitoring wells from the monitoring well network with sufficient spatial distribution to define the extent of the contaminant plume within the plume stability evaluation area over multiple years. The well set specific to the arsenic and selenium plume stability analysis will be sampled during the fall 2019 monitoring event only (Table 2-2), although some of these wells will also be sampled in spring 2019 as part of the trend analysis monitoring outlined in Section 2.1. The plume stability analyses will be performed for the fall season only since this is the period of minimum year to year hydrologic variability (as compared to spring), and to reduce the spring season monitoring scope and costs. Note that the selected well sets for the areas downgradient of the Facility differ for each of the COCs, since the plume configurations are different for arsenic and selenium.
3. For each well, calculate an annual average concentration of the COC. A single average concentration will be calculated for paired or nested wells (see Table 2-2), in order to associate one average concentration at a given location.
4. Generate a grid file of interpolated concentration values within the given plume stability area for an individual monitoring year and contaminant, using spatial analysis software such as Surfer® by Golden Software. As noted in Ricker (2008), grid files are typically generated on log-transformed concentration data (for smoother interpolation), then transformed back to original concentration units prior to further calculations.
5. Use the grid file to calculate various average plume metrics for the monitoring year, including:
    a. Plume area;
    b. Average plume concentration; and
    c. Plume centroid of concentration.

As described in Ricker (2008), calculated values of these metrics may then be compared over time using trend testing techniques (such as those described above in Section 2.1) to determine the presence or absence of any trends in total plume area or average plume concentration. For example, the average arsenic concentration greater than 0.010 mg/L within the plume stability area, calculated on an annual average basis for a range of monitoring years, can be plotted and tested to determine if there is a statistically significant trend. In addition, Ricker (2008) notes that the location of the plume centroid of concentration or mass can be calculated and mapped over time, to provide further evidence of temporal plume behavior and stability (i.e., whether the plume is expanding, stable, shrinking, or otherwise fluctuating).

In combination with the individual well trend evaluations discussed above, the plume stability metrics offer an efficient and objective process for assessing the performance of remedial measures over time. Comparison of hand-drawn plume maps based on specific monitoring events allows for interpretation of broad overall trends in plume geometry and configuration when maps from different monitoring events are compared. The remediation phase plume stability calculations proposed in this CAMP, however, are intended to minimize potential bias and provide a more quantifiable comparison by using a consistent set of monitoring wells with suitable period of record, along with a consistent software-based gridding algorithm, and annual average concentrations to smooth out seasonal variability.

In summary, the remediation phase performance evaluation monitoring approach for the East Helena Facility outlined above includes multiple data evaluation methods. Trend analyses of water levels throughout the project area, and COCs and indicator geochemical parameters in former smelter site source areas and at the perimeter and downgradient extents of the selenium and arsenic plumes will allow direct assessment of changes in concentration and groundwater elevations over time in response to remedial measures. Plume stability analyses will allow evaluation of any fluctuations in the spatial extent of the arsenic and selenium plumes in the area downgradient of former smelter site sources and an integrated assessment of varying concentrations at multiple on-Facility and downgradient wells.

3.0 SAMPLING LOCATIONS AND FREQUENCY

This section of the CAMP describes the groundwater and surface water sampling locations and the frequency of sampling selected to meet the project objectives described in Section 1.2, including evaluation of the remediation phase performance evaluation metrics specified in Section 2. Details on sampling methodologies, sample handling, and analytical requirements are presented in Sections 4, 5, and 6, respectively. The 2019 CAMP will be implemented in accordance with the QAPP and DMP for the East Helena Facility (Hydrometrics, 2015 and 2011).

Based on the 2019 CAMP objectives, the scope of water resources monitoring under this CAMP includes periodic monitoring at a set of groundwater and surface water locations with sufficient spatial distribution to provide a synoptic evaluation of groundwater and surface water conditions utilizing groundwater and surface water hydrographs, surface water flow measurements, groundwater potentiometric maps, temporal concentration trend graphs, and assessments of contaminant plume geometry and stability. The 2019 groundwater monitoring well network includes a subset of monitoring wells on the former smelter site (on-site wells), as well as monitoring, residential, and municipal water supply wells in areas upgradient and downgradient of the former smelter (off-site wells). On-site sampling locations include selected wells located near identified contaminant sources and along historically-identified plume migration routes. Off-site sampling locations include monitoring wells located in East Helena, in and north of Lamping Field (west of East Helena), and residential and municipal water supply wells located south, west, and north of the Facility.

Monitoring well and residential / municipal water supply well locations are shown on Exhibit 1. Surface water monitoring locations were selected to represent Prickly Pear Creek and the discharge to Prickly Pear Creek from the former Upper and Lower Lake area. Surface water monitoring locations selected for 2019 are shown on Figure 3-1. An overall summary schedule for the 2019 East Helena Facility groundwater and surface water monitoring is shown in Table 3-1. Table 3-1 presents the 2019 schedule for various groundwater and surface water monitoring activities, along with the monitoring objectives addressed by each activity.

3.1 GROUNDWATER MONITORING

Wells included in the 2019 groundwater monitoring program are summarized in Tables 3-2 (monitoring wells) and 3-3 (residential and water supply wells). For the monitoring wells scheduled for groundwater quality sampling, Table 3-2 summarizes the wells to be sampled in the spring and fall, and the objectives addressed by each monitoring well (note that some wells address multiple objectives). The number of wells selected to address each of the groundwater-related CAMP objectives (Section 1.2) includes:

- ✓ Objective (1) – Assessment of sitewide groundwater level trends and groundwater flow directions (water level monitoring only) – **187** wells;
- ✓ Objective (2) – Assessment of groundwater quality trends at specific wells located in both Facility source areas and downgradient areas – **22** wells;
- ✓ Objective (3) – Assessment of arsenic and selenium plume geometry and stability – **55** wells;
- ✓ Objective (4) – Evaluation of residential/public water supply well water quality in the area of former smelter site impacts – **20** wells; and
- ✓ Objective (6) – Evaluation of groundwater chemistry in CAMU area wells – **11** wells.

Groundwater level and water quality sampling will be performed in accordance with applicable SOPs summarized in Sections 4 and 5 and provided in the project QAPP. Field parameters and static water levels will be recorded when water samples are collected. Samples will be analyzed for common ions and dissolved metals, with residential and municipal water supply wells also sampled and analyzed for total metals, as described in Section 6. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical (1 day for comprehensive water level measurement events, 2 to 3 days for the spring 2019 monitoring event, and 6 to 10 days for the fall 2019 monitoring event) to provide a synoptic snapshot of hydrogeologic conditions. The sampling schedule for residential and municipal water supply wells will depend on coordination with well owners to arrange access; however, sampling and water level measurement activities will be performed in the shortest time period practical.

3.1.1 Sitewide Water Level Monitoring

A Facility-wide set of monitoring wells and piezometers (187) is scheduled for measurement of groundwater levels in 2019. Measurement locations are shown on Exhibit 1. Water level data will be used to evaluate groundwater elevation trends as described in Section 2.1. This data will also be used in combination with surface water flow and elevation data to provide information to develop groundwater potentiometric surface maps, to monitor groundwater/surface water interactions on a seasonal basis, to assess the potential impact of seasonal variability on flow directions and surface water gain/loss, and to refine future monitoring programs (CAMPs). Monitoring well static water level measurement will be supplemented by measurement of water levels in residential wells (subject to access limitations) during the residential well monitoring events described in Section 3.1.4.

Water level monitoring will be performed in spring and fall, to capture seasonal variability during typical high and low water level periods. Additional water level monitoring events at selected wells may be scheduled as part of monitoring activities outside the scope of this CAMP. Manual measurements will be obtained at all locations to within 0.01 feet.

Water level measurements will be obtained in accordance with applicable SOPs summarized in Sections 4 and 5. The sitewide water level measurements will be obtained prior to initiation of the spring and fall sampling events. Sitewide water level monitoring events will also be conducted in coordination with the surface water elevation and flow measurement monitoring events described in Section 3.2, in order to provide a complete representation of groundwater and surface water elevations across the project area.

3.1.2 Spring 2019 Monitoring Well Sampling

A total of 23 monitoring wells are scheduled for sampling in spring 2019, as shown in Table 3-2 and on Exhibit 1. The total number of wells includes the 22 trend analysis evaluation wells listed in Table 2-1, along with one former private well (Dartman) being sampled by the Custodial Trust to provide information to the East Helena School District (Table 3-2). Monitoring at these locations will allow ongoing evaluation of groundwater quality trends in former smelter site source areas (including the West Selenium Area, the North Plant Arsenic Area, the former Acid Plant area, and the Slag Pile), and at selected wells along the perimeter of the downgradient arsenic and selenium plumes, as described in Section 2.1. Due to the limited scope of the spring 2019 monitoring, updated sitewide arsenic and selenium groundwater plume maps will not be prepared based on the spring data set; plume maps will be updated based on the fall 2019 data set as described below.

3.1.3 Fall 2019 Monitoring Well Sampling

A total of 78 monitoring wells are scheduled for sampling in fall 2019, as shown in Table 3-2 and on Exhibit 1. The fall 2019 sampling event will support multiple objectives, and includes the 22 trend analysis evaluation wells listed in Table 2-1, the 55 plume stability evaluation wells listed in Table 2-2 (note that some wells support both objectives), the 11 CAMU area monitoring wells, the Dartman well described in Section 3.1.2, and two wells at the American Chemet facility (Amchem4 and Amchem Injection), to be sampled at the request of EPA (Table 3-2). Monitoring at these locations will allow completion of the trend analysis and plume stability evaluations described in Sections 2.1 and 2.2, respectively. The specific objective(s) addressed by each of the 78 wells scheduled for sampling in fall 2019 are denoted in Table 3-2. Updated sitewide arsenic and selenium groundwater plume maps will also be prepared based on the fall 2019 data set.

3.1.4 Residential / Municipal Water Supply Well Monitoring

Residential and public water supply wells are included in the 2019 groundwater monitoring program to address CAMP Objective (4), evaluation of residential/public water supply well water quality in the area of former smelter site impacts. As noted in the RCRA groundwater protection guidance (EPA, 2004), documenting and addressing potential human exposures is one of EPA's high priority short-term protection goals. Data packets describing the residential/public water supply monitoring results and any exceedances of applicable water quality standards are provided to individual well owners following the receipt and validation of laboratory data for each monitoring event.

The residential and municipal water supply wells included in the 2019 semiannual water quality sampling program are listed in Table 3-3, and are shown on Exhibit 1 and Figure 3-2. Monitoring is scheduled at 20 wells on a semiannual basis (spring and fall 2019). Note that, based on a previous well owner survey conducted in 2015 as part of the 2015 CAMP, a number of identified residential wells are not included on the current sampling schedule, due to lack of access, inoperative pumps, or other reasons (see Table 3-3). In addition, a number of wells have been abandoned as part of the voluntary residential well abandonment program being funded by the Custodial Trust (Table 3-3). Although these wells are shown on Exhibit 1 and in Table 3-3 (shaded cells) for informational purposes, they are not included on the 2019 monitoring schedule.

3.2 SURFACE WATER MONITORING

This section describes the locations selected for monitoring water levels, water quality, and streamflow in surface water bodies near the Facility. Surface water sampling and measurement locations and frequencies are listed in Table 3-4 and shown on Figure 3-1. The surface water monitoring program has been designed to address CAMP Objective (5), evaluation of surface water flow and quality trends, from upstream of the Facility through the Prickly Pear Creek realignment area, and downstream to Canyon Ferry Road.

3.2.1 Elevation Monitoring

Surface water elevation measurements will be collected concurrently with sitewide groundwater level monitoring events in spring and fall 2019 (Table 3-4). Water elevation measurements at surface water locations will be obtained using a survey-grade global positioning system (GPS) instrument. Sites selected for elevation monitoring (9 sites) are listed in Table 3-4 and shown on Figure 3-1.

3.2.2 Surface Water Flow and Water Quality Sampling

Surface water flow measurements and water quality monitoring for 2019 will be conducted during spring (high flow) and fall (low flow) conditions. Locations selected for flow measurement and water quality sampling (7 sites) are listed in Table 3-4 and shown on Figure 3-1. The timing of the surface water quality monitoring events will be coordinated as closely as practical with the semiannual groundwater monitoring events to obtain a comprehensive synoptic understanding of groundwater and surface water conditions near the Facility.

Instantaneous flow measurements will be obtained using current velocity meters and the cross-section method, or (for smaller flows) flumes or volumetric methods. Flow measurement methods are further described in Section 4.2.2. Surface water quality sampling on flowing water bodies with more than one sampling location (Prickly Pear Creek) will be conducted from downstream to upstream in a single day, to provide information on streamflow gains and losses, potential interactions with groundwater, and in-stream parameter loading trends across various stream reaches, while minimizing the possibility of temporal variability.

The surface water quality sampling and flow measurements will be performed in accordance with applicable SOPs summarized in Sections 4 and 5. Field parameter measurements and streamflows will be recorded when samples are collected. Samples will be analyzed for common ions and total recoverable metals as described in Section 6.

4.0 SAMPLING METHODS

Groundwater and surface water sampling activities will be conducted in accordance with the procedures are described in this section of the 2019 CAMP. Standard Operating Procedures (SOPs) for planned field activities are listed in Table 4-1. The sampling methods outlined below for groundwater (Section 4.1) and surface water (Section 4.2) are consistent with methods described in previous CAMPs, including the 2018 CAMP (Hydrometrics, 2018). Collection of field quality control (QC) samples for groundwater and surface water is discussed in Section 4.3. Groundwater and surface water sampling methods are based on the procedures described in the SOPs and in the East Helena QAPP (Hydrometrics, 2015). Some of the procedures specified in this 2019 CAMP may differ slightly from those outlined in the SOPs and/or the QAPP; in those circumstances, the procedures outlined in the 2019 CAMP will be used to conduct sampling activities.

4.1 GROUNDWATER MONITORING

Groundwater samples will be collected from both monitoring wells and residential or municipal water supply wells in 2019. Procedures for collection of samples at these two types of wells differ, since water supply wells typically have dedicated pumps installed, and are pumped frequently in comparison to monitoring wells. Collection of samples from monitoring wells (Section 4.1.1) and water supply wells (Section 4.1.2) are discussed separately below.

4.1.1 Monitoring Well Samples

The collection of groundwater samples from site monitoring wells generally will consist of three steps:

1. Measurement of static water level;
2. Well purging and monitoring for field parameter stabilization; and
3. Water quality sample collection.

4.1.1.1 <u>Static Water Level Measurement</u>

Before collection of samples or removal/introduction of any equipment into the well, the static water level will be measured, to the nearest 0.01 foot, at each well using an electric water level probe to determine the depth of groundwater below a specified measuring point (typically the top of the polyvinyl chloride [PVC] well casing). Water level measurements and surveyed measuring point elevations will be used to compute groundwater elevations at each monitoring point. A complete set of static water level measurements will be obtained at all wells designated for water levels before initiating a quarterly or semiannual water quality sampling event. This procedure allows static water levels to be measured over a shorter time period (usually one day) than would be possible if measurements were collected concurrently with water quality sampling activities (i.e., days to weeks).

4.1.1.2 Well Purging, Field Parameter Measurement, and Water Quality Sample Collection

In general, groundwater sampling will proceed in order from wells with lower concentrations of constituents of concern to wells with higher concentrations, based on previous data collected at the Facility, to reduce the potential for cross-contamination of water samples. Field personnel will determine the appropriate sampling order before conducting sampling in cooperation with the field team leader, the project manager, and METG.

Dedicated high-density polyethylene (HDPE) tubing is installed in all monitoring wells. Submersible pumps (either a 12-volt submersible pump or a 2-inch Grundfos submersible pump or equivalent) will be utilized for purging and sampling. Purging will be conducted using the "standard purge" method of removing three to five well volumes while routinely monitoring field parameters (pH, dissolved oxygen, temperature, specific conductance, turbidity, and ORP).

Following removal of the first well volume, field measurements will be collected at regular time intervals during purging of the second and third well volumes, based on the purge rate and required purge volume. A minimum of five sets of field parameter measurements will be collected during well purging to monitor stabilization of field parameters. Field parameters will be measured using a flow-through device to minimize potential effects from atmospheric exposure. Field meters will be calibrated daily according to factory instructions, with calibration results recorded on calibration forms. Purge water and decontamination water generated during groundwater sampling activities will be handled in accordance with the following process:

EAST HELENA FACILITY GROUNDWATER SAMPLING PURGE WATER HANDLING PROCEDURE

1. Well purge and decontamination water from wells that do not exceed any water quality standards (based on previous data), and are not located within the City of East Helena or on the Facility, may be discharged to the ground near the well, where it will not cause a discharge to surface water.
2. Well purge and decontamination water generated at wells in the City of East Helena, on the former smelter site, or that do exceed one or more water quality standards (based on previous data) will be containerized and transferred to the million-gallon water tanks at the south end of the slag pile, for storage and eventual off-site disposal.

Samples for laboratory analysis will be collected only after one of the following purge conditions is met:

- A minimum of three well volumes has been removed, and <u>three successive</u> field parameter measurements agree to within the stability criteria given below.
- At least five well volumes have been removed although field parameter stabilization criteria are not yet met.
- The well has been pumped dry and allowed to recover sufficiently such that adequate sample volumes for rinsing equipment and collecting samples can be removed. Pumping wells dry will be avoided if possible by reducing pumping rates.

Criteria for field parameter stabilization are as follows:

Parameter (Units)	Stability Criteria
pH (standard units)	±0.1 pH unit
Water temperature (°C)	±0.2°C
Specific conductance (µmhos/cm)	±5% (SC ≤100 µmhos/cm) ±3% (SC >100 µmhos/cm)
Dissolved oxygen (mg/L)	±0.3 mg/L
Turbidity (NTU)	±10% (turbidity 10-100 NTU) or 3 consecutive readings <10 NTU

NOTES:

Stability criteria obtained from USGS *National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples* (September 2006). Turbidity criteria modified for low turbidity (<10 NTU) samples.

ORP measurements will be monitored during stabilization; however, given the inherent variability of ORP measurements, the USGS does not recommend its use as an indicator of stabilization, and it will not be included as a stabilization indicator during groundwater sampling under the 2019 East Helena CAMP.

Following well purging, final field parameter measurements will be collected and recorded, and groundwater quality samples will be obtained. Sample bottles will be filled directly from a sampling port, before the pumped water passes through the flow-through cell. Samples for dissolved metals analyses (including the common cations calcium, magnesium, sodium, and potassium) will be filtered through a 0.45-micrometer (µm) filter before preservation. Samples for common anions (sulfate, chloride, bicarbonate) will not be filtered.

Clean sample containers will be obtained from the analytical laboratory before sample collection. Following sample collection, samples will be preserved as appropriate, and stored on ice in coolers at ≤6°C during transport. Water quality sample container and preservation requirements are specified in the project QAPP (Hydrometrics, 2015) and in Table 4-2.

All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms.

Groundwater sampling equipment reused between monitoring locations (flow cell, short piece of discharge line used to connect to the dedicated well tubing, submersible pump system, and any non-dedicated tubing) will be thoroughly decontaminated between uses. Equipment decontamination will consist of the following steps:

- Rinse with soapy water (clean tap water plus Alconox or other non-phosphate detergent).
- Rinse thoroughly with clean tap water.
- Final rinse with deionized water.

The effectiveness of the decontamination procedure will be evaluated through the periodic collection of equipment rinsate and deionized water blanks, as outlined in Section 4.3, the East Helena Facility QAPP and SOPs.

4.1.2 Water Supply Well Samples

Collection of water samples from residential or municipal water supply wells will follow the same general sequence as that for monitoring wells:

1. Measurement of static water level.
2. Well purging and monitoring for field parameter stabilization.
3. Water quality sample collection.

An SOP for residential/municipal water supply well monitoring was developed for 2011 FSAP monitoring (METG, 2011). This document (METG-SOP-001) is included in Table 4-1 and in Appendix A, and should be consulted as the guide for conducting water supply well sampling as part of this 2019 CAMP. A general description of the private well monitoring procedure is provided below.

Property access and a scheduled sampling time will be arranged with the well owner prior to visiting the site for sampling. Static water level measurements will be obtained prior to sampling, at those water supply wells where an access port is present.

Purging of private wells will be accomplished through a purge hose (as necessary), with water discharge directed away from the wellhead and any nearby buildings. Purge volumes will generally be based on an estimate of the total water present in the well casing, piping, and water storage system (i.e., pressure tank), and approximately three well volumes will be purged prior to sampling. Purge rates will be determined volumetrically using a five-gallon bucket. Field parameter measurements will be collected at the beginning, middle, and end of the purging cycle, using a flow cell or other system arranged to allow flow of purged water across field parameter sensors prior to contact with the atmosphere.

Purge rates will be reduced prior to collecting samples. If a purge hose was used, the hose should be removed and water samples collected directly from the faucet or spigot. Private well samples will be collected for analysis of common constituents, dissolved metals and total metals in accordance with Table 4-2. Following sample collection, samples will be preserved as appropriate, and stored on ice in coolers at ≤6°C during transport. All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms. Prior to leaving the sampling location, the homeowner will be notified that sampling has been completed.

4.2 SURFACE WATER MONITORING

Surface water monitoring will consist of one or more of the following steps (depending on the monitoring schedule):

1. Measurement of water elevation;
2. Measurement of streamflow; and
3. Water quality sample collection.

4.2.1 Water Elevation Measurement

Water elevation measurements for ponds and flowing water sites will be collected using a survey-grade GPS instrument (Topcon Hiper+/Legacy E). Real-time kinematic (RTK) surveys will be conducted using a base station set up at a known East Helena control point (typically a monitoring well). Data collected will include horizontal coordinates (NAD83 Montana State Plane international feet) and elevations in feet above mean sea level (AMSL).

4.2.2 Streamflow Measurement

Surface water flow measurements at flowing water sites will be collected using a HACH Model FH950.1 current meter and wading rod (area-velocity method) or equivalent equipment following the appropriate project SOPs (see Table 4-1). If measurement conditions are unsafe because of high flows, the field sampling team will estimate the flow.

Measurement of streamflow is performed in accordance with the area-velocity method developed by the U.S. Geological Survey (USGS) (Turnipseed and Sauer, 2010). In general, the entire stream width is divided into subsections and the stream velocity measured at the midpoint of each subsection and at a depth equivalent to either (1) six-tenths of the total subsection depth, or (2) at two-tenths and eight-tenths if the water depth exceeds 2.5 feet (with these velocities averaged for subsequent flow calculation). The velocity in each subsection is then multiplied by the cross-sectional area to obtain the flow volume through each subsection. The subsection flows are then summed to obtain the total streamflow rate. Streamflow measurements are typically collected in a stream reach that is as straight and free of obstructions as possible, to minimize potential measurement error introduced by converging or turbulent flow paths.

4.2.3 Field Parameters and Water Quality Sample Collection

Field parameters measured at surface water quality monitoring sites will include the following:

- pH;
- Specific conductance;
- Dissolved oxygen; and
- Water temperature.

Field meters will be calibrated daily according to factory instructions, with calibration results recorded in the field notebook and/or on calibration forms. Field parameter measurements will be obtained directly in the stream if possible; however, high-velocity areas should be avoided to limit possible pH measurement errors caused by streaming potentials. Alternatively, a clean container may be filled with sample water for parameter measurement. Results are recorded in the field notebook and on standard sample forms. Field meters are checked periodically throughout the day for drift by measuring standard solutions (pH buffers, specific conductivity solutions, etc.), and are recalibrated as necessary.

A water quality sample will be collected from each surface water monitoring location by passing an uncapped sample container across the area of flow. When wading, samples are collected across the area of flow upstream of the sampler; during unsafe wading conditions, samples are collected from the stream bank. Samples will be preserved as appropriate for the intended analysis and stored on ice in coolers at ≤6°C for transport. Note that surface water samples will be analyzed for total recoverable metals concentrations (unfiltered samples).

Water quality sample container and preservation requirements for surface water sites are specified in the project QAPP (Hydrometrics, 2015) and in Table 4-2.

All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms.

4.3 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be collected and analyzed as part of the 2019 groundwater and surface water monitoring programs in accordance with the procedures outlined in this section; note that field QC sampling frequencies for monitoring well samples have been changed for 2019. The previous frequency requirement of "one per twenty samples (1/20) or one per day, whichever is more frequent," has been changed to "5%, or one per twenty natural samples (1/20) over the course of the monitoring event". The field and laboratory program for the East Helena groundwater and surface water monitoring is now well-established and the 5% field QC sample frequency is considered sufficient for ongoing data validation and data quality assessment.

Required field QC sample types for the 2019 CAMP groundwater and surface water monitoring programs will include the following:

- Equipment rinsate blanks (monitoring well sampling only).
- Deionized (DI) water blanks (groundwater and surface water sampling, including both monitoring and water supply wells).
- Field duplicate samples (groundwater and surface water sampling, including both monitoring and water supply wells).

4.3.1 Field Blanks (Rinsate Blanks and DI Blanks)

Equipment rinsate blanks consist of reagent grade (deionized) water processed through decontaminated sampling equipment (including filtration equipment as appropriate), collected into sample bottles and preserved. DI blanks consist of deionized water placed directly from storage containers into sample containers and preserved. Rinsate and DI blanks for monitoring well groundwater samples, and DI blanks for water supply well and surface water samples will be collected at a frequency of 5%, or one per twenty natural samples (1/20) over the course of the monitoring event. Deionized water for collection of field blanks will be obtained from the analytical laboratory.

Additional information regarding collection of rinsate blank samples is provided in the applicable SOP and in the project QAPP (Hydrometrics, 2015).

4.3.2 Field Duplicates

Field duplicate samples are replicate samples from a single sampling location submitted to a laboratory for the same set of analyses. For the purposes of this project, field duplicates will be collected by filling two sets of sample containers consecutively from the sampling location. Duplicates will be sent to the same laboratory, but will be identified with different sample numbers. Field duplicates for monitoring well and water supply well groundwater samples, as well as surface water samples will be collected at a minimum frequency of 5%, or one per twenty natural samples (1/20) over the course of the monitoring event.

All field QC samples will be submitted blind to the laboratory (QC samples will be packaged and shipped in such a manner that the laboratory will not be aware of the nature of the samples). Additional information regarding collection of duplicate samples is provided in the applicable SOP and in the project QAPP (Hydrometrics, 2015).

5.0 SAMPLE HANDLING AND DOCUMENTATION

All samples transferred to the laboratory for analysis will follow standard documentation, packing, and chain-of-custody procedures. Samples will be stored in iced coolers or refrigerated following collection, then hand-delivered to the laboratory in iced coolers to maintain sample temperatures of ≤6°C. The SOPs for sample labeling, documentation, and chain-of-custody procedures are listed in Table 4-1 and discussed further in the project QAPP (Hydrometrics, 2015).

Sample custody (responsibility for the integrity of samples and prevention of tampering) will be the responsibility of sampling personnel until samples are shipped or delivered to the laboratory. Any containers used to ship samples via independent courier will be sealed with custody seals before shipping, and the receiving laboratory will record the condition of the seals upon arrival to ensure that the containers have not been opened during transport. Custody seals are not required for samples that are maintained under the direct custody of sampling personnel until being hand-delivered to the laboratory. Upon arrival at the laboratory, sample custody shifts to laboratory personnel, who are responsible for tracking individual samples through login, analysis and reporting. At the time of sample login, the laboratory will assign a unique laboratory sample number, which can be cross-referenced to the field sample number and used to track analytical results.

Documents generated during sample collection will consist of:

1. Sample collection field notes and forms;
2. Chain-of-custody forms; and
3. Shipping receipts in the event that samples are sent to a laboratory via independent courier.

Sampling activities will be recorded in a project-specific field notebook, and the appropriate water sample collection form will be completed. Each sample will be identified with a unique sample number, along with the date and time of collection, on adhesive labels attached to sample bottles. All labels will be completed using waterproof ink.

Field notebooks used to record pertinent sampling information will include, at a minimum, the following:

- Project name;
- Date and time;
- Sample location;
- Sample number;

- Sample depth (if applicable);
- Media type;
- Field meter calibration information;
- Sampling personnel present;
- Analyses requested;
- Sample preservation;
- Field parameter measurements;
- Weather observations; and
- Other relevant project-specific site or sample information.

Entries will be made in permanent ink. Corrections to field notebooks will be made by crossing out erroneous information with a single line and initialing the correction. Field books will be signed and dated at the bottom of each page by personnel making entries on that page.

Individual samples (including QC samples) will be assigned unique sample numbers according to the following sample numbering scheme:

AAA[A]-YYMM-XXX

where AAA[A] is a three- or four-character code denoting the project, YYMM is a four-digit code denoting the year and month (e.g., 1910 for October 2019), and XXX is a three-digit code incremented sequentially for each successive sample.

6.0 LABORATORY ANALYTICAL PROCEDURES AND REPORTING

Laboratory analysis will be conducted by Energy Laboratories' Helena, Montana branch. Energy Laboratories is certified by EPA Region 8 and the State of Montana under the Safe Drinking Water Act. Field parameters will be analyzed by field personnel using the procedures outlined in Section 4 above, and in the applicable SOPs (see Table 4-1). All laboratory analysis will be fully documented and conducted in accordance with EPA-approved and/or industry standard analytical methods.

6.1 GROUNDWATER ANALYSES

Required parameters, analytical methods, and project-required detection limits (PRDLs) for 2019 groundwater quality samples collected at the Facility are shown in Table 6-1. Groundwater samples will be analyzed for physical parameters, common constituents and a comprehensive suite of trace constituents. Trace constituents will be analyzed as dissolved for monitoring well samples, and as both dissolved and total for private well samples.

The PRDLs for individual parameters have been set at concentrations normally achievable by routine analytical testing in the absence of unusual matrix interference. These limits will support project objectives for trend analysis and contaminant plume characterization as well as comparison with regulatory standards for groundwater (shown in Table 6-1 for reference). It must be recognized that the PRDL is a detection limit goal, which may not be achieved in all samples because of sample matrix interference or other problems. If a PRDL is not met by the laboratory, the data will be reviewed to determine if any actions (e.g., sample reanalysis or selection of an alternative analytical method) are required.

6.2 SURFACE WATER ANALYSES

Required parameters, analytical methods, and PRDLs for surface water quality samples collected at the Facility are shown in Table 6-2. Similar to groundwater, surface water samples will be analyzed for physical parameters, common constituents, and a comprehensive suite of trace constituents. The PRDLs for individual parameters have been set at concentrations normally achievable by routine analytical testing in the absence of unusual matrix interference and are equivalent to the required reporting values (RRVs) published in the most recent version of Circular DEQ-7 (Montana Numeric Water Quality Standards). These limits will support project objectives for evaluation of groundwater/ surface water interactions, as well as comparison with regulatory standards for surface water; therefore, PRDLs for a number of parameters are different in surface water compared to groundwater. It must be recognized that the PRDL is a detection limit goal, which may not be achieved in all samples because of sample matrix interference or other problems. If a PRDL is not met by the laboratory, the data will be reviewed to determine if any actions (e.g., sample reanalysis or selection of an alternative analytical method) are required.

6.3 DATA REVIEW AND VALIDATION

Procedures for data review, validation, and reporting are presented and discussed in the Site QAPP (Hydrometrics, 2015) and in the DMP (Hydrometrics, 2011), including control limits and criteria for specific types of field and laboratory QC samples, data validation and verification methods, potential corrective actions if criteria are not met, and database management issues. The DMP includes checklists for review of both field and laboratory documentation (prior to formal validation of laboratory data), and post-validation review and approval of the East Helena database (Hydrometrics, 2011). Both of these checklists will be completed for each monitoring event conducted during 2019.

All data deliverables containing analytical data and QC information will be reviewed for overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in the project planning documents (including this CAMP) are present. At a minimum, deliverables will include field notes and/or forms, transmittal information, sample chain-of-custody forms, analytical results, methods and practical quantification limits (PQL), and laboratory QC summaries. The reviewer will determine whether all required items are present and request copies of missing deliverables.

The number and type of samples collected will be compared to project specifications to ensure conformance with the sampling process design. Review of sample collection and handling procedures will include verification of the following:

- Completeness of submittal packages;
- Completeness of field documentation, including chain-of-custody documentation;
- Field equipment calibration and maintenance and/or quality of field measurements; and
- Adherence to proper sample collection procedures.

All data will be reviewed for completeness of deliverables, and adherence to the sampling and analytical protocols prescribed in this CAMP and the project QAPP (Hydrometrics, 2015). Data validation will include a detailed review of all analytical results, including:

- Reporting limits (RL) and PQLs vs. PRDLs;
- Holding times;
- Analytical methods;
- Field QC sample results; and
- Laboratory QC sample results.

Data qualifiers will be applied to any analytical results associated with QC exceedances, as outlined in the QAPP.

All project data will be archived in hard copy format, and also will be imported to and stored in the electronic project database software, along with associated data qualifiers. The project Data Management and Validation Coordinator will be responsible for reviewing, organizing, revising, and certifying the integrity of the project database. Maintenance and use of the project database, including uploading of analytical results and downloading of data in various formats to support other Facility-related investigations are presented in detail in the DMP (Hydrometrics, 2011).

6.4 DATA REPORTING

After all 2019 data is received from the laboratory and validated, a 2019 Water Resources Monitoring (WRM) report will be prepared describing the scope and results of the monitoring conducted in 2019 under this CAMP. The 2019 WRM report will include an updated project background and introduction; a description of monitoring activities conducted in 2019, including sampling locations, frequencies, and methodologies; a summary of the 2019 monitoring results; and a data analysis section describing current groundwater conditions and the results of the performance evaluation monitoring metrics described in this CAMP (water level trend analysis, water quality trend analysis, and plume stability evaluations). In addition, the hydrogeologic conceptual site model (CSM) for the East Helena project will be updated if warranted based on the 2019 monitoring results, and the updated CSM will be presented and described in the 2019 WRM report. An outline of the table of contents for the 2019 WRM is provided in Appendix B.

7.0 REFERENCES

CH2M, 2018. *Former ASARCO East Helena Facility Corrective Measures Study Report (Public Review Draft).* Prepared for The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust. March 2018.

EPA, 1983. Methods for Chemical Analysis of Water and Wastes. EPA-600/14-79-020. Revised March 1983.

EPA, 2004. Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action. EPA 530-R-04-030. April 2004.

EPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530-R-09-007. March 2009.

EPA, 2013. Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions. OSWER 9355.0-129. Office of Superfund Remediation and Technology Innovation. November 2013.

EPA, 2014a. Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well. OSWER 9283.1-44. August 2014.

EPA, 2014b. Groundwater Remedy Completion Strategy – Moving Forward With The End In Mind. OSWER Directive 9200.2-144. Office of Solid Waste and Emergency Response. May 2014.

EPA, 2014c. Groundwater Statistics Tool – User's Guide. OSWER 9283.1-46. Office of Superfund Remediation and Technology Innovation. July 2014.

GSI, 2012. GSI Mann-Kendall Toolkit for Constituent Trend Analysis – User's Manual (Version 1.0). November 2012.

Hydrometrics, Inc., 2011. Data Management Plan for Environmental Data Collection Activities, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. Revised August 2011.

Hydrometrics, Inc., 2015. Quality Assurance Project Plan Update 2015, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. Revised July 2015.

Hydrometrics, Inc., 2018. 2018 Groundwater and Surface Water Corrective Action Monitoring Plan, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. June 2018.

METG, 2011. 2011 Groundwater and Surface Water Field Sampling and Analysis Plan – East Helena Site. March 2011.

Ricker, J.A., 2008. A Practical Method to Evaluate Ground Water Contaminant Plume Stability. *Ground Water Monitoring & Remediation* 28(4): 85-94. Fall 2008.

Singh, A. and R. Maichle, 2013. ProUCL Version 5.0.00 User's Guide. Statistical Software for Environmental Applications for Datasets With and Without Nondetect Observations. EPA/600/R-07/041. September 2013.

Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (also available at http://pubs.usgs.gov/tm/tm3-a8/.)

U.S. District Court, 2012. First Modification to the 1998 Consent Decree. Civil Action No. CV 98-3-H-CCL. Case 6:98-cv-00003-CCL. Document 38. Filed January 17, 2012.

USGS, 2006. Collection of Water Samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9. Chap. A4, accessed Jun 7, 2018, from http://pubs.water.usgs.gov/twri9A. September 2006.

TABLES

Table 2-1. 2019 Concentration Trend Analysis Monitoring Wells -- East Helena Facility

Well	Trend Monitoring Area
DH-17	North Plant Arsenic (Source Area)
DH-79	North Plant Arsenic (Source Area)
DH-56	Slag Pile (Source Area)
DH-66	West Selenium (Source Area)
DH-80	Acid Plant (Source Area)
2843 Canyon Ferry	Selenium Plume
2853 Canyon Ferry	Selenium Plume
EH-120	Selenium Plume
EH-123	Selenium Plume
EH-129	Selenium Plume
EH-130	Selenium Plume
EH-134	Selenium Plume
EH-138	Selenium Plume
EH-139	Selenium Plume
EH-141	Selenium Plume
EH-143	Selenium Plume
EH-204	Selenium Plume
EH-210	Selenium Plume
EH-68[(1)]	Arsenic Plume
EH-69[(1)]	Arsenic Plume
EH-114	Arsenic Plume
EH-115	Arsenic Plume

NOTES:

Well locations shown on Exhibit 1.

All wells will be sampled in spring and fall 2019.

[(1)]These locations will also provide groundwater quality data upgradient of the proposed
East Helena Municipal water supply well to be installed near the East Helena Wastewater Treatment Plant.

Table 2-2. 2019 Plume Stability Analysis Monitoring Wells -- East Helena Facility

Arsenic Plume Stability Analysis Wells

Well/Well Set*	X	Y
EH-104	1358282.522	862312.6614
EH-106	1358337.119	862709.9336
EH-110	1359199.735	862408.9392
EH-111	1358121.671	863063.8249
EH-114	1357769.757	863127.7487
EH-115	1357963.035	862717.8146
EH-117	1357815.102	863491.194
EH-118	1357370.97	863059.9069
EH-119	1357263.087	863617.6238
EH-120	1357409.933	864330.2403
EH-124	1356666.492	863928.3931
EH-50/100	1358817.999	862195.6926
EH-51/101	1359828.415	862186.9796
EH-52/102	1360752.337	862191.6556
EH-53	1358268.831	863387.4722
EH-54	1359822.332	863345.3893
EH-57A	1357731.038	862625.8977
EH-58	1361553.2	861985.385
EH-59	1361023.244	862766.0055
EH-60/61/103	1359295.783	862093.3668
EH-62	1358812.977	863373.6172
EH-63	1359427.431	862682.4886
EH-65/107	1358789.927	862702.9806
EH-66/121	1358105.331	864406.8992
EH-69	1360852.608	863791.1154

Selenium Plume Stability Analysis Wells

Well/Well Set*	X	Y
EH-104	1358282.522	862312.6614
EH-106	1358337.119	862709.9336
EH-110	1359199.735	862408.9392
EH-111	1358121.671	863063.8249
EH-114	1357769.757	863127.7487
EH-115	1357963.035	862717.8146
EH-117	1357815.102	863491.194
EH-118	1357370.97	863059.9069
EH-119	1357263.087	863617.6238
EH-120	1357409.933	864330.2403
EH-123	1356631.306	863027.3459
EH-124	1356666.492	863928.3931
EH-126	1356002.798	865515.797
EH-129/134	1355425.088	865649.6907
EH-132	1355360.408	864040.3529
EH-135	1357384.976	865688.5946
EH-206	1356012.784	862969.4011
EH-50/100	1358817.999	862195.6926
EH-51/101	1359828.415	862186.9796
EH-52/102	1360752.337	862191.6556
EH-53	1358268.831	863387.4722
EH-54	1359822.332	863345.3893
EH-57A	1357731.038	862625.8977
EH-60/61/103	1359295.783	862093.3668
EH-62	1358812.977	863373.6172
EH-63	1359427.431	862682.4886
EH-65/107	1358789.927	862702.9806
EH-66/121	1358105.331	864406.8992
EH-70/125	1357077.783	864971.9141

Plant Site Plume Stability Analysis Wells

Well/Well Set*	X	Y
DH-6/15	1360252.419	861527.0799
DH-8	1359404.724	860693.1656
DH-17	1359668.631	860997.414
DH-42	1359938.798	859587.2008
DH-52	1360876.159	861372.1393
DH-55	1360945.555	860568.8169
DH-56	1360350.744	861098.4318
DH-66	1359333.409	861005.14
DH-67	1359095.512	861657.6447
DH-69	1360783.894	859899.5982
EH-204	1358703.601	860660.9927

NOTES: *Data from well sets (paired wells) will be combined to yield a single overall average concentration for a given monitoring year for plume stability calculations.
All wells will be sampled in fall 2019.

Table 3-1. East Helena Facility 2019 Water Resources Monitoring Schedule and Objectives

		Groundwater Monitoring Activity			Surface Water Monitoring Activity		
Month		**Water Level Measurements**	**Residential / Municipal Water Supply Well Sampling Events**	**Monitoring Well Sampling Events**	**Elevation Monitoring**	**Flow Monitoring**	**Surface Water Quality Monitoring**
June		X	X	X	X	X	X
July							
August							
September							
October		X	X	X	X	X	X
November							
2019 CAMP Objective Addressed	*[1] Groundwater Level Trend / Flow Direction Analysis*	X			X		
	[2] Groundwater Concentration Trend Analysis			X			
	[3] Plume Stability / Geometry Analysis			X			
	[4] Evaluate Residential / Public Water Supply Well Water Quality		X				
	[5] Evaluate Surface Water Quality and Flow Trends				X	X	X
	[6] Evaluate CAMU Area Groundwater Quality			X			

Table 3-2. 2019 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Spring 2019 Monitoring Event	Fall 2019 Monitoring Event	Monitoring Objectives Addressed		
						Contaminant Trend Analysis	*Plume Stability Analysis*	*CAMU Monitoring*
2843 Canyon Ferry	872346.42	1354330.00	Unknown	X	X	✓		
2853 Canyon Ferry	872391.53	1354773.24	Unknown	X	X	✓		
Amchem4	861677.01	1359836.24	Unknown		X[1]			
Amchem Injection	861628.31	1360331.42	Unknown		X[1]			
Dartman	864632.318	1360118.055	3863.03	X[2]	X[2]			
DH-15	861541.0629	1360256.995	3889.816		X		✓	
DH-17	860997.414	1359668.631	3904.839	X	X	✓	✓	
DH-42	859587.2008	1359938.798	3931.613		X		✓	
DH-52	861372.1393	1360876.159	3889.18		X		✓	
DH-55	860568.8169	1360945.555	3972.755		X		✓	
DH-56	861098.4318	1360350.744	3958.166	X	X	✓	✓	
DH-6	861527.0799	1360252.419	3889.85		X		✓	
DH-66	861005.14	1359333.409	3913.433	X	X	✓	✓	
DH-67	861657.6447	1359095.512	3899.765		X		✓	
DH-69	859899.5982	1360783.894	3934.404		X		✓	
DH-79	860422.215	1359937.191	3916.04	X	X	✓	✓	
DH-8	860693.1656	1359404.724	3916.828		X		✓	
DH-80	859665.447	1360005.892	3919.52	X	X	✓	✓	
EH-100	862197.1906	1358800.894	3889.825		X		✓	
EH-101	862185.0606	1359841.734	3879.947		X		✓	
EH-102	862174.5306	1360751.101	3880.446		X		✓	
EH-103	862095.3328	1359303.117	3890.541		X		✓	
EH-104	862312.6614	1358282.522	3887.834		X		✓	
EH-106	862709.9336	1358337.119	3882.069		X		✓	
EH-107	862700.4946	1358801.991	3880.15		X		✓	
EH-110	862408.9392	1359199.735	3884.054		X		✓	
EH-111	863063.8249	1358121.671	3876.502		X		✓	
EH-114	863127.7487	1357769.757	3878.071	X	X	✓	✓	
EH-115	862717.8146	1357963.035	3883.29	X	X	✓	✓	
EH-117	863491.194	1357815.102	3871.333		X		✓	
EH-118	863059.9069	1357370.97	3879.949		X		✓	
EH-119	863617.6238	1357263.087	3873.754		X		✓	
EH-120	864330.2403	1357409.933	3865.781	X	X	✓	✓	
EH-121	864410.1362	1358127.823	3869.493		X		✓	
EH-123	863027.3459	1356631.306	3885.713	X	X	✓	✓	
EH-124	863928.3931	1356666.492	3874.455		X		✓	
EH-125	864978.443	1357089.97	3863.222		X		✓	
EH-126	865515.797	1356002.798	3870.001		X		✓	
EH-129	865649.6907	1355425.088	3870.207	X	X	✓	✓	
EH-130	866018.012	1356641.209	3858.548	X	X	✓		
EH-132	864040.3529	1355360.408	3893.899		X		✓	
EH-134	865643.4817	1355425.545	3870.213	X	X	✓	✓	
EH-135	865688.5946	1357384.976	3852.245		X		✓	
EH-138	867179.0458	1355646.472	3839.703133	X	X	✓		
EH-139	867197.4533	1354635.304	3839.777133	X	X	✓		
EH-141	868713.295	1354782.704	3813.322	X	X	✓		
EH-143	870683.749	1354372.763	3803.366	X	X	✓		
EH-204	860660.9927	1358703.601	3925.692	X	X	✓	✓	
EH-206	862969.4011	1356012.784	3898.102		X		✓	
EH-210	861653.6027	1358674.679	3901.19	X	X	✓		
EH-50	862195.6926	1358817.999	3889.392		X		✓	
EH-51	862186.9796	1359828.415	3880.087		X		✓	
EH-52	862191.6556	1360752.337	3880.497		X		✓	
EH-53	863387.4722	1358268.831	3872.817		X		✓	
EH-54	863345.3893	1359822.332	3869.655		X		✓	
EH-57A	862625.8977	1357731.038	3885.451		X		✓	
EH-58	861985.385	1361553.2	3888.148		X		✓	
EH-59	862766.0055	1361023.244	3876.568		X		✓	
EH-60	862093.3668	1359295.783	3888.46		X		✓	

Table 3-2. 2019 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Spring 2019 Monitoring Event	Fall 2019 Monitoring Event	Monitoring Objectives Addressed		
						Contaminant Trend Analysis	*Plume Stability Analysis*	*CAMU Monitoring*
EH-61	862095.8588	1359282.097	3889.774		X		✓	
EH-62	863373.6172	1358812.977	3875.065		X		✓	
EH-63	862682.4886	1359427.431	3878.319		X		✓	
EH-65	862702.9806	1358789.927	3879.958		X		✓	
EH-66	864406.8992	1358105.331	3869.475		X		✓	
EH-68	863877.1312	1360331.472	3867.596	X	X	✓		
EH-69	863791.1154	1360852.608	3869.095	X	X	✓	✓	
EH-70	864971.9141	1357077.783	3863.48		X		✓	
MW-1	858771.6535	1358766.757	3953.046		X			✓
MW-10	858554.2009	1359549.266	3946.28		X			✓
MW-11	857959.4701	1358516.749	3973.331		X			✓
MW-2	859191.6356	1358745.842	3945.967		X			✓
MW-3	859196.8246	1359132.386	3940.951		X			✓
MW-4	858802.4764	1359150.013	3947.064		X			✓
MW-5	858414.7012	1358930.241	3956.184		X			✓
MW-6	858876.2702	1359556.469	3938.143		X			✓
MW-7	858777.0044	1358177.774	3963.674		X			✓
MW-8	857962.2351	1359400.931	3958.646		X			✓
MW-9	857977.442	1358978.984	3965.363		X			✓
			Total # Wells Per Event	**23**	**78**			
			Total # Planned Samples for 2019	**101**				
					# Wells Addressing Objective	**22**	**55**	**11**

NOTES: Water levels will be measured in all wells except Amchem4 and Amchem Injection (187 wells total) as part of the spring and fall monitoring events.

All monitoring locations shown on Exhibit 1

Total number of planned groundwater quality samples does not include field quality control samples

Field QC (rinsate blank, DI blank, and duplicate samples) each collected at frequency of 1 per 20

(1) Samples collected from American Chemet cooling water and injection wells per EPA request

(2) Samples collected from Dartman well by Custodial Trust to provide information to East Helena School District

Table 3-3. 2019 Residential/Municipal Water Supply Well Sampling Schedule
East Helena Facility

Map ID[1]	Northing	Easting	Status
Known Active Wells - Scheduled for Spring and Fall Sampling in 2019			
R1	863425.39	1359501.01	Active
R2	863266.68	1359337.84	Active
R3	863296.03	1360955.74	Active
R4	863053.71	1361184.11	Active
R5	864206.53	1358674.56	Active
R6	866156.57	1356934.48	Active
R7	872346.42	1354330.00	Active
R8	872391.53	1354773.24	Active
R9	872086.41	1355030.70	Active
R10	863376.30	1361815.27	Active
R11	863255.39	1358240.44	Active
R12	861502.42	1362101.41	Active
R13	855347.37	1359909.48	Active
R14	863233.58	1359840.14	Active
R15	861784.41	1356574.41	Active
R16	861925.29	1356400.09	Active
R17	861781.59	1356290.54	Active
R18	872558.37	1356681.06	Active
R19	871444.75	1356882.84	Active
R20	868437.60	1356673.10	Active
Inactive/Inoperative/Not Located/No Access Wells - No Sampling Scheduled			
A	862450.60	1359157.38	No Access
B	861861.51	1361212.16	No Access
C	861854.50	1361415.54	No Access
D	863069.96	1361069.38	No Access
E	862259.92	1355055.07	No Access
F	862355.37	1362082.87	No Access
G	861830.00	1362540.24	No Access
H	862864.36	1360861.52	No Well Located
I	863109.81	1359725.42	No Well Located
J	863257.08	1358568.29	No Well Located
K	863278.12	1357979.20	No Well Located
L	863327.86	1360948.64	Pump Inoperative
M	863250.07	1358456.08	Pump Inoperative
N	863264.10	1358105.44	Pump Inoperative
O	863671.87	1362422.81	Pump Inoperative
Abandoned Wells			
X1	863237.91	1360019.06	Abandoned
X2	863270.75	1359501.67	Abandoned
X3	862873.52	1360767.10	Abandoned
X4	863250.07	1359185.43	Abandoned
X5	863263.27	1359031.01	Abandoned
X6	863256.45	1359904.15	Abandoned
X7	863256.45	1359757.14	Abandoned

NOTES: (1) See Exhibit 1 and Figure 3-2

Table 3-4. 2019 Surface Water Monitoring Schedule -- East Helena Facility

Site ID	Northing	Easting	Water Elevation Measurements (GPS Survey)	Instantaneous Flow Measurements	Water Quality Monitoring
			Spring and Fall		
PPC-3A	856283.87	1361694.37	X	X	X
Trib-1D	859392.30	1361402.33	X	X	X
PPC-4A	858437.51	1361223.39	X	X	X
PPC-5A	859861.73	1361601.60	X	X	X
PPC-7	861473.74	1360743.50	X	X	X
PPC-8	863372.55	1360137.99	X		
PPC-36A	864556.11	1358753.31	X	X	X
PPC-9A	865555.92	1357841.22	X		
SG-16	872677.17	1350559.96	X	X	X

Total Measurements Per Monitoring Event	**9**	**7**	**7**
Total Monitoring Events	**2**	**2**	**2**
Total Measurements for 2019	**18**	**14**	**14**

NOTES: All monitoring locations shown on Figure 3-1.

Table 4-1. Standard Operating Procedures Applicable to East Helena Facility Water Resources Monitoring

SOP #(1)	Title
HSOP-2	Determination, Identification, and Description of Field Sampling Sites
HF-SOP-3	Preservation and Storage of Inorganic Water Samples
HSOP-4	Chain-of-Custody Procedures, Packing and Shipping Samples
HSOP-5	Global Positioning System (GPS) Equipment Operation
HSOP-7	Decontamination of Sampling Equipment
HF-SOP-9	Logging of Monitoring Wells - Geologic Conditions, Construction and Development
HF-SOP-10	Water Level Measurement with an Electric Probe
HF-SOP-11	Sampling Monitoring Wells for Inorganic Parameters
HSOP-13	Equipment Rinsate Blank Collection
HF-SOP-15	Measurement of Stream or Pond Stage
HF-SOP-17	Streamflow Measurement Using a Parshall Flume
HF-SOP-19	Obtaining Water Quality Samples from Streams
HF-SOP-20	Field Measurement of pH using a pH Meter
HF-SOP-22	Field Measurement of Dissolved Oxygen
HF-SOP-23	Field Measurement of Redox Potential (Eh)
HF-SOP-26	Streamflow Measurement Using a Flume
HF-SOP-27	Flow Estimation Method for Springs and Culverts
HSOP-29	Labeling and Documentation of Samples
HF-SOP-30	Decision Process for Field Variances and Nonconformances
HSOP-31	Field Notebooks
HF-SOP-37	Streamflow Measurement Using a Marsh-McBirney Water Current Meter
HF-SOP-44	Flow Measurements Using a Portable 90° V-Notch Cutthroat Flume
HF-SOP-46	Streamflow Measurement Using a Portable 3-inch Parshall Flume (Montana Flume)
HF-SOP-49	Use of a Flow Cell For Collecting Field Parameters
HF-SOP-50	Synoptic Runs on Streams
HSOP-58	Guidelines for Quality Assurance of Environmental Data Collection Activities: Data Quality Planning, Review, and Management
HF-SOP-71	Fluid Sampling With Peristaltic Pump
HF-SOP-73	Filtration of Water Samples
HF-SOP-79	Field Measurement of Specific Conductivity
HF-SOP-84	Field Measurement of Temperature
HF-SOP-102	Sampling of Municipal Wells
HSOP-105	Low Flow Sampling of Monitoring Wells for Inorganic Parameters
HSOP-106	Field Measurement of pH, Dissolved Oxygen, Conductivity, ORP, and Temperature Using a Multi-Meter
METG-SOP-001(2)	Residential Well Sampling for Inorganic Parameters

Notes:
(1) SOPs were prepared by Hydrometrics, Inc. and presented in various plans (e.g., QAPP; Hydrometrics, 2015).
(2) SOP was prepared by METG and is presented in Appendix A.

Table 4-2. Sample Container and Preservation Requirements

Matrix	Parameters	Sample Container	Preservative
Groundwater	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to ≤6°C
	Dissolved Metals[1]	250 mL HDPE	Filter samples (0.45 µm) HNO3 to pH <2 Cool to ≤6°C
	Total Metals [2]	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to ≤6°C
Surface Water	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to ≤6°C
	Total Recoverable Metals	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to ≤6°C

Notes:

(1) Dissolved metals will be analyzed in both monitoring and private (residential/water supply) well samples.

(2) Total metals will be analyzed in private well samples only.

Table 6-1. 2019 Groundwater Sample Analytical Parameter List -- East Helena Facility

Parameter	Analytical Method [(1)]	Project Required Detection Limit (mg/L)	Montana Groundwater Human Health Standards (mg/L)[(2)]
Physical Parameters			
pH	150.2/SM 4500H-B	0.1 s.u.	NA
Specific Conductance	120.1/SM 2510B	1 µmhos/cm	NA
TDS	SM 2540C	10	NA
TSS	SM 2540D	10	NA
Common Ions			
Alkalinity	SM 2320B	1	NA
Bicarbonate	SM 2320B	1	NA
Sulfate	300.0	1	NA
Chloride	300.0/SM 4500CL-B	1	NA
Bromide	300.0	0.05	NA
Calcium	215.1/200.7	1	NA
Magnesium	242.1/200.7	1	NA
Sodium	273.1/200.7	1	NA
Potassium	258.1/200.7	1	NA
Trace Constituents (Total and/or Dissolved) [(3)(4)]			
Antimony (Sb)	200.7/200.8	0.003	0.006
Arsenic (As)	200.8/SM 3114B	0.002	0.01
Cadmium (Cd)	200.7/200.8	0.001	0.005
Copper (Cu)	200.7/200.8	0.001	1.3
Iron (Fe)	200.7/200.8	0.02	NA
Lead (Pb)	200.7/200.8	0.005	0.015
Manganese (Mn)	200.7/200.8	0.01	NA
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.001	0.002
Selenium (Se)	200.7/200.8/SM 3114B	0.001	0.05
Thallium (Tl)	200.7/200.8	0.001	0.002
Zinc (Zn)	200.7/200.8	0.01	2
Field Parameters [(5)]			
Static Water Level	HF-SOP-10	0.01 ft	NA
Water Temperature	HF-SOP-20	0.1 °C	NA
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L	NA
pH	HF-SOP-20	0.01 pH standard unit	NA
Turbidity		0.1 NTU	NA
ORP/Eh	HF-SOP-23	1 mV	NA
Specific Conductance (SC)	HF-SOP-79	1 µmhos/cm	NA

Notes:

(1) Analytical methods are from *Standard Methods for the Examination of Water and Wastewater* (SM) or EPA's *Methods for Chemical Analysis of Water and Waste* (1983).

(2) Standards from Montana Circular DEQ-7 (May 2017 Version). NA = not applicable (no human health standard).

(3) Residential/water supply well samples will be analyzed for both total and dissolved trace constituents; monitoring well samples will be analyzed for dissolved metals only

(4) Samples to be analyzed for dissolved constituents will be field-filtered through a 0.45 µm filter.

(5) Field parameters should be measured in a flow cell in accordance with project SOPs.

Table 6-2. 2019 Surface Water Sample Analytical Parameter List -- East Helena Facility

Parameter	Analytical Method [1]	Project Required Detection Limit (mg/L)
Physical Parameters		
pH	150.2/SM 4500H-B	0.1 s.u.
Specific Conductance	120.1/SM 2510B	1 µmhos/cm
TDS	SM 2540C	10
TSS	SM 2540D	10
Common Ions		
Alkalinity	SM 2320B	1
Bicarbonate	SM 2320B	1
Sulfate	300.0	1
Chloride	300.0/SM 4500CL-B	1
Calcium	215.1/200.7	1
Magnesium	242.1/200.7	1
Sodium	273.1/200.7	1
Potassium	258.1/200.7	1
Trace Constituents (Total Recoverable)		
Antimony (Sb)	200.7/200.8	0.0005
Arsenic (As)	200.8/SM 3114B	0.001
Cadmium (Cd)	200.7/200.8	0.00003
Copper (Cu)	200.7/200.8	0.002
Iron (Fe)	200.7/200.8	0.02
Lead (Pb)	200.7/200.8	0.0003
Manganese (Mn)	200.7/200.8	0.01
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.000005
Selenium (Se)	200.7/200.8/SM 3114B	0.001
Thallium (Tl)	200.7/200.8	0.0002
Zinc (Zn)	200.7/200.8	0.008
Field Parameters		
Stream Flow	HF-SOP-37/-44/-46	NA
Water Temperature	HF-SOP-20	0.1 °C
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L
pH	HF-SOP-20	0.01 s.u.
Specific Conductance (SC)	HF-SOP-79	1 µmhos/cm

Notes:

(1) Analytical methods are from *Standard Methods for the Examination of Water and Wastewater* (SM) or EPA's *Methods for Chemical Analysis of Water and Waste* (1983).

FIGURES

Hydrometrics, Inc.
Consulting Scientists and Engineers

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EAST HELENA FACILITY
2019 CORRECTIVE ACTION
MONITORING PLAN

GENERAL LOCATION MAP

FIGURE
1-1

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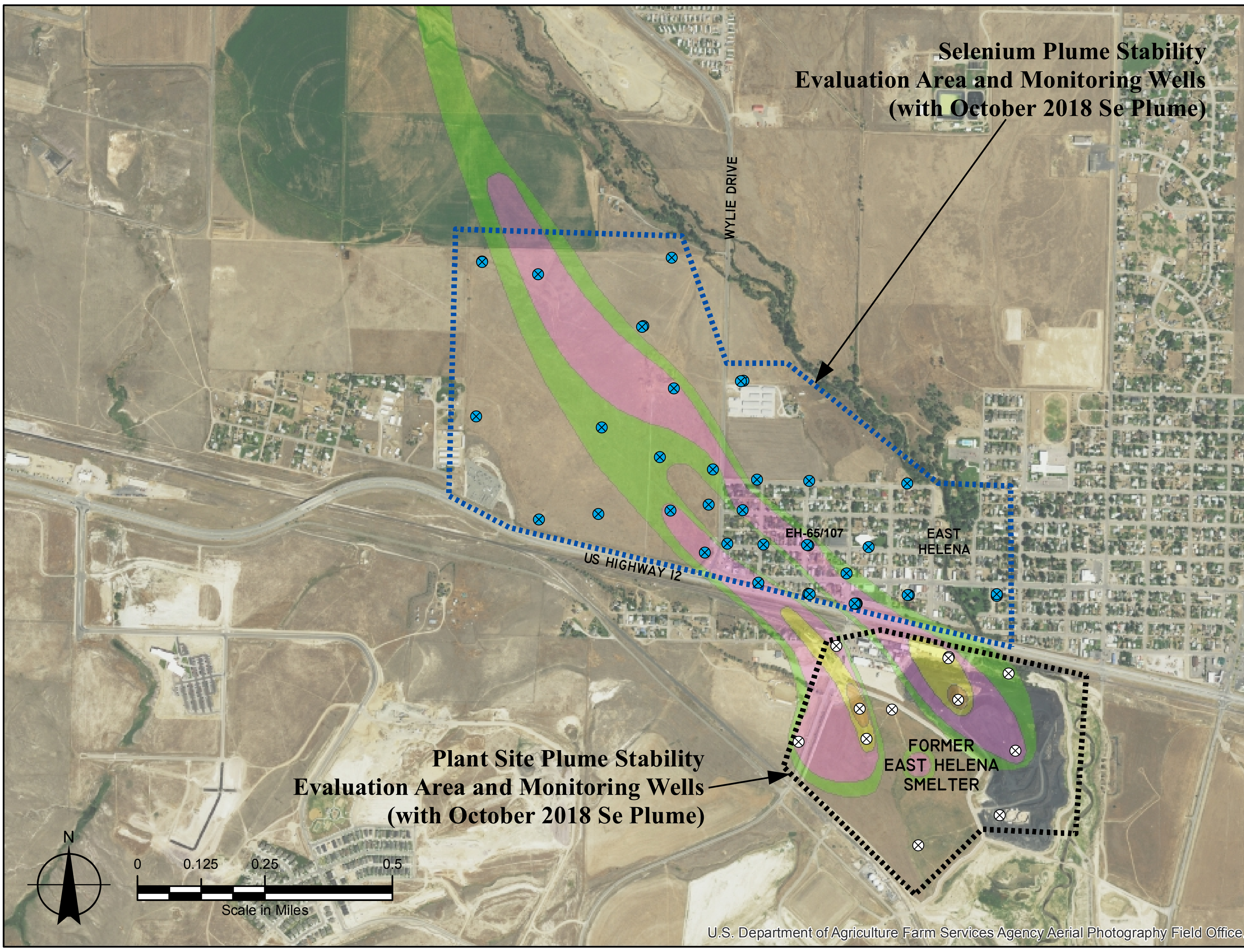

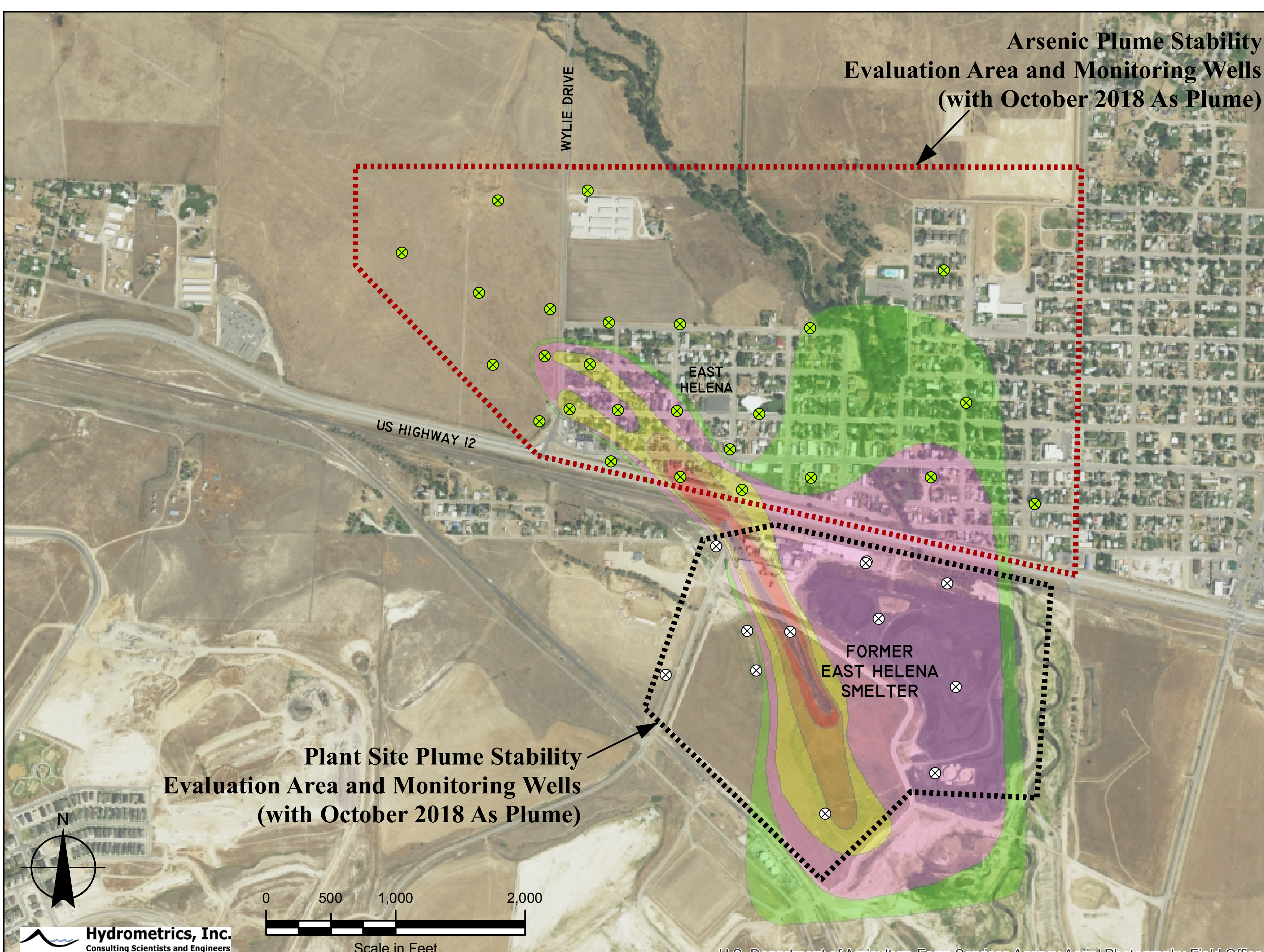

2019 CORRECTIVE ACTION
MONITORING PLAN
EAST HELENA FACILITY

2019 PLUME STABILITY EVALUATION AREAS AND MONITORING WELLS

FIGURE

2-1

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Hydrometrics, Inc. Consulting Scientists and Engineers Date Saved: 4/9/2019 2:54:57 PM	EAST HELENA FACILITY 2019 CORRECTIVE ACTION MONITORING PLAN	**2019 SURFACE WATER MONITORING LOCATIONS**	**FIGURE** **3-1**

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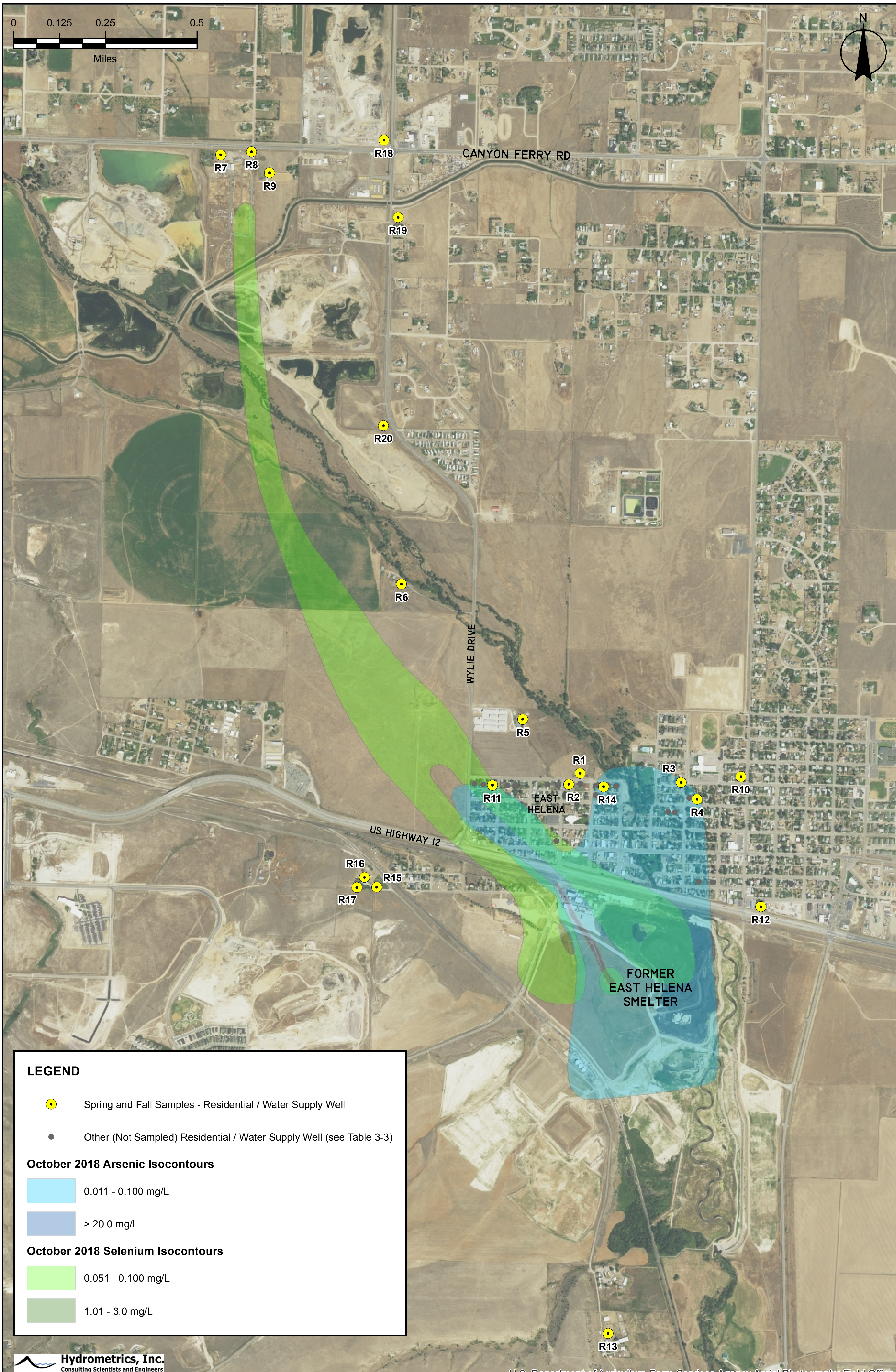

2019 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	2019 RESIDENTIAL / WATER SUPPLY WELL SEMIANNUAL SAMPLING SCHEDULE	FIGURE 3-2

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APPENDIX A

METG-SOP-001

RESIDENTIAL WELL SAMPLING

FOR INORGANIC PARAMETERS

STANDARD OPERATING PROCEDURE

RESIDENTIAL WELL SAMPLING FOR INORGANIC PARAMETERS

METG-SOP-001

1.0 PURPOSE

This procedure describes the methods to be used in collection of groundwater samples from private residential wells. The purpose of this standard operating procedure (SOP) is to describe the general methodology for collecting representative groundwater samples from residential wells within the vicinity of the Montana Environmental Trust Group – East Helena Site. The procedure is designed for sampling residential wells where inorganic constituents are the contaminants of interest. This procedure is intended to serve as guidance for field crews collecting these samples – this SOP does not cover communication with residential well owners (e.g., obtaining access authorization, sampling notification). Methods presented in this SOP are based on recent USGS guidance (USGS, 2006).

2.0 SCOPE

This procedure applies to all METG personnel and any assigned contractors tasked with sampling residential wells. The scope of work includes the preparation, preservation, collection, and submittal of samples for analytical analysis.

3.0 GENERAL

This technical procedure has been established to standardize the sampling team preparation, collection, preservation, and submittal of residential well water samples to the analytical laboratory. Analyses conducted on these samples may include inorganic compounds (metals, sulfate, anions, cations, etc.) and must be conducted by a Montana certified laboratory. Procedures and methodologies may only be added or changed at the direction of the METG or its designated contractor. To ensure the sample collected is representative of the groundwater, the system must be purged prior to sample collection. This SOP will be used in conjunction with the East Helena QAPP (Hydrometrics, 2010 or its equivalent) and applicable field sampling and analyses plans (SAPs) to ensure the sampling event is properly performed, documented and yields quality results.

4.0 RESPONSIBILITIES

METG and assigned field staff shall ensure that:

- Property access has been obtained at each well to be sampled;
- Each property owner is notified and provided with the anticipated sample date and time before each sampling event;

- Residential well sampling schedules are coordinated to extent practical with other METG directed groundwater monitoring activities; and
- Representative residential drinking water well samples are obtained according to this procedure and other applicable QAPP or SAP requirements.

5.0 EQUIPMENT

Residential wells will be sampled using existing pumps installed in the wells by the property owners. Additional equipment needed to conduct sampling activities may include:

- Summary of addresses, well locations, preferred sampling location (inside, outside, spigot, faucet, etc.), estimated purge volumes (or calculator for determining purge volumes, holding tank volume), and other special instructions
- Distilled or deionized water
- 0.45 µm filter apparatus with inert filters
- Laboratory supplied pre-cleaned and preserved sample containers for analyses
- Stopwatch or watch with second hand
- Field logbook
- Sampling sheets
- Sample labels
- Chain-of-custody sheets
- Custody seals
- Chemical-free paper towels
- Waterproof pens (Sharpies)
- Paper towels
- Trash bags
- Nitrile gloves
- Garden hoses
- Buckets (5-gallon, 2-gallon)
- Pliers
- Standard connectors
- Sample coolers
- Extra-large zip-lock bags
- Ice for sample preservation
- Safety glasses
- Cell phone or two-way radio
- Water quality meters (Eh, pH, conductivity, ORP, temperature)

- Flow through cell
- Copies of Private Well Water Sampling Notice

6.0 PROCEDURES

6.1 Well Access

Upon arrive at the property, introduce yourself to the property owner/occupant and discuss the purpose of the sampling and the planned sampling protocols. Ask the property owner/occupant if they have been recently using the well and about the well's general usage. Record the answer.

If the information hasn't already been provided, the property owner should be questioned as to the well depth and pressure tank capacity, if known. Additionally, the owner should be asked if they have a water filtration or conditioning unit in their system. If a water filter is connected to the water system, permission should be asked to obtain the sample before the water passes through such systems. If the property owner is not home but has given permission to sample, consult the sampling instructions for the location of the outside spigot.

6.2 Well Purging

The purpose of purging the well is to remove any stagnant water within the system and to obtain a representative sample of the groundwater. The following steps should be followed to the extent practicable:

A. **Locate the well and sampling port**. Locate the sampling port nearest to the wellhead. The sampling port should be before the holding tank, pressure tank, water filtration, or water treatment system. If the sample port is outdoors, ask if the owner has a preference for where to discharge the purge water. It may be necessary to run a hose from the sampling port to an acceptable discharge location away from the house or other features.

B. **Obtain water level measurement** (see water level HF-SOP-010), if well has an access port. NOTE: electric water level probes are typically not recommended for sounding wells; instead, use a weighted measuring tape or other equipment. Measurements should not be made when the pump is operating.

C. **Prepare sampling port for purging.**

Houses with inside tap:

- If the faucet is fixed with an aerator (a small screen), remove the aerator carefully. If pliers are needed, place a nitrile glove or similar between the pliers and aerator to protect it.
- Establish a constant flow and determine the purge flow rate using a known volume container and timer.

Houses with outside spigot:

- If a hose is already connected, disconnect it.

- Attach the purge hose and direct end of hose so that water discharges away from the house, wellhead, etc.

D. **Determine the well purge volume.** This task can be done in advance and verified in the field, if information is obtained from the well owner before visiting the property. The volume of water to be purged before groundwater samples are collected will be calculated as follows:

- If the house has a holding tank and the volume is known, estimate length of piping to the well, and the well depth[1]. The total volume to purge the system is

  = tank volume[2] + well casing volume[3] + water line volume[4].

  The well casing volume, expressed in gallons (1 ft^3 = 7.48 gallons), is

  $$= \frac{\pi * d^2 * h}{77.01}$$

  Where:

  π = 3.14;
  d = Diameter of the well casing expressed in inches; and
  h = Total depth of the water column in the well in feet (well depth – static water level, see Static Water Level Determination HF-SOP-010).

- If the holding tank volume is unknown:
  - Assume a 35-gallon pressure tank.
  - Assume that ~ 5 gallons are contained in the water line.
  - Assume well volume ≈ 20 gallons.
  - Assume total purge volume = 60 gallons.

E. **Determine the purge time**

- Turn the spigot on and establish a constant flow. Determine the purge flowrate using a known volume container and a timer Time the filling of a 5-gallon bucket (outside) or a 2-liter beaker (inside).
- Calculate the purge time based on the purge rate in gallons per minute (gpm) and the total purge volume in gallons as follows:

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1 The well depth may be obtained from well logs, owners statements, or direct measurements – if wellhead is accessible.
2 This value should include the volume of holding tank and/or pressure tank between the well and the sampling port. All samples should be obtained before any water filtration or water treatment systems.
3 A minimum of one well casing volume should be purged prior to sampling if the well is actively used. If the well has been stagnant or infrequently used three to five well casing volumes should be purged.
4 The water line volume can be calculated using the formula for the well casing volume by replacing d with the inside diameter of the pipe and h with the estimated length of the water line in feet.

$$= \frac{\text{Well Purge Volume (gallons)}}{\text{Purge Rate (gpm)}}$$

Where:

$$\text{Purge Rate} = \frac{\text{Volume of Container (gallons)}}{\text{Time to fill container (minutes)}}$$

Example:
Well Purge Volume calculated to be 60 gallons. If it takes 45 seconds to fill one 5-gallon bucket, the purge rate would be 6.8 gpm [5 gallons / 45 seconds (0.75 minutes)]. The estimated purge time would be about 9 minutes (60 gallons/6.8 gpm or 12 (# of bucket volumes in the system) x 45 (seconds) = 540 seconds or about 9 minutes.

F. **Purge the system**

- Let the water flow for the required purge time.
- Follow any homeowner instruction regarding where to direct the purge water. All reasonable efforts should be made to prevent water ponding near the residence.
- As the water system is purging:
  - Fill in the following information on the sample labels and apply them to the sample containers (see HSOP-29):
    - sample date;
    - sample time; and
    - samplers initials.
  - Complete entries in the Field Logbook (see Section 8 and HSOP-31)
  - Using a calibrated water quality measurement meters (YSI or equivalent)[5] and a low flow cell, record the following measurements at the beginning, middle and end of the purging period (see applicable SOP listed in Section 9):
    - dissolved oxygen;
    - oxygen reduction potential;
    - temperature;
    - pH;
    - specific conductance; and
    - turbidity (Hach Turbidometer or equivalent).

    Field parameters are considered "stable" when the variability between sequential measurements is as follows:

Parameter	Stability Criteria
pH	±0.1
Temperature (°C)	±0.2
SC (µmhos/cm)	±5% (SC ≤ 100) or ±3% (SC > 100)

[5] Preference is that water quality parameters be measured using a low flow cell. Other measurement methods are acceptable, but should be documented.

Dissolved oxygen (mg/L)	±0.3
Turbidity (NTU)	±10% (NTU < 100)

Modifications of the standard purge procedure are allowable if site conditions, the project work plan, or study objectives dictate such modifications.

- Note and record any unusual color, turbidity or odor associated with the water as it is purging and during sampling.

6.3 Sample Collection

- Once purging is complete, sample collection can begin. If a hose was used to direct away the purge water, remove the hose before filling the sample bottles. To collect the sample:
    - Use a very low flow rate. Turn the faucet down to a flow of < 100 mL/min and allow the water to run a few seconds before collecting the sample.
    - Sample bottles may be filled directly from the tap for most analyses. For dissolved metal analyses water should be field filtered using 0.45 µm filter apparatus with inert filters (see HF-SOP-073).
    - Wear nitrile gloves to fill the sample bottles. This is to maintain the integrity of the sample and to protect your skin from any spillage of the preservative in the bottles.
    - Fill the bottles at arm's length, pointing away from you. Wear safety glasses.
    - Sample bottles should be filled as directed by the Analytical Laboratory.
    - Do not allow bottles with preservative to overflow. If a preserved bottle overflows, discard it and sample again with a new bottle to avoid dilution of the preservative.
    - Preserve and store samples as appropriate for the intended laboratory analysis.
    - After the samples have been collected, they should immediately be placed in an ice filled cooler until relinquished or shipped to the appropriate contract laboratory (see HSOP-4).
    - Replace any faucet aerators, or reattach homeowner's hose, if necessary.
    - Pick up and remove all waste and wipe up any water spillage.
    - If the owner is present, tell them you have completed the task and are leaving. If the owner is not present, place the "Private Well Water Sampling Notice" in the door or other convenient location (Note: do not place in mailbox).

7.0 DECONTAMINATION

Equipment that is shared between sampling locations (water level meters, water quality meters) should be decontaminated before leaving the property (see Decontamination of Sampling Equipment HSOP-7). Buckets and hoses should be emptied on site. If it is known that the residential well is contaminated, equipment should be thoroughly rinsed with potable water.

8.0 RECORDS

Accurate record keeping is necessary to demonstrate sampling methodologies and the validity of the samples. Field notes shall be kept in a bound field logbook as specified in the Field Notebook technical procedure (HSOP-31). Records shall be recorded using waterproof ink. Sampling records should include:

- Site Name/Number;
- Date and time of sampling;
- Names of Sampling Team members;
- Weather conditions;
- Location and address of residential well;
- Well use history;
- Location of sampling (inside or outside);
- Field sketch of property/structure showing where sample was collected;
- Photograph of well location and sampling port location;
- Description of sample port type (e.g., ¾" gate value, kitchen faucet with aerator)
- Calculations (e.g., calculation of purged volume);
- Data for purge volume calculation (e.g., well depth, SWL, casing diameter, etc.);
- Volume of water purged before sampling;
- Location of sample tap;
- Discharge rate of faucet;
- Starting field parameters;
- Progressive field parameters as a function of time;
- Demonstration of field parameter stabilization, (i.e., at least 3 consecutive stable measurements);
- Parameters (inorganic compounds, metals, etc.) for which sample is to be analyzed;
- Sample volume, number, and container types;
- Laboratory chain of custody form;
- Sample cooler shipping document number, if applicable;
- Sample preservation;

- QA/QC samples collected; and
- Irregularities or problems.

9.0 ASSOCIATED DOCUMENTS

A. Decontamination of Sampling Equipment **(HSOP-7)**
B. Water Level Measurement with an Electric Probe **(HF-SOP-010)**
C. Field Measurement of pH using a pH Meter **(HF-SOP-020)**
D. Field Measurement of Dissolved Oxygen **(HF-SOP-022)**
E. Field Measurement of Specific Conductivity **(HF-SOP-079)**
F. Field Measurement of Temperature **(HF-SOP-084)**
G. Filtration of Water Samples **(HF-SOP-073)**
H. Chain-of-Custody Procedures, Packing, and Shipping Samples **(HSOP-4)**
I. Labeling and Documentation of Samples **(HSOP-29)**
J. Field Notebooks **(HSOP-31)**

The following forms will be completed and retained in the project file:

A. Water Sampling Form;
B. Chain-of-Custody Form; and
C. Shipping receipts.

10.0 REFERENCES

USGS, 2006. *National Field Manual for the Collection of Water-Quality Data: Chapter A4, Collection of Water Samples.* USGS TWRI Book 9, September 1999; Revised 2006..

Hydrometrics, 2010. *Quality Assurance Project Plan for Environmental Data Collection Activities – East Helena Facility*. Prepared by Hydrometrics, Inc. for the Montana Environmental Trust Group. May 2010.

METG
Montana Environmental Trust Group

Date/Time: ________________________

Dear Neighbor:

Thank you for allowing us to sample your well today. We will be submitting the water sample for analytical testing. We anticipate the results of this testing will be available in approximately one month and will provide the results to you.

Please feel free to contact METG if you have any questions or concerns regarding this sampling by either:

Phone: (406) 227-3734 or
Email at lg@g-etg.com

You cooperation is greatly appreciated.

Sincerely,

Montana Environmental Trust Group, LLC
1000 Smelter Road, P.O. Box 1230
East Helena, MT 59635

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APPENDIX B

2019 WATER RESOURCES MONITORING REPORT
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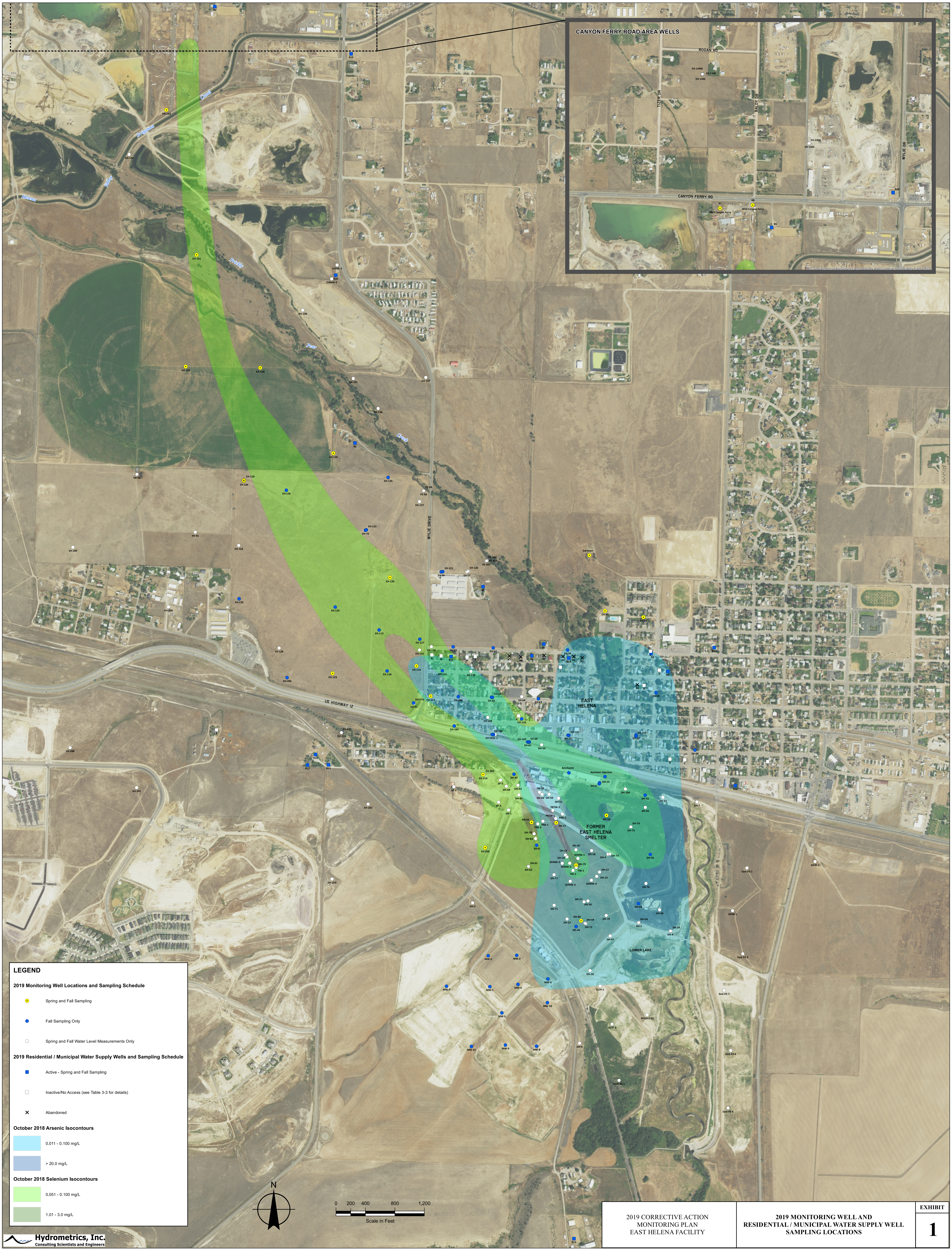
EXHIBIT 1

2019 MONITORING WELL AND RESIDENTIAL / MUNICIPAL WATER SUPPLY WELL SAMPLING LOCATIONS



2019 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	**2019 MONITORING WELL AND RESIDENTIAL / MUNICIPAL WATER SUPPLY WELL SAMPLING LOCATIONS**	**EXHIBIT 1**